INDIO Water Authority

Recycled Water Master Plan

December 2011

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CITY OF INDIO
INDIO WATER AUTHORITY

RECYCLED WATER MASTER PLAN

FINAL
December 2011

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CITY OF INDIO
INDIO WATER AUTHORITY

RECYCLED WATER MASTER PLAN

TABLE OF CONTENTS

Page

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AACE	Association for Advancement of Cost Engineering
AAD	Average Annual Demand
ADD	Average Day Demand
AFY	acre-feet per year
ASR	Aquifer Storage Recovery
CDPH	California Department of Public Health
CEC	Compounds of Emerging Concern
CIP	Capital Improvement Program
City	City of Indio
CVSD	Coachella Valley Sanitation District
CVWD	Coachella Valley Water District
EDCs	Endocrine Disrupting Compounds
EIR	Environmental Impact Report
ENRCCI	Engineering News Record Construction Cost Index
EPA	Environmental Protection Agency
ET	Evapotranspiration
ft/kft	Feet per one thousand feet
GIS	Geographic Information System
GP	General Plan
HOA	Homeowners Association
I – 10	Interstate 10
IPR	Indirect Potable Reuse
IWA	Indio Water Authority
MDD	Max Day Demand
MF	Microfiltration
MG	Million Gallons
MINMD	Minimum Month Demand
MMD	Maximum Month Demand
MMSL	Mean Sea Level
PHD	Peak Hour Demand
RO	Reverse Osmosis
ROW	Right of Way
RW Policy	Recycled Water Policy
RWMP	Recycled Water Master Plan
RWQCB	Regional Water Quality Control Board
SWP	State Water Project
SWRCB	State Water Resources Control Board
TM	Technical Memorandum
TM No.1	Market and Demand Assessment, January 2010
TM No. 4	Recycled Water Treatment Alternatives and Delivery Corridor Options, January 2010
VFD	Variable Frequency Drive
VSD	Valley Sanitation District
WWTP	Wastewater Treatment Plant
$/AF	Dollars per acre-foot

1.0 INTRODUCTION

This chapter describes the project background and goals of this Recycled Water Master Plan (RWMP), followed by a description of the study area, data review, and report organization.

1.1 Project Background

The Indio Water Authority (IWA) is exploring the feasibility of utilizing recycled water as a new source of water for landscape irrigation within and near its existing and future City of Indio (City) limits. The use of recycled water would supplement the groundwater and canal water that is currently used for these demands. The purpose of this RWMP is to identify the cost and feasibility of developing a recycled water system to diversify IWA's water supply mix in the future.

1.2 Goals and Objectives

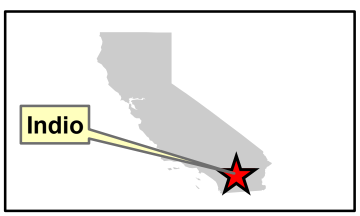
The purpose of this study is to present information to help the IWA plan for the implementation of a recycled water system. A recycled water system will reduce the demands on the potable water distribution system and offset withdrawals from the groundwater aquifer and canal water supply. The ultimate goal of this project is to present a capital improvement program (CIP) that IWA can use to make decisions on the implementation of a recycled water system and to provide a phasing plan that prioritizes the various projects.

1.3 Study Area

The IWA service area boundary and City limits forms the basis of the study area boundary for this RWMP. The IWA's service area includes approximately 38 square miles and supplied 8,100 million gallons (MG) (24,873 acre-feet) of water to approximately 75,000 businesses and residents in the City of Indio in 2008[1]. Some areas outside the IWA service area and City limits were also considered in this study due to their high potential for recycled water use.

The City is located along Interstate 10 (I-10) in Southern California's Coachella Valley, between the cities of Palm Springs and Coachella, and near the Salton Sea Recreation Area. Figure 1 presents a location map showing the City and IWA service area relative to neighboring cities, while Figure 2 shows the study area boundary, IWA service area boundaries, and the current City limits.

[1] Source: www.indio.org (Indio Water Authority)



Legend

City of Indio

Major Roads

Urban Areas

Hydrography

State of California

0 7.5 15 Miles

Figure 1
Location Map
Recycled Water Master Plan
Indio Water Authority

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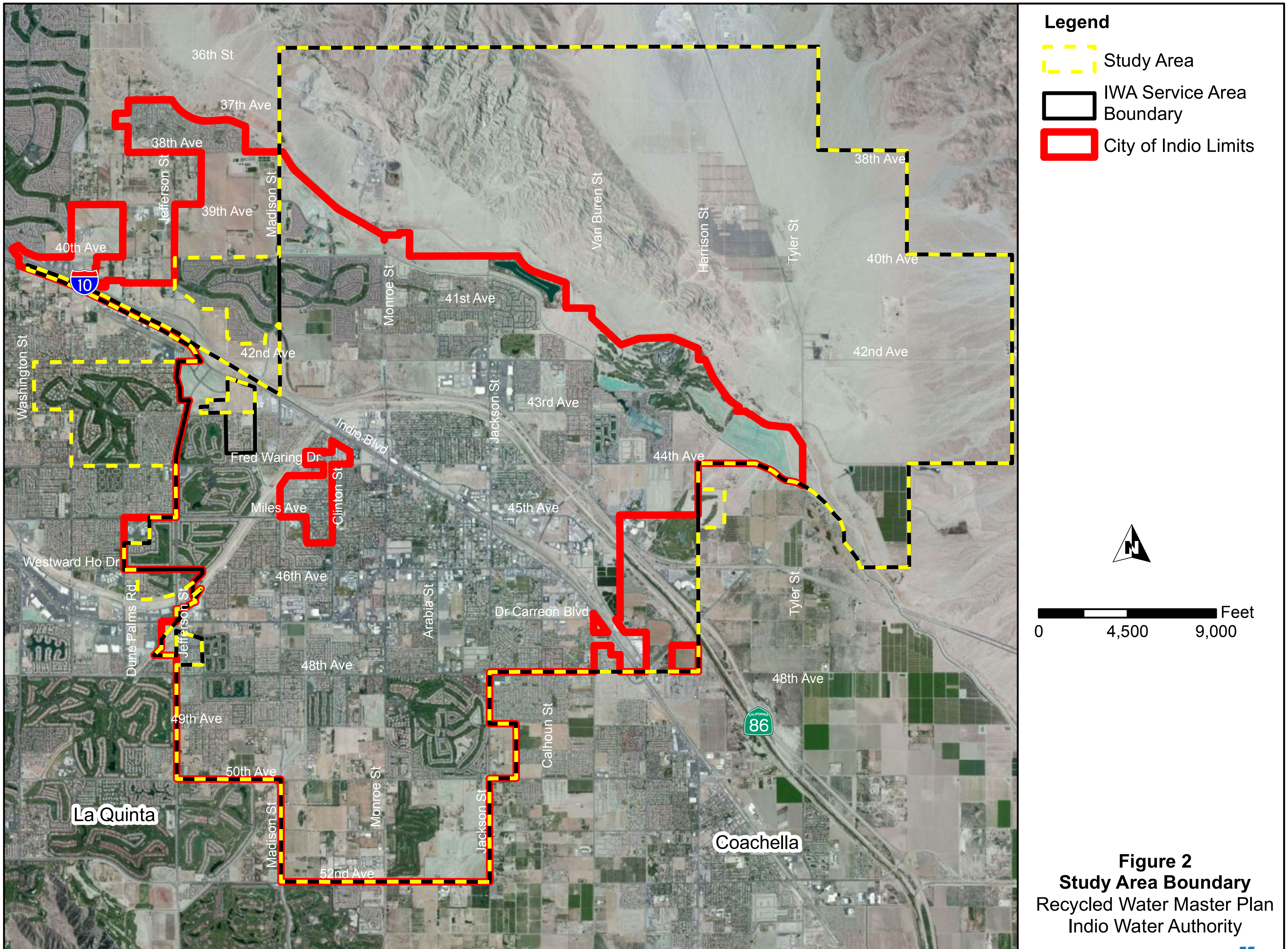

Figure 2
Study Area Boundary
Recycled Water Master Plan
Indio Water Authority

As shown in Figure 2, IWA's service area encompasses areas on both the North and South sides of Interstate 10 (I-10). The IWA service area is bordered by the City of Coachella to the East, the City of La Quinta to the Southwest and unincorporated areas of Riverside County to the North, West and South. The study limits roughly extend from 52nd street on the south to roughly past 37th avenue to the north; and from Washington Street on the west to Tyler Street on the east.

The study area is characterized by a desert arid-type climate with low annual rainfall, low humidity, hot days, and cool nights. Most of the rainfall occurs between November and March with an average annual rainfall of roughly 3.1 inches. The average monthly precipitation and average monthly temperature from years 1894 to 2010 are depicted in Figure 3.[2] The Study Area's elevation ranges from about 40 feet below mean sea level (msl) on the south and east sides of the City, to about 300 feet above msl at Lost Horse Reservoir.

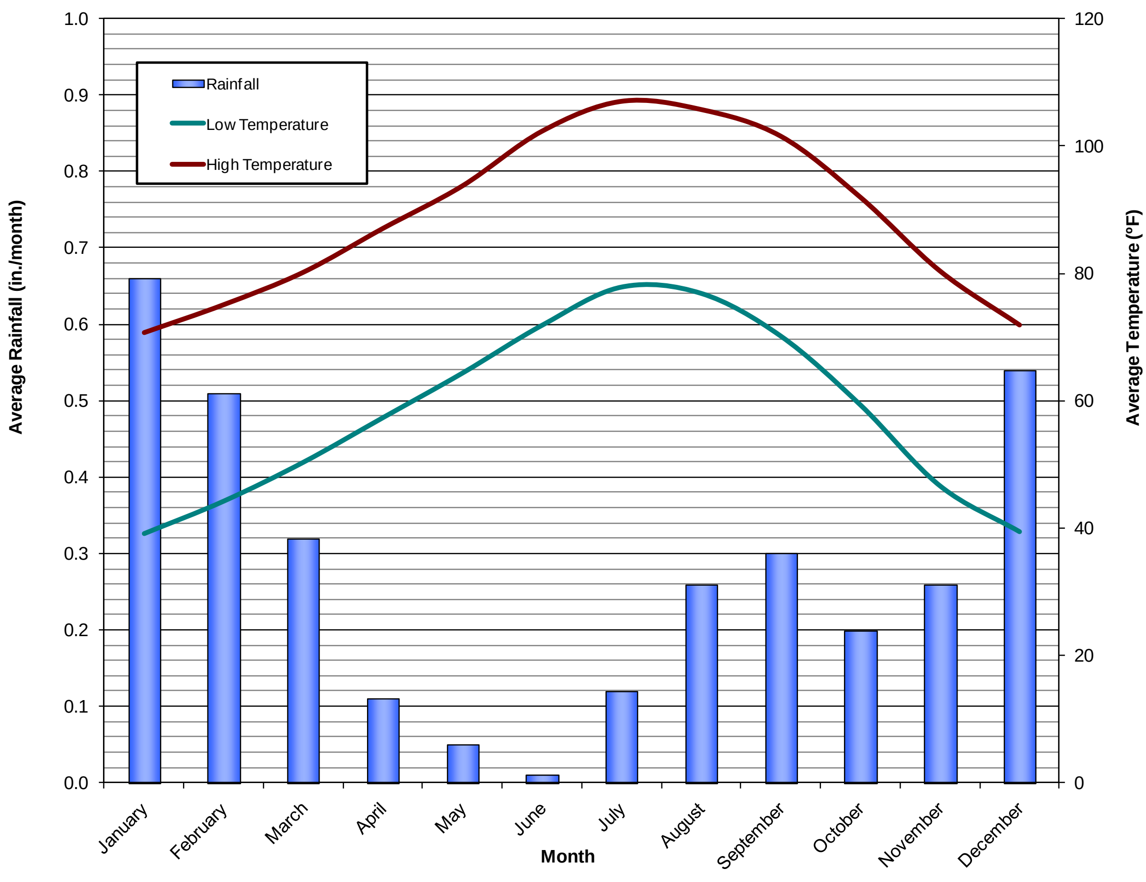

Figure 3 Climograph

[2] Source: Western Regional Climate Center (http://www.wrcc.dri.edu), Station 044259 (Indio)

1.4 Data Gathering and Review

Several existing studies and reports were reviewed to provide general background information for the development of this report. These reports include the following:

- 2005 Urban Water Management Plan Update, August 2006, Metcalf and Eddy/AECOM
- Draft Environmental Impact Report for Indio Water Authority, Tom Dodson and Associates, August 2011
- Indio Water Authority Water Master Plan Update, 2007, Dudek Engineering and Environmental
- Recycled Water Feasibility Study-Phase I, 2004, Dudek Engineering and Environmental
- Technical Memorandum (TM) No. 1, Market and Demand Assessment, Carollo Engineers, Inc., 2010
- TM No. 2, Water Balance Study, Thomas Harder & Co., 2009
- TM No. 3, Recycled Water Uses, Carollo Engineers, Inc., 2010
- TM No. 4, Recycled Water Treatment Alternatives and Delivery Corridor Options, Carollo Engineers, Inc., 2010
- Valley Sanitation District Wastewater Treatment Plant Master Plan, October 2006, Lee and Ro, Inc.

1.5 Report Organization

The recycled water master plan report contains six (6) sections, followed by appendices that provide supporting documentation for the information presented in the report. The sections are briefly described below.

Section 1 - Introduction. This section presents the need for this recycled water master plan and the objectives of the study.

Section 2 – Recycled Water Demands. The proposed user demands were evaluated based on the findings from TM No. 1. This includes market assessment, demand estimates and proposed peaking factors.

Section 3 – Recycled Water Supplies. This section presents a discussion on the available recycled water supplies and a comparison with the projected recycled water demands presented in Section 2. This balance of the recycled water supplies includes seasonal and diurnal variations. This section also includes a discussion of the California Water Code Regulations, Title 22, which dictates the primary regulations governing recycled water use.

Section 4 – Hydraulic Model. The section describes the development of the IWA's recycled water distribution system hydraulic model. This model was used for planning and sizing the new proposed recycled water distribution system.

Section 5 - System Analysis. This section presents the evaluation criteria used to size the recycled water system. Subsequently, the feasibility analysis of the system sized to meeting ultimate demands is presented. This feasibility analysis includes a presentation of the estimated unit cost in dollars per acre-foot of recycled water demand served ($/af) to implement various segments.

Section 6 - Capital Improvement Program. This section presents the recommended CIP for the IWA's recycled water system. The program is based on the projected recycled water availability and feasibility analysis. The CIP is separated into two phases.

2.0 RECYCLED WATER DEMANDS

This section details the process and results of the recycled water market assessment that was performed by Carollo Engineers (Carollo) and presented in the Market and Demand Assessment Technical Memorandum Number 1 (TM No.1) dated January 2010. TM No.1 is also included in Appendix A. This section includes summaries of the customer market assessment, demand projection methodology, peaking factors, and a demand summary for various demand conditions.

2.1 Customer Market Assessment

The potential recycled water customers listed in TM No.1 were identified using a variety of sources. These sources include aerial photos, digital maps, General Plan (GP) land use maps, and potable water consumption data. This information was examined to locate parks, schools, golf courses, and other potential irrigation customers.

Potential customers with very low recycled water demand potential were considered only if they were located in close proximity to a large potential recycled water user or a logical alignment of a recycled water pipeline to service another user.

The customer market assessment evaluated three (3) potential customer categories: landscape irrigation, industrial, and agricultural customers. In addition, opportunities for indirect potable reuse (IPR) were explored.

2.1.1 Landscape Irrigation Customers

For potential irrigation customers, the available irrigable acreage was estimated using aerial photographs and Geographic Information System (GIS) techniques. The estimated available irrigation acreage formed the primary basis for the development of potential recycled water demands. Water supply and irrigation demand information was obtained from interviews and from discussions with golf course and other staff where possible. These potential customers and associated irrigation demands were identified in TM No.1.

A total of 39 potential landscape irrigation customers were identified consisting of golf courses, parks, schools, and homeowners associations (HOA's) within IWA's existing service area. In addition, the Bermuda Dunes Golf Course (outside the IWA boundary), as well as the Indian Springs Golf Courses (with a portion of the course located just outside the IWA boundary) were included as potential users.

2.1.2 Industrial Customers

There are no potential recycled water industrial customers identified.

2.1.3 Agricultural Customers

Due to the long distance required to supply recycled water to local agricultural customers, these customers were not considered in this study.

2.1.4 Potential for Indirect Potable Reuse

Indirect potable reuse (IPR) can be accomplished by recharging the groundwater aquifer with recycled water from Valley Sanitation District (VSD) wastewater reclamation plant. Recharge can occur either by surface spreading or by installing Aquifer Storage Recovery (ASR) wells. Based on discussions with IWA staff, Posse Park and Indio Municipal Golf Course were identified as the most promising location for IPR with ASR wells. These wells could recharge the remaining wastewater flow during low demand periods (e.g. winter) with a number of gravity feed ASR wells.

2.2 Demand Projection Methodology

The following sections provide summaries of the methodology used to prepare demand estimates for the potential recycled water customers under various seasonal conditions. These demand conditions are as follows and defined below:

- Average Annual Demand (AAD)
- Average Day Demand (ADD)
- Minimum Month Demand (MinMD)
- Maximum Month Demand (MMD)
- Maximum Day Demand (MDD)
- Peak Hour Demand (PHD)

2.2.1 Average Annual Demand

The AAD is the total annual recycled water demand developed for each potential user as determined in TM No. 1. This water use will be the basis for the water demands associated with each user.

2.2.2 Average Day Demand

The ADD is the total annual recycled water demand divided by the number of days in that year.

Average Day Demand= AAD/365 days

2.2.3 Minimum Month Demand

The MinMD is the average demand for the month with the lowest recycled water demand. The MinMD reduction factor was estimated using monthly landscape irrigation requirements and shown in Table 3 of TM No. 1. This table shows the month of December as the lowest recycled water demand with 0.26 times the average day demand.

Minimum Month Demand = 0.26 x ADD

2.2.4 Maximum Month Demand

The MMD is the average demand for the month with the highest recycled water demand. This MMD peaking factor was estimated using the monthly landscape irrigation requirements provided in Table 3 of TM No. 1. As shown in this table, the month with the largest irrigation requirement is October with roughly 1.87 times the average day demand.

Maximum Month Demand = 1.87 x ADD

2.2.5 Maximum Day Demand

The MDD is the greatest recycled water demand during a 24-hour period of the year. The MDD peaking factor is expressed as a multiplier applied to the average seasonal demand. This study assumes that the MDD is roughly equal to the MMD; therefore, the factor was determined to be 2.0 times the average day demand.

Maximum Day Demand = 2.0 x ADD

2.2.6 Peak Hour Demand

The PHD is the highest recycled water demand during any one-hour period of the year. Hourly data was not available and therefore a direct computation of PHD is not possible. For this reason, the PHD for all accounts was calculated using appropriate peaking factors derived from the diurnal demand patterns collected from the customer surveys. The PHD has been determined for each individual user based on maximum day demand and the irrigation period as determined in TM No. 1.

Peak Hour Demand = Maximum Day Demand x 24-hours/Irrigation period

Table 1 summarizes the potential recycled water customers and the estimated irrigation areas. It can be seen that golf courses make up a number of large customers throughout the area. Figure 4 shows a map with the locations for potential customers of recycled water.

Table 1 Potential Recycled Water Customers and Irrigable Area Estimates
Recycled Water Master Plan
Indio Water Authority

Customer Name	Total Area (acres)	Irrigable Area[1] (acres)	Irrigable Area[1] (%)	WDF (AF/Acre)	Average Annual Demand (AFY)
Golf Courses					
Eagle Falls Golf Course	221	123	56%	5	1,107
Rancho Casa Blanco Country Club and HOA	83	13	16%	1	117
Indio Municipal Golf Course	40	38	94%	9	358
Terra Lago Golf Club	512	192	38%	3	1,728
Empire and Eldorado Polo Clubs	512	421	82%	6	2,950
Plantation Golf Club	489	170	35%	2	972
Indian Palms Country Club	643	210	33%	3	1,865
Indian Springs Country Club	360	125	35%	2	750
Heritage Palms Golf Course	488	175	36%	3	1,600
Bermuda Dunes Golf Course	359	180	50%	4	1,260
Shadow Hills Golf Course	808	192	24%	2	1,760
HOA's					
Motorcoach Country Club	32	17	52%	4	112
Outdoor Resort Indio HOA	78	24	31%	2	168
Desert Shores Resales HOA	62	20	33%	2	140
Parks					
Carreon Park	4	2	37%	2	9
Dominguez Park	5	3	51%	3	14
Indio Community Park	5	3	64%	3	18
Indio Terrace Park	5	5	85%	5	25
Jackson Park	21	16	74%	2	38
Miles Avenue Park	9	7	75%	4	38
Posse Park	20	4	22%	1	22
Riverside County Fairgrounds	69	10	14%	1	54
Shields Park	2	1	41%	2	5
Yucca Park	1	1	62%	4	5
Schools					
Andrew Jackson Elementary School	10	5	45%	2	25
Amelia Earhart Elementary School	19	7	40%	2	40
Amistad Continuation School	9	7	73%	4	37
Carrillo Ranch Elementary School	2	1	39%	2	3
Dr. Reynoldo J. Carreon Jr. Acadamy	20	4	22%	1	23
Glenn John Middle School	19	9	45%	2	46
Herbert Hoover Elementary School	11	6	53%	3	31
Indio High School	38	17	44%	2	90
Indio Middle School	21	18	84%	5	95
James Madison Elementary School	23	19	81%	4	100
Mountain View Elementary School	30	20	66%	4	106
Thomas Jefferson Middle School	14	21	148%	8	111
Van Buren Elementary School	26	22	85%	4	116
River Springs Charter School	10	7	70%	4	38
Indirect Potable Reuse Sites					
Posse Park	20	-	-	415	8,150
Indio Municipal Golf Course	40	-	-	204	8,150

Notes:
(1) Irrigable Area for existing customers developed based on inspection of an aerial photo of the existing limits of the study area and from background information presented in TM1.

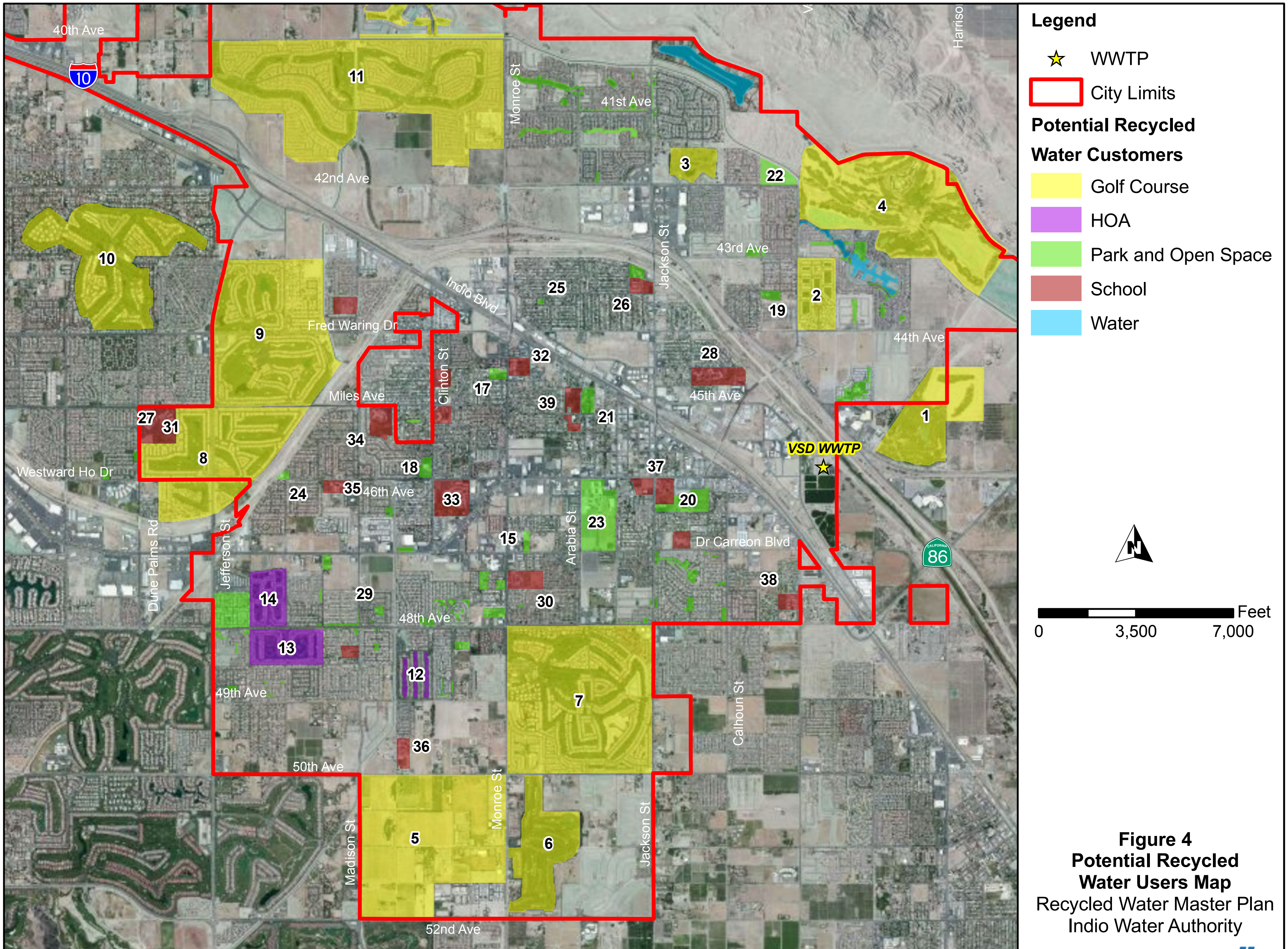

Figure 4
Potential Recycled Water Users Map
Recycled Water Master Plan
Indio Water Authority

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2.3 Hourly Demand Variation

For this study, most landscape irrigation using recycled water is assumed to occur during non-operational times at a constant rate between the hours of 7:00 p.m. and 7:00 a.m. Irrigation times from TM No. 1 were used to develop individual diurnal patterns for each individual user. This includes diurnal patterns based on 5-hour, 7-hour, 8-hour, 10-hour and 12-hour irrigation periods. One potential customer has an estimated irrigation window outside of the 7:00 p.m to 7:00 am window for typical turf irrigation and therefore a separate pattern was created. The daily diurnal pattern for each customer is expressed through a series of hourly multipliers applied to the MDD. This diurnal pattern was developed using the assumptions developed in TM No. 1 from discussions with the potential customers. An example of 10-hour irrigation period based diurnal pattern is shown on Figure 5.

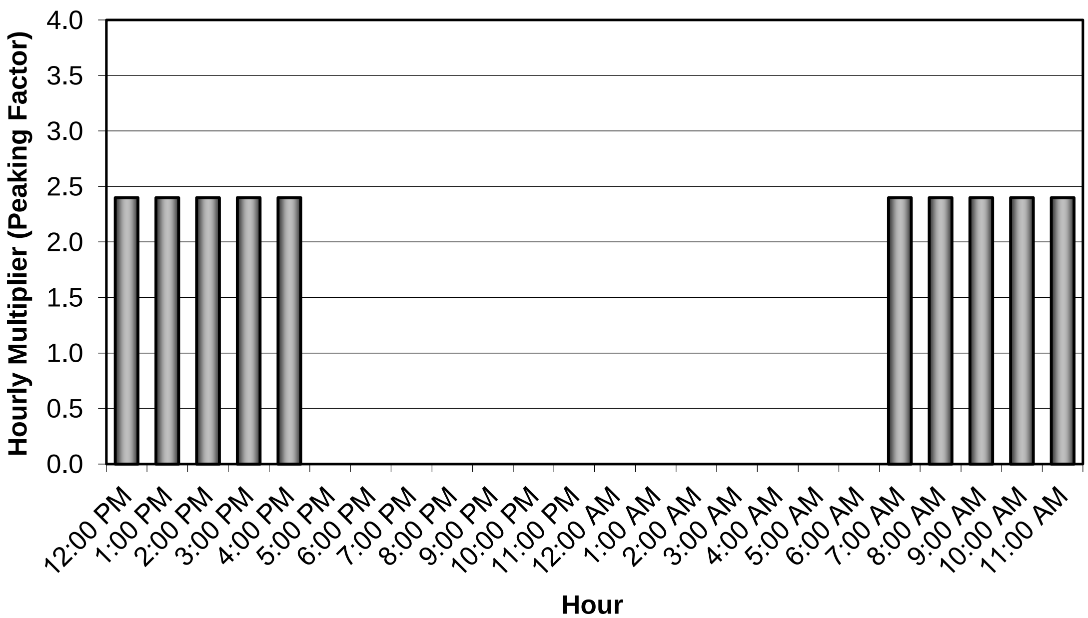

Figure 5 Example of 10-Hour Irrigation Diurnal Pattern

As shown on Figure 5, the hourly peaking factor for the 10-hour diurnal is 2.4. This hourly peaking factors varies from 2.0 for customers with a 12-hour irrigation pattern to 3.4 for customers with a 7-hour irrigation pattern. These hourly peaking factors are applied to the MDD estimates for each customer to estimate the peak hour demand for each customer.

2.4 Potential Recycled Water Demand Summary

The potential recycled water customers and their AAD, ADD, MMD, MDD, and PHD are summarized in Table 2. As shown in this table, the total potential demand of all 39 customers is estimated at 15,974 acre-feet per year (afy). The vast majority of this demand is from the 11 golf courses (14,467 afy or 91 percent), while the remaining nine percent is for irrigation at appropriate HOAs, parks, and schools.

Table 2 Recycled Water Demand Estimates
Recycled Water Maste Plan
Indio Water Authority

Figure ID.	Customer Name	Irrigable Area (acres)	Average Day Demand[1] (mgd)	Average Annual Demand[2] (afy)	Max. Month Demand[3] (mgd)	Max. Day Demand[4] (mgd)	Irrigation Period (hrs)	Peak Hour Demand[5] (gpm)
Golf Courses								
1	Eagle Falls Golf Course	123	0.99	1,107	1.85	1.98	10	3,293
2	Rancho Casa Blanco Country Club and HOA	14	0.10	117	0.20	0.21	8	435
3	Indio Municipal Golf Course	40	0.32	358	0.60	0.64	8	1,331
4	Terra Lago Golf Club	192	1.54	1,728	2.89	3.09	12	4,284
5	Empire and Eldorado Polo Clubs	420	2.63	2,950	4.93	5.27	10	8,776
6	Plantation Golf Club	167	0.87	972	1.62	1.74	7	4,131
7	Indian Palms Country Club	174	1.67	1,865	3.11	3.33	10	5,548
8	Indian Springs Country Club	121	0.67	750	1.25	1.34	5	4,462
9	Heritage Palms Golf Course	170	1.43	1,600	2.67	2.86	12	3,966
10	Bermuda Dunes Golf Course	198	1.13	1,260	2.10	2.25	10	3,748
11	Shadow Hills Golf Course	191	1.57	1,760	2.94	3.14	10	5,236
	Golf Courses Subtotal	1,810	12.92	14,467	24.16	25.84	-	45,209
HOA's								
12	Motorcoach Country Club HOA	16	0.10	112	0.19	0.20	10	333
13	Outdoor Resort Indio HOA	24	0.15	168	0.28	0.30	10	500
14	Desert Shores Resales HOA	20	0.13	140	0.23	0.25	10	416
	HOA's Subtotal	61	0.38	420	0.70	0.75	-	1,249
Parks								
15	Carreon Park	2	0.01	9	0.01	0.02	10	26
17	Dominguez Park	3	0.01	14	0.02	0.03	10	43
18	Indio Community Park	3	0.02	18	0.03	0.03	10	55
19	Indio Terrace Park	5	0.02	25	0.04	0.04	10	74
20	Jackson Park	7	0.03	38	0.06	0.07	10	112
21	Miles Avenue Park	7	0.03	38	0.06	0.07	10	112
22	Posse Park	4	0.02	22	0.04	0.04	10	64
23	Riverside CountY Fairgrounds	10	0.05	54	0.09	0.10	10	160
24	Shields Park	1	0.00	5	0.01	0.01	10	14
25	Yucca Park	1	0.00	5	0.01	0.01	10	13
	Parks Subtotal	42	0.20	226	0.38	0.40	-	673
Schools								
26	Andrew Jackson Elementary School	5	0.02	25	0.04	0.04	10	73
27	Amelia Earhart Elementary School	7	0.04	40	0.07	0.07	10	118
28	Amistad Continuation School	7	0.03	37	0.06	0.07	10	110
29	Carrillo Ranch Elementary School	1	0.00	3	0.01	0.01	10	9
30	Dr. Reynoldo J. Carreon Jr. Acadamy	4	0.02	23	0.04	0.04	10	70
31	Glenn John Middle School	9	0.04	46	0.08	0.08	10	137
32	Herbert Hoover Elementary School	6	0.03	31	0.05	0.06	10	92
33	Indio High School	17	0.08	90	0.15	0.16	10	267
34	Indio Middle School	18	0.08	95	0.16	0.17	11	257
35	James Madison Elementary School	19	0.09	100	0.17	0.18	12	249
36	Mountain View Elementary School	20	0.09	106	0.18	0.19	13	242
37	Thomas Jefferson Middle School	21	0.10	111	0.19	0.20	14	236
38	Van Buren Elementary School	22	0.10	116	0.19	0.21	15	231
39	River Springs Charter School	7	0.03	38	0.06	0.07	10	112
	Schools Subtotal	160	0.77	861	1.44	1.54	-	2,203
	Total	**2,073**	**14.26**	**15,974**	**26.68**	**28.53**	**-**	**49,335**

Notes:

(1) Average Day Demand = Average Annual Demand / 365 for golf courses and Hoa's from TM1 or 5.4 feet per irrigable acreage.
(2) Average Seasonal Demand for golf courses and HOA's developed from TM1. Others estimated using required irrigation of 5.4 feet per acre.
(3) Maximum Month Demand to Average Seasonal Demand Peaking Factor = 1.87, or Maximum Month Demand = Seasonal Demand x 1.87
(4) Maximum Day Demand to Average Seasonal Demand Peaking Factor = 2.0, or Maximum Day Demand = Seasonal Demand x 2.0
(5) Peak Hour Demand to Average Seasonal Demand Peaking Factor varies, Peak Hour Demand = Seasonal Demand x 24-hours/ Irrigation Window

As shown in Table 2, the estimate demand for golf course ranges from 1,100 (Eagle Falls Golf Course) to 1,900 afy (Indian Palms Country Club), excluding the Empire and Eldorado Polo Clubs. It should be noted that this is extremely high compared to typical demands for (18-hole) golf courses in Southern California that commonly range 200-1,000 afy. And although the extreme hot weather during the summer and the low precipitation (3 inches/year in Indio versus 12 inches/yr in Los Angeles County) will result in substantial higher demands than typical values in Southern California, the difference in evapotranspiration (ET) factors is not nearly as high as the difference in demand estimates indicates.

It is anticipated that a portion of this difference can be attributed to inaccurate information from the customer surveys as well as overwatering. As the majority of these potential recycled water customers have access to very cheap water sources (private groundwater wells and/or canal water), it can be expected that the actual irrigation demands would decrease substantially if customers would have to pay typical recycled water rates. It is therefore recommended that additional meetings with the largest customers be conducted to verify these demand estimates and make the necessary adjustments to the recycled water system sizing proposed in this RWMP.

In addition, the higher cost of recycled water will also make it difficult to convert these potential customers from their current low-cost water supply to recycled water. It is recommended that IWA and the City of Indio develop and adopt a mandatory recycled water use ordinance and work closely with the largest customers to obtain letters of interest to connect to the recycled water system prior to system design and construction.

3.0 RECYCLED WATER REGULATIONS AND SUPPLIES

This section starts with a description of current and anticipated water quality regulations regarding recycled water. Subsequently, the water supply sources are described. This section is concluded with the recycled water supply balance, which compares the projected recycled water demands and supplies on a seasonal basis.

3.1 Recycled Water Quality Regulations

This section identifies the major existing and proposed state and regional regulatory requirements governing the use of recycled water in the City.

3.1.1 Existing Regulatory Considerations

The California Water Code Regulations, Title 22 dictates the primary regulations governing recycled water use. The wastewater treatment and disposal is regulated by the Colorado River Regional Water Quality Control Board (RWQCB) Region 7. The State Water Resources Control Board (SWRCB) and the RWQCB have regulatory authority along with the California Department of Public Health (CDPH) over projects using recycled water. The interagency involvement between the SWRCB, RWQCB, and CDPH is further discussed in the following sections.

3.1.2 Title 22

The existing water recycling regulations, which dictate wastewater treatment processes and effluent quality criteria, are contained in the California Code of Regulations, Title 22, Division 4, Chapter 3, Sections 60301 through 60355. A compilation of the water recycling regulations can be found in "The Purple Book[3]." The regulations are intended "...to establish acceptable levels of constituents of recycled water and to prescribe means for assurance of reliability in the production of recycled water in order to ensure that the use of recycled water for the specified purposes does not impose undue risks to health..." The most recent revision to these regulations came into effect in 2001.

The CDPH regulations define four types of recycled water determined by the treatment process and total coliform, bacteria, and turbidity levels. The four treatment types of recycled water that are currently permitted by the CDPH are summarized in Table 3.

[3] http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/Purplebookupdate6-01.PDF

Table 3 Approved Uses of Recycled Water
Recycled Water Master Plan
Indio Water Authority

Treatment Level	Approved Uses	Total Coliform Standard (median)
Disinfected Tertiary Recycled Water	Spray Irrigation of Food Crops	2.2/100 ml
	Landscape Irrigation[(1)]	
	Nonrestricted Recreational Impoundment	
Disinfected Secondary - 2.2 Recycled Water	Surface Irrigation of Food Crops	2.2/100 ml
	Restricted Recreational Impoundment	
Disinfected Secondary - 23 Recycled Water	Pasture for Milking Animals	23/100 ml
	Landscape Irrigation[(2)]	
	Landscape Impoundment	
Undisinfected Secondary Recycled Water	Fodder, Fiber and Seed Crops	N/A

Notes:
(1) Includes unrestricted access golf courses, parks, playgrounds, schoolyards, and other landscaped areas with similar access.
(2) Includes restricted access golf courses, cemeteries, freeway landscapes, and landscapes with similar public access.

In the case of the Indio Wastewater Treatment Plant (WWTP) effluent, the facility currently meets the Disinfected Secondary - 23 criteria based upon Title 22 regulations. However, the IWA is planning to upgrade to meet the Disinfected Tertiary criteria based upon Title 22 regulations.

Article 3 of the Water Recycling Criteria details the acceptable uses of recycled water. Some of the uses specifically addressed include irrigation, impoundment, and cooling. Appendix A outlines the acceptable uses of recycled water. The only exception noted for using recycled water is that the regulations shall not apply to on-site use at a water recycling plant, or wastewater treatment plant, provided public access is restricted to the area where reuse occurs.

3.1.3 Recycled Water State Policy

The SWRCB recognizes that a burdensome and inconsistent permitting process can impede the implementation of recycled water projects. The SWRCB adopted a Recycled Water Policy (RW Policy) in 2009 to establish more uniform requirements for water recycling throughout the State and to streamline the permit application process in most instances.

The RW Policy includes a mandate that the State increase the use of recycled water over 2002 levels by at least 200,000 AFY by 2020 and by at least 300,000 AFY by 2030. Also included are goals for stormwater reuse, conservation, and potable water offsets by recycled water. The onus for achieving these mandates and goals is placed on both recycled water purveyors and potential customers.

Absent unusual circumstances, the RW Policy puts forth that recycled water irrigation projects that meet CDPH requirements, and other State or Local regulations, be adopted by Regional Boards within 120 days. These streamlined projects will not be required to include a monitoring component.

The RW Policy specifies that a Blue-Ribbon Advisory Panel be convened to guide future actions with respect to Compounds of Emerging Concern (CEC). If any regulations arise from new knowledge of risks associated CECs, then projects will be given compliance schedules.

3.1.4 Updates to the 2010 California Plumbing Code

The California Plumbing Code was recently updated to relax the restrictive rules for installing dual plumbing for indoor recycled water use, as well as for gray water. These changes pertain to Chapter 16 of Title 24, Part 5, of the California Code of Regulations.

The code revisions for recycled water were approved by the Building Standards Commission and will be part of the 2010 Code. The new rules remove some of the restrictions on the installation of recycled water pipe in buildings. The major features of the new dual plumbing rules are:

- Recycled water pipe can now run in the same wall/ceiling cavity as potable pipe
- The labeling requirements for purple pipe are relaxed
- The annual inspection is a visible inspection, followed by a cross-connection test if there is reason to believe a cross-connection exists, rather than an automatic cross-connection test each year

3.1.5 Future Regulatory Considerations

Future regulatory concerns for the use of recycled water consist of the potential regulation of endocrine disrupting chemicals and other CECs. The State Recycled Water Policy highlights CECs as a potential issue for recycled water. A discussion of the current status of these emerging pollutants is provided below.

In recent years, there has been heightened scientific awareness and public debate over potential impacts that may result from exposure to microconstituents, some of which are endocrine disrupting compounds (EDCs). Humans, fish, and wildlife species could potentially be affected by sufficient environmental exposure to EDCs.

In 1996, new legislation required that the United States Environmental Protection Agency (EPA) “determine whether certain substances may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen or other such endocrine effect.” In response, the EPA developed the Endocrine Disrupter Screening and Testing Advisory Committee.

Based on the current state of knowledge and the low levels of microconstituents in surface waters, it is likely to be many years before any such standards are promulgated. Nonetheless, in December 2009, the EPA took the first step in the regulation of microconstituents in water by putting 13 of these compounds on their Contaminant Candidate List. These compounds will be tested in the future to determine whether drinking water criteria are necessary.

While there are no current regulations regarding these constituents in recycled water, the State Recycled Water Policy convened a Blue Ribbon Panel to advise regulators as to the best way to proceed with monitoring for EDCs and other CECs. On April 15, 2010, the Blue Ribbon Panel released its draft recommendations for monitoring CECs in recycled water. The Panel recommends immediately monitoring for caffeine, 17-beta estradiol (a sex hormone) and triclosan (the active ingredient in antimicrobial soaps). Once their recommendations are finalized, the SWRCB will decide how to incorporate them into future permits. It will be important to continue to track research and regulations related to microconstituents in recycled water.

3.2 Water Supplies

The IWA currently relies on groundwater for all potable water needs. Recycled water makes up a small portion of irrigation water in the study area. Currently the Coachella Valley Sanitation District (CVSD) supplies recycled water to a golf course within the study area. Future sources of recycled water supply would come from the treatment of wastewater by the Valley Sanitation District (VSD). These sources are explained in detail in this section.

3.2.1 <u>Groundwater</u>

IWA relies on groundwater from the Whitewater River groundwater subbasin to provide water to its residential, industrial, and commercial customers. In addition to groundwater, supplemental supplies for the Coachella Valley have historically included surface water diverted from local streams, Coachella/All American Canal water imported from the Colorado River, imported water exchanged for the State Water Project (SWP) entitlement water, and recycled water from wastewater treatment plants and fish farms.[4] The Whitewater River subbasin is part of the Coachella Valley basin. The demand for the Coachella Valley groundwater has annually exceeded the natural recharge to the Whitewater River Sub-basins and is therefore considered to be in a state of overdraft.[5]

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[4] 2005 Urban Water Management Plan Update, August 2006, Metcalf and Eddy- AECOM.
[5] Whitewater River Subbasin Description and Information, DWR Bulletin 118 - Update 2003

3.2.2 Recycled Water from CVWD

The Shadow Hills Golf Course is the only known user of recycled water within the study limits at this time. The golf course receives recycled water from the Coachella Valley Water Districts (CVWD) water reclamation plant located north of the golf course.

3.2.3 Recycled Water from VSD

The VSD does not currently provide Title 22 treated recycled water. However, it does divert approximately 1 million gallons per day (mgd) of flow through a wetlands area before being discharged to the Whitewater storm channel. Several treatment alternatives for the production of recycled water that meets the California Title 22 requirements have been identified in the Recycled Water Treatment Alternatives and Delivery Corridor Options-Technical Memorandum Number 4 (TM No. 4) dated January 2010 and the Draft Recycled Water Environmental Impact Report (EIR) prepared for the expansion of VSD's wastewater treatment plant (WWTP). TM No. 4 is included in Appendix B.

With the addition of tertiary level treatment, the VSD would be able to provide recycled water to customers. Different treatment alternatives were identified for the production of recycled water for irrigation and for groundwater recharge.

Treatment to Title 22 standards for landscape irrigation include tertiary filtration, membrane bioreactors, and disinfection. Groundwater recharge with recycled water would require advanced treatment with microfiltration (MF) and reverse osmosis (RO). MF is required as pretreatment for RO, and RO is responsible for demineralization and removal of dissolved organic compounds in recycled water. This advanced treatment would also include ultraviolet advanced oxidation process, using hydrogen peroxide to provide disinfection and oxidation of microconstituents. Advanced treatment would allow recycled water to be used with indirect potable using ASR wells. These wells could be used at the Posse Park and Indio Municipal Golf Course during the low-demand winter months to maximize recycled water-use year round.

VSD's existing WWTP currently treats approximately 6.5 mgd as stated in the EIR and summarized in Table 4.

Table 4 Recycled Water Supply Compared with Potential Demand
Recycled Water Master Plan
Indio Water Authority

Flow Condition	Current Capacity (mgd)	Current Capacity (afy)	Ultimate Capacity (mgd)	Ultimate Capacity (afy)
Average Annual WWTP Flow	6.5	7,282	16.0	17,925
Wetlands Treatment(1)	1.0	-	0.0	-
Minimum Discharge to Channel	0.5	-	0.5	-
Available Ave. Recycled Water Flow	6.0	6,722	15.5	17,365
Potential Average Annual RW Demand	-	15,387	-	15,387

Notes:
(1) The existing wetlands treatment facility could be eliminated after adding tertiary treatment facilities to the VSD WWTP.
Source: Draft Indio Water Authority Recycled Water Environmental Impact Report.

As shown in Table 4, approximately 1 mgd of the existing 6.5 mgd plant flow is currently diverted to a wetlands project. This project can be eliminated once the tertiary treatment process is in place. However, a minimum discharge to the Coachella Valley Canal of 0.5 mgd remains to maintain existing habitat in the discharge channel. Hence, the existing plant could provide approximately 6.0 mgd of recycled water supply under average day flow conditions.

At build-out, the WWTP is expected to reach a total capacity of 17.2 mgd as stated in the VSD Wastewater Treatment Plant Master Plan. As shown in Table 4 above, this amounts to approximately 16 mgd of average annual flow rate from VSD WWTP and approximately 15.5 mgd of available average recycled water irrigation flow rate.

3.3 Seasonal Demand Availability

The demands for the service area change with the seasonal weather fluctuations. These weather fluctuations directly affect irrigation practices. Figure 6 shows the potential monthly demands under build out conditions, which reflect fluctuations in weather conditions and irrigation rates. October has a higher demand due to the amount of irrigation required to support overseeding at golf courses and large turf areas. Winter months have lower demands due to rainfall and lower evaporation rates.

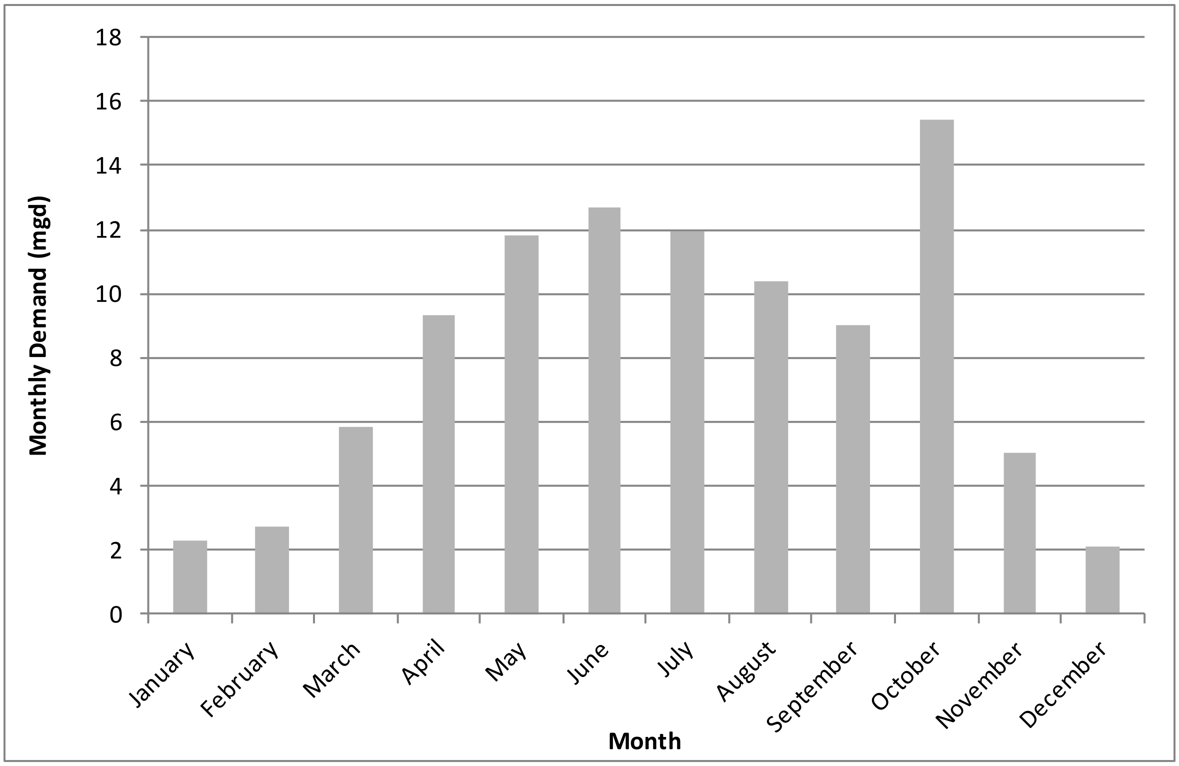


Figure 6 Potential Seasonal Demand Variation

3.4 Supply and Demand Balance

As shown in Table 2, the estimated MDD of all potential customers is 28.5 mgd. It is evident that this is substantially higher than the available average recycled water flow of 15.5 mgd under build-out conditions (see Table 4). Hence, approximately 13 mgd of potential customers will not have recycled water available under MDD conditions. Because the WWTP does not have adequate supply to accommodate all potential demands, the system was oriented to supply water to the most feasible customers based on location relative to the WWTP and amount of recycled water available.

The supply and demand balance for the WWTP under build-out conditions is shown in Figure 7. Customers were added to the system such that the MMD during October match the available recycled water supply after meeting the minimum discharge requirement of 0.5 mgd to the Coachella Canal. To maximize the use of recycled water year-round, the monthly difference between the available WWTP supply and the demands could be used for groundwater recharge using ASR wells. Based on the demand balance presented in Figure 7, it is estimated that approximately 8,150 afy of recycled water can be recharged into the groundwater basin.

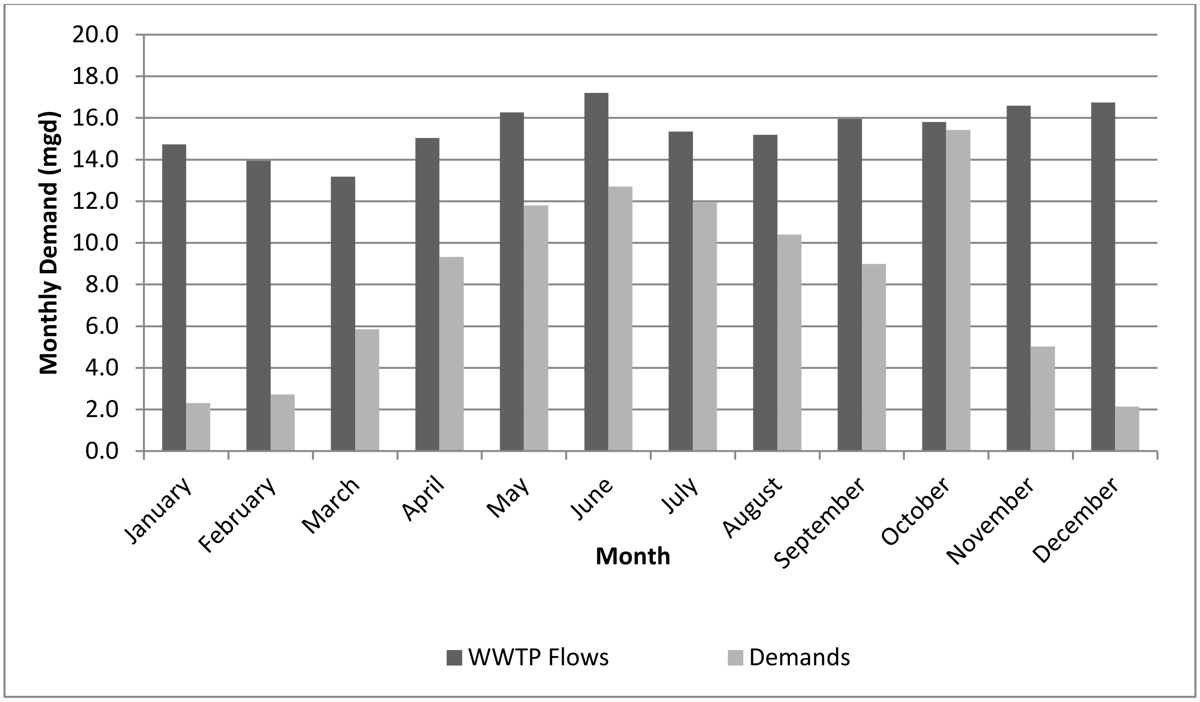


Figure 7 Build-out Supply and Demand Balance

4.0 HYDRAULIC MODEL

Hydraulic network analysis is a powerful tool used in all aspects of recycled water distribution system planning, design, operation, management, system reliability analysis, as well as water quality simulations. The IWA's hydraulic model was developed to size the components of the proposed distribution system. A screenshot of IWA's recycled water model developed for this RWMP is presented on Figure 8.

4.1.1 Data Collection and Validation

The only data necessary to develop the IWA recycled water system model was:

- GIS shapefiles of the IWA's borders and location of the VSD WWTP
- Aerial photography
- Elevation data
- GIS data for possible customers

The initial sizing and configuration of the system was obtained using TM No. 1 and TM No. 4. This configuration has been modified during the hydraulic analysis of the proposed pipelines to meet the estimated peak hour demands.

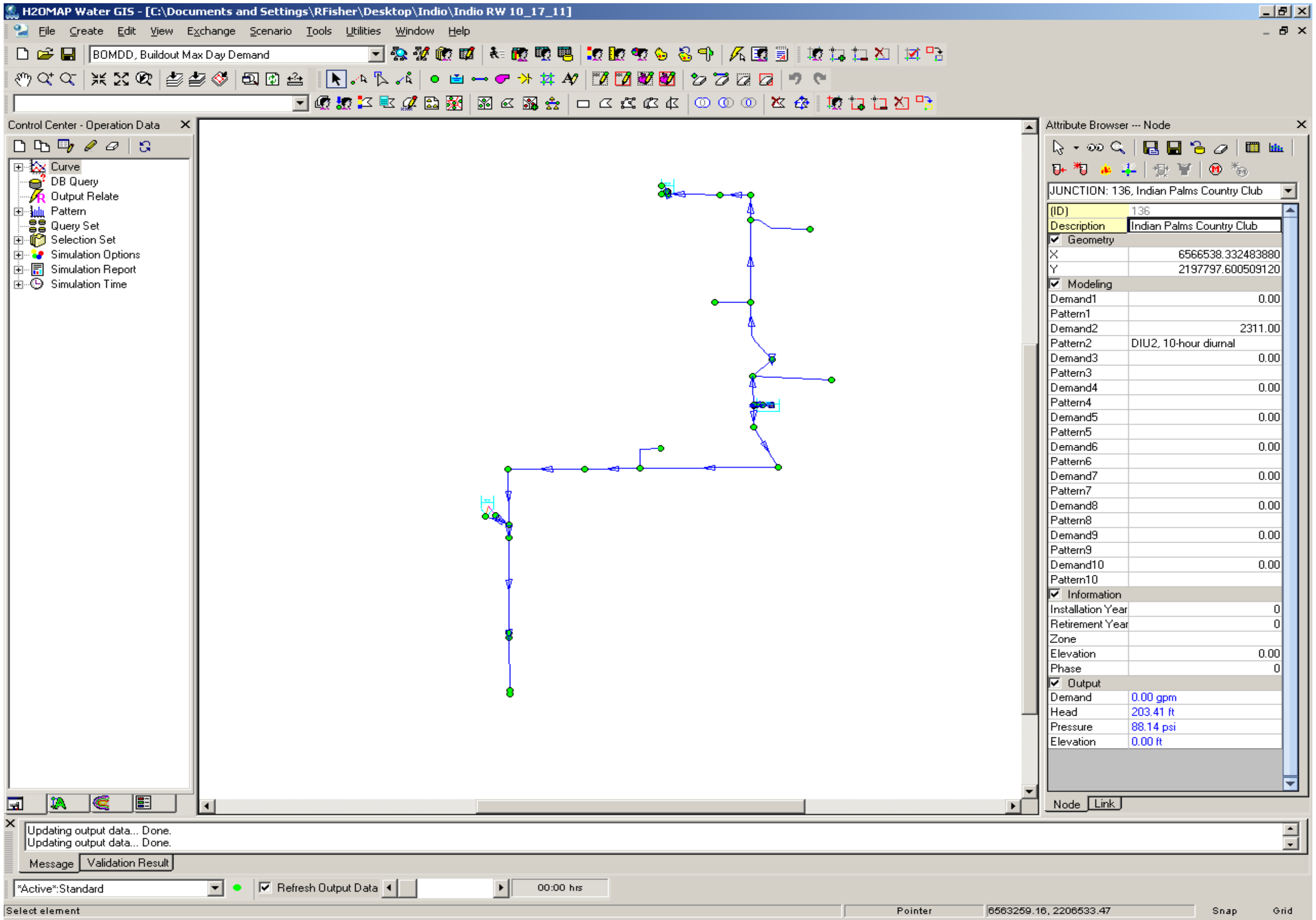


Figure 8
Hydraulic Model Screenshot
Recycled Water Master Plan
Indio Water Authority

carollo

4.1.2 Elements of the Hydraulic Model

The IWA's recycled water hydraulic model combines information on the physical and operational characteristics of the recycled water system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes and pressures at nodes. Elements comprising the computer modeling process are: developing the recycled water system, defining pipes, nodes, sources and pumps, and allocating water demands. These elements were analyzed in a number of scenarios to accomplish the most feasible distribution system.

Pipes and Nodes

Computer modeling requires gathering detailed numerical information on the physical characteristic of the modeled recycled water system, such as pipe diameters, lengths, and general system geometry. This information was obtained from the general layout provided in TM No. 1.

Pipes and nodes represent the physical elements describing the distribution network. A node represents a location in the network where a demand can be applied or recycled water supplied to the system, while a pipe segment represents the actual transmission or distribution pipe itself. The model includes 31 nodes and approximately 11 miles of pipe to supply recycled water to potential recycled water customers.

Storage Tanks

Storage tanks were modeled in the distribution system to buffer hourly fluctuations in demand. Storage tanks are typically sized to handle the difference between PHD and MDD.

Pump Stations

Pump stations were modeled for all ground level storage tanks because there is not adequate elevation head available from the storage tanks due to the relatively flat terrain of the study area. Pump stations should utilize variable frequency drives (VFD) to allow flexibility in the pump stations.

Demand Allocation

Nodes that have a demand allocated to them represent potential recycled water customers. There are 12 demand nodes used in the IWA model. Diurnal patterns were assigned to each demand node that represent the usage pattern of the customer at that particular location.

5.0 SYSTEM ANALYSIS

5.1 Evaluation Criteria

The recycled water supply, storage, and distribution facilities for the conceptual distribution system were sized based on the planning criteria defined in this section. The criteria include standards from the IWA's Water Distribution System Master Plan and other planning criteria recommended by Carollo. The criteria address the recycled water supply capacity, storage capacity, acceptable service pressures, distribution main velocity, headloss, and daily and hourly peaking factors.

5.1.1 Recycled Water Supply Capacity

Recycled water supply capacity is the total capacity of the recycled water supplied by the WWTP. In determining the adequacy of the recycled water supply facilities, the source must be large enough to meet varying demand conditions.

In accordance with the criteria defined herein, the recycled water system's supply source from the WWTP should have the capacity to meet the system's MDD. For reliability purposes, it is desirable to maintain a firm pump station capacity equal to the MDD. Firm capacity is equal to the total capacity of the pump station at the WWTP, minus the capacity of the largest pump. Supply in excess of MDD required for PHD could come from ground level storage tanks with pump stations.

5.1.2 Storage

The principal function of storage in a recycled water system is to provide a reserve water supply for operational and emergency storage. Temporary interruptions are typically acceptable for irrigation sites because potable water can be used to supplement recycled water. Therefore, emergency storage is not required. Fire flow storage is not required either, as potable water will be used for fire protection within IWA's service area. Hence, the only type of storage required for IWA's recycled water system is operational storage.

Operational storage is the amount of water needed to buffer the difference between the demand and supply in a 24-hour period. For the purpose of this study, it is assumed that the wastewater treatment plant expansion will also include the installation of equalization basins to provide a constant recycled water supply for IWA's recycled water system.

Based on the assumption of a constant recycled water supply and the aggregate diurnal curve of all potential customers, the required amount of operational storage can be calculated. The calculation using the customers connected to the proposed build out system is presented in Figure 9. As shown in this figure, the minimum amount of operational storage is 58 percent of MDD.

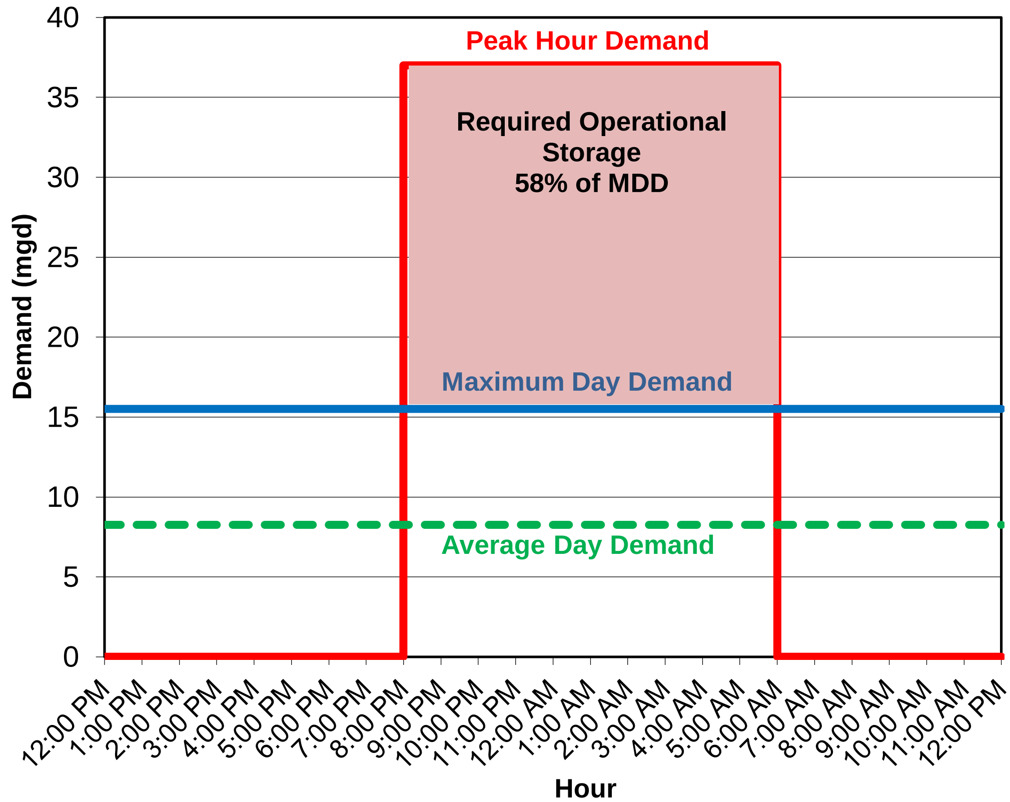


Figure 9 Operational Storage Requirement

5.1.3 Transmission Mains

Transmission mains in recycled water systems are generally sized to carry the PHD. Other criteria related to the transmission piping include the maximum and minimum velocities and the maximum allowable head loss.

For the purposes of this study, recycled water pipelines 12-inches in diameter or less were sized for a maximum pipeline velocity of 7 fps, while recycled water pipelines 16-inches in diameter or more were sized for a maximum pipeline velocity of 5 fps. In addition, recycled water pipelines were sized per typical industry standards of a maximum headloss of 5 feet per thousand feet (ft/kft) under PHD conditions.

A Hazen-William's roughness coefficient ("C" factor) of 130 was assumed for calculating head loss in recycled water pipes.

5.1.4 Service Pressures

Distribution system pressures vary depending on system operations and pressure zone topography. Based on the criteria presented in the IWA's Water Distribution System Master Plan, it is recommended that a minimum pressure of 60 pounds per square inch (psi) be maintained during PHD conditions. This pressure is to maintain a seamless transition from a potable water system to recycled water.

5.1.5 Planning Criteria Summary

The above stated criteria will be the basis for the analysis of the recycled water distribution system. Table 5 provides a summary of the planning and sizing criteria discussed herein.

Table 5 System Evaluation Criteria
Recycled Water Master Plan
Indio Water Authority

Parameter	Evaluation Criteria		Demand Condition
System Pressure			
Minimum System Pressure	60	psi	Peak Hour Demand
Maximum System Pressure(1)	125	psi	Minimum Hour Demand
Pipeline Velocity/Headloss			
Max. Velocity (diameter > 12-inch)	5	ft/s	Peak Hour Demand
Max. Velocity (diameter ≤ 12-inch)	7	ft/s	Peak Hour Demand
Max. Head Loss	5	ft/1,000 ft	Peak Hour Demand
Friction Factor (Hazen-Williams)			
New Pipelines	130		All conditions
Storage Volume			
Operational Storage(2)	58% of MDD		Maximum Month Demand
Pump Station Standby Capacity			
For Zones with Gravity Storage	Meet MDD with largest pump unit OOS(3)		Maximum Month Demand
For Zones without Gravity Storage	Meet PHD with largest pump unit OOS(3)		Peak Hour Demand
Backup Power	Connection for Portable Generator		Peak Hour Demand

Notes:
(1) Maximum pressure without pressure reducing valves; higher pressures are acceptable if pressure-reducing valves are installed at the meter connection (CPC, 2007).
(2) Based on a 10-hour irrigation period (10-hours divided by 24). Note: this period could be extended if golf courses would have on-site storage in lakes to buffer some of the flows. Using a 12-hour irrigation period, the storage criteria could be reduced to 50%.
(3) OOS = out of service

5.2 Feasibility Analysis

The Recycled Water Feasibility Study- Phase 1 performed by Dudek and Associates, Inc. was completed in 2004 (see Appendix C). This study provides the IWA with a basis for the development of a recycled water system. This study addressed potential customers, supply options, rehabilitation of the storm channel crossing, and probable costs. The results from this study along with findings from TM No. 1- TM No. 4 were used to determine the most feasible distribution system. In addition, the Indio Municipal Golf course and Posse Park are key customers that will set the standard for connecting to the recycled water system because the property is owned by the City. The following sections explain the feasibility analysis for the proposed recycled water system.

5.2.1 Distribution System Analysis

The distribution system has been analyzed based on potential customers in the recycled water system. Large potential customers such as golf courses were given a higher priority than smaller customers such as schools and parks. The distribution system has been divided into two portions, a system to the north and a system to the south of VSD's WWTP.

The northern portion is based on the ability to deliver recycled water to two key customers of City-owned land at the Indio Municipal Golf Course and Posse Park. The other potential large customers of this system include three golf courses, one HOA, and two parks. Potential small customers further than one mile from the main transmission line were not considered due to the small benefit compared to the additional pipeline costs. The northern section of the system has adequate users to utilize the available WWTP supply for the current WWTP flows.

The southern portion of the proposed recycled water system was determined by connecting large users that are situated in the lower portion of the study area. This includes two large golf courses, two polo clubs with over 420 irrigable acreage, and three parks. These users were considered the most feasible due to the location relative to the WWTP and the associated pipeline costs required to connect additional users.

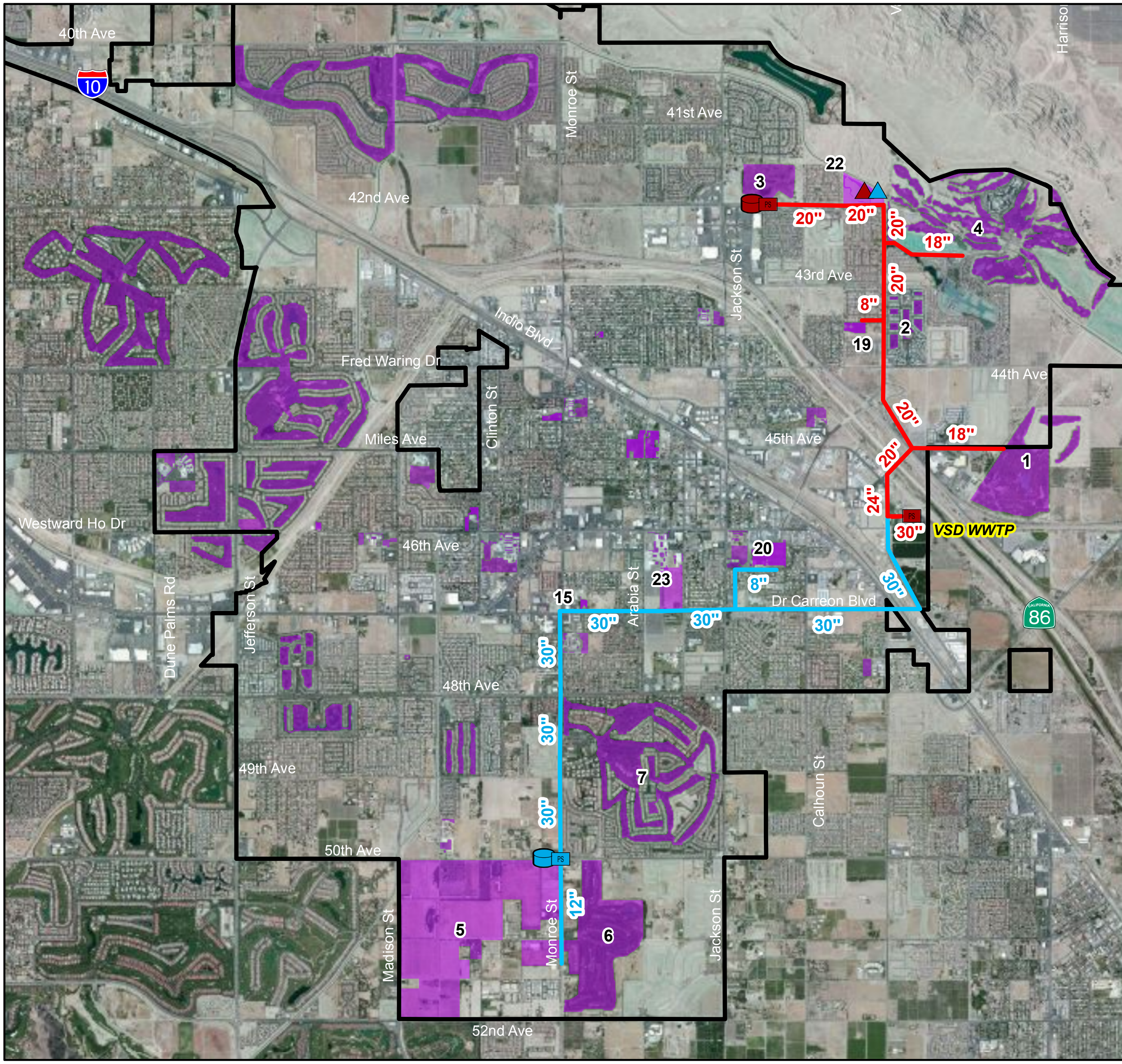
Other large users in the western portion of the study area were excluded due to the much higher transmission pipeline cost and need for a booster pumping station to serve these customers at higher elevations.

The proposed system layout is presented in Figure 10, while system cost estimates are discussed in Section 5.2.3.

ASR Well Analysis

The initial locations of possible ASR wells are sited at Posse Park and Indio Municipal Golf Course. These two locations are City-owned and can be used for landscape irrigation and indirect potable reuse with ASR wells. The addition of ASR wells could increase the feasibility of installing a pipeline to reach these two customers because recycled water can be utilized year round. The ASR wells will be sized to handle the difference between the seasonal demands and the available recycled water as shown in Figure 7. As mentioned previously, it is estimated that approximately 8,150 afy of recycled water could be recharged under build out conditions, after the minimum discharge requirements to the Coachella Channel (0.5 mgd) and the build our recycled water system demand (---afy) have been met.

It should be noted that in addition to the installation of ASR wells, the pipelines between the WWTP and Posse Park will need to be increased in size from 24-inch to 30-inch diameter to support the additional flows for the ASR wells. The unit cost analysis for this groundwater recharge option is discussed in Section 5.2.3.



Legend

Proposed Recycled Water Facilities

Tanks
- Phase 1
- Phase 2

Pumps
- Phase 1
- Phase 2

ASR Wells
- Phase 1
- Phase 2

Pipelines
- Phase 1
- Phase 2

Potential Recycled Water Customers
- Irrigated Area
- City of Indio Limits

Feet
0 3,500 7,000

Figure 10
Conceptual Recycled Water Distribution System
Recycled Water Master Plan
Indio Water Authority

carollo

5.2.2 Energy Analysis

Two options for delivery of recycled water to customers were investigated. The first option is to supply recycled water that will provide adequate pressures to the customers for large irrigation sprinklers. As discussed in the criteria section, the distribution system was sized to adequately supply water at 60 psi at each customer. The study area is relatively flat with customer elevations ranging from -30 feet to 20 feet above MSL. The WWTP pump station is adding approximately 280 feet of head into the distribution system.

The second option is to supply water to customers at a lower service pressure of 5 psi. Due to the abundance of golf courses with lakes and ponds, a higher service pressure is not needed because irrigation water is pumped out of the lakes. This option will allow an energy savings for the WWTP pump station because the system will not need to operate at an elevated hydraulic grade line to supply the higher 60 psi pressure. This would require the end customer to boost water pressures to the desired service pressure. The lower pressure system would require the WWTP to supply at least 80 feet of head into the distribution system to maintain a minimum of 5 psi.

The estimated cost savings for the lower pressure system is approximately $38,000 per month based on the WWTP pumping MMD during the summer months. The energy cost was estimated using $0.12/ per kilowatt-hour. Pump stations were sized according to the required horsepower to support the MDD at the two different hydraulic grade lines.

5.2.3 Feasibility Summary

The results of the feasibility analysis are summarized in Table 6. This table shows the cost per acre-foot of recycled water used for each of the three key system expansion segments that were analyzed.

Table 6 Feasibility Analysis Summary
Recycled Water Master Plan
Indio Water Authority

Pipeline Segment	ADD (afy)(3)	Capital Cost ($ million)	Unit Cost(2) ($/afy)
Northern Section	3,356	$12.6	$146
Southern Section	5,887	$20.4	$134
Western Section	4,031	$18.2	$220
IPR with ASR Wells(1)	8,000	$41.2	$200

Notes:
(1) Includes 4 ASR wells of 2,000 gpm ($1 million/well), $1 million for pipeline upgrades, and RO treatment.
(2) Based on a 50-year depreciation period for pipelines and 3 percent interest.

Based on the results presented in Table 6, it can be concluded that the southern section would provide the highest demand in afy for the lowest unit cost. It can also be seen that the western portion has a much higher unit cost than the northern and southern segments. These higher cost were due to extended length of pipe from the WWTP required to reach the potential customers and the need for a pump station. As the amount of recycled water supply is limited, the western segment was not included in the build out system configuration.

The northern segment includes the Indio Municipal Golf Course, a city-owned property that could be converted first to recycled water and serve as a model customer and to build experience and trust with other potential customers. For this reason, it is recommended that the northern section of the distribution system be developed first. This segment is therefore also referred to as Phase 1, while the southern segment is referred to as Phase 2.

Table 6 also shows that the addition of ASR wells at Posse Park makes the northern segment more expensive on a unit cost basis; however, groundwater recharge provides additional benefits from a water supply reliability perspective. Ultimately, the decision on implementing ASR wells with the required treatment needs to be compared to other water supply alternatives. This comparison is beyond the scope of this study.

5.3 Recycled Water System Layout

This section gives recommendations for the proper sizing and operation of the recycled water system. The following sections summarize the findings of the system analysis.

5.3.1 <u>Recycled Water Supply Capacity</u>

The recycled water supply requirements to meet the MDD are presented in Table 7.

Table 7 Recycled Water Supply Capacity Requirements
Recycled Water Master Plan
Indio Water Authority

Phase	WWTP MDD (mgd)	Environmental Obligations (mgd)(1)	Available Recycled Water Supply (mgd)(2)	MDD (mgd)	Supply Balance(3) (mgd)
1	6.5	0.5	6.0	6.0	0
2	9.5	-	9.5	9.5	0
Total	**16.0**	**-**	**15.5**	**15.5**	**0**

Notes:
(1) The existing wetlands treatment facility could be eliminated with the addition of tertiary treatment facilities to the VSD WWTP, and minimum discharge to the channel= 0.5 mgd.
(2) Available recycled water supply is WWTP Flow – Environmental Obligations.
(3) Supply Balance = WWTP Flow- Environmental obligations- Demands.

As shown in Table 7, the required firm capacity (capacity with largest pump out of service) of a recycled water pump station at the WWTP to meet the Phase 2 MDDs is 15.5 mgd. This represents the ultimate allowable flow of the WWTP as stated in TM No. 1. The transmission system has been sized to handle flows up to 15.5 mgd and the pump station should have a firm capacity of 15.5 mgd with pump redundancy. It is recommended that the pump station be designed to accommodate both Phase 1 and Build-Out (Phase 2) recycled water demands, although the installation of individual pumps could be staged in accordance with the incremental increase in recycled water demand.

5.3.2 Storage Tanks

As shown in Table 8, the required storage volume of the potential irrigation customers to meet the operational storage requirements for the build-out period up to Phase 2 is 10.5 million gallons (MG). Phase 1 should consist of one storage tank with a capacity of 3.5 million gallon. This storage tank could be sited on the City-owned property at either Indio Municipal Golf Course or Posse Park to avoid land acquisition costs.

Storage to accommodate additional demands related to Phase 2 would require installation of one 6.5 MG ground level recycled water storage reservoir. It is estimated that this storage tank will require property acquisition of approximately 2 acres. This will allow sufficient space for the storage tank, pump stations, appurtenances, pump stations, and site access.

Table 8 Recycled Water Storage Requirements
Recycled Water Master Plan
Indio Water Authority

Phase	MDD (mgd)	Required Storage[1] (MG)
1	6.0	3.5
2	9.5	6.5
Total	**15.5**	**10.0**

Notes:
(1) Storage is sized at 67 percent of MDD

5.3.3 Storage Tank Booster Pump Stations

The proposed recycled water storage tanks will also require the installation of booster pump stations at each of the tank locations. Therefore, one new booster pump station is recommended for Phase 1 and one new pump station for Phase 2. Pump station design capacities should be sized to pump the difference between the peak hour and maximum day demand. Phase 1 pump stations should have a firm capacity of 5,300 gpm providing 160 feet of head to supplement the peak hour flows in addition to the WWTP pump station.

Phase 2 will require one pump station near the southern end of the project and will require a firm capacity of 11,500 gpm providing 180 feet of head. The storage reservoirs and pump stations can be staged with the expansion of the recycled water system and add pumps as the demands increase in the system.

5.3.4 ASR Wells

With the addition of ASR wells, the IWA will be able to maximize recycled water use in non-peak demand periods (winter). The minimum month flows are approximately 25 percent of the total max month demand. The ASR wells will be sized to receive this flow and use IPR to store water in the groundwater aquifer. The ASR wells will be able to operate year round by recharging the difference between the MDD and the available wastewater flow as shown on Figure 7. As stated previously, the difference between the two (2) areas equates to approximately 8,150 afy of indirect potable water reuse. This assumes that the ASR wells will be operating year round except during the max month demand in the month of October. It is estimated that approximately four ASR wells would be constructed at either Posse Park or Indio Municipal Golf Course, depending on the soil percolation rates in each area. Each well is estimated to percolate 2,000 gpm of recycled water. The areas surrounding Posse Park and Indio Municipal Golf Course will need to have a detailed analysis before sizing the ASR wells.

As stated, the maximum recharge amount under build out conditions is estimated to be 8,150 afy. Based on the monthly variation in available recharge flow, the maximum amount of recharge would occur in the month of December with an estimated average flow of 14.6 mgd or 10,000 gpm. Based on a recharge capacity of 2,000 gpm/well, this phase would require five (5) wells. However, it is more cost-effective to install only four (4) wells and reduce the amount of recharge in the winter months, while still capturing all the available flow in the remaining months. By installing four (4) ASR wells with an estimated capacity of 2,000 gpm/well, the total recharge capacity would be reduced to 8,000 gpm, with an estimated annual recharge of 7,777 afy. During four months per year (November-February), the maximum recharge capacity of 8,000 gpm or 11.5 mg would be utilized. Based on a 20 percent bypass, the required RO treatment capacity would be 9.2 mgd. The bypass stream would require disinfection prior to blending and recharge.

For planning purposes, it is assumed that two of the ASR wells and 50 percent of the ultimate treatment capacity (or 4.6 mgd) would be installed during Phase 1.

It should be noted that a separate study should be conducted to evaluate the feasibility and benefits of ASR recharge. The number of wells can be optimized by not recharging all available flow in the winter months but targeting the average supply availability. In addition, groundwater recharge characteristics such as infiltration rates need to analyzed with field testing and water quality evaluations need to be completed to develop planning level treatment plant sizing and cost estimates. The ASR analysis is beyond the scope of this study and is only presented herein to demonstrate the potential benefit of combining a recycled water system for direct use with groundwater augmentation. All numbers presented in this report related to IPR are only feasibility level estimates.

5.3.5 Conceptual Recycled Water Distribution System

A conceptual recycled water distribution system layout was prepared to service the potential existing and future irrigation customers identified in Section 2.0. Based on the evaluation criteria discussed in Section 3.2.3, a recycled water hydraulic model was used to size the recycled water system facilities. The hydraulic model evaluation consisted of 24-hour simulations during MDD conditions, which includes PHD conditions.

The conceptual recycled water distribution system is sized for both existing and future customer demands. Should the IWA choose to construct a recycled water system, it is recommended that the pipeline diameters and pump station capacities be constructed so that the facilities have sufficient capacity for existing and future conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended.

Figure 10 provides a graphical illustration of the improvements to implement a conceptual recycled water distribution system. Each project will need further site-specific or project level engineering analysis. The demands estimates for potential customers is show on Table 9. Improvements are summarized in Table 10 for the proposed recycled water distribution system.

Table 9 Recycled Water Demand Estimates
Recycled Water Evaluation
City of Indio

Customer Name	Irrigable Area (acres)	Average Day Demand(1) (mgd)	Average Annual Demand(2) (afy)	Min Month Demand(3) (mgd)	Max. Month Demand(4) (mgd)	Max. Day Demand(5) (mgd)	Irrigation Window (hrs)	Peak Hour Demand(6) (gpm)
Phase 1 Customers								
Eagle Falls Golf Course	123	0.99	1,107	0.26	1.85	1.98	10	3,293
Rancho Casa Blanco Country Club and HOA	14	0.10	117	0.03	0.20	0.21	8	435
Indio Municipal Golf Course	40	0.32	358	0.08	0.60	0.63	8	1,312
Terra Lago Golf Club	192	1.54	1,728	0.40	2.89	3.10	12	4,284
Posse Park	4	0.02	22	0.00	0.04	0.04	10	64
Indio Terrace Park	5	0.02	25	0.01	0.04	0.04	10	74
Phase 1 Subtotal	**378**	3.00	**3,356**	0.78	5.60	6.00	**-**	**9,461**
Phase 2 Customers								
Jackson Park	7	0.03	38	0.01	0.06	0.07	10	112
Riverside CountY Fairgrounds	10	0.05	54	0.01	0.09	0.10	10	160
Carreon Park	2	0.01	9	0.00	0.01	0.02	10	26
Indian Palms Country Club	174	1.67	1,865	0.43	3.11	3.33	10	5,548
Empire and Eldorado Polo Clubs	420	2.63	2,950	0.68	4.93	5.27	10	8,776
Plantation Golf Club(6)	167	0.87	972	0.23	1.62	1.74	7	4,131
Phase 2 Subtotal	**780**	**5.26**	**5,887**	**1.37**	**9.83**	**10.51**	**-**	**18,752**
Total								
Phase 1 Total	**378**	**3.00**	**3,356**	**0.78**	**5.60**	**6.00**	**-**	**9,461**
Phase 2 Total	**1,157**	**8.25**	**9,243**	**2.15**	**15.44**	**16.51**	**-**	**28,213**

Notes:

(1) Annual Day Demand= Average Annual Demand/ 365
(2) Average Seasonal Demand developed from TM1
(3) Min. Month Demand to Average Seasonal Demand Peaking Factor = 0.26, or MINMD = Seasonal Demand x 0.26
(3) Max. Month Demand to Average Seasonal Demand Peaking Factor = 1.87, or MMD = Seasonal Demand x 1.87
(4) Max. Day Demand to Average Seasonal Demand Peaking Factor = 2.0, or MDD = Seasonal Demand x 2.0
(5) Peak Hour Demand to Average Seasonal Demand Peaking Factor varies, PHD = Seasonal Demand x 24-hours/ Irrigation Window
(6) Plantation Golf Club can only be supplied approximately 60% of the total demand, the remaining shall be supplied by canal water.

Table 10 Proposed Recycled Water Distribution System
Recycled Water Master Plan
Indio Water Authority

	Type of Improvement	Description/ Street	Description / Limits	Phase	New Size/ Diam. (in)	Length (ft)
Pipelines						
P-1	Pipe	WWTP	From WWTP to Van Buren Street	1	30	400
P-2	Pipe	Van Buren Street, Avenue 45	From WWTP Connection to Commerce Street	1	24	1,400
P-3	Pipe/Casing	State Highway 10 Crossing	From Avenue 45 to Indio Springs Drive	1	20/30	1,100
P-4	Pipe	Indio Springs Drive, Golf Center Parkway	From Indio Springs Drive to Avenue 44	1	20	3,100
P-5	Pipe	Avenue 44	From Golf Center Parkway to Eagle Falls Golf Course	1	18	2,900
P-6	Pipe	Hopi Avenue	From Golf Center Parkway to Indio Terrace Park	1	8	600
P-7	Pipe	Golf Center Parkway	From Avenue 44 to Avenue 42	1	20	4,000
P-8	Pipe	Terra Lago Parkway	From Golf Center Parkway to Terra Lago Golf Course	1	18	2,700
P-9	Pipe	Golf Center Parkway	From Terra Lago Parkway to Avenue 42	1	20	1,200
P-10	Pipe	Avenue 42	From Golf Center Parkway to Posse Park	1	20	1,300
P-11	Pipe	Avenue 42	From Posse Park to Indio Municipal Golf Course	1	20	2,500
P-12	Pipe	Van Buren Steet	From WWTP Connection to Cabanzon Road	2	30	2,600
P-13	Pipe/Casing	Rairoad Crossing	From Cabazon Road to Dr Carreon Boulevard	2	36/60	600
P-14	Pipe	Dr Carreon Boulevard	From Van Buren Street to Jackson Street	2	30	4,600
P-15	Pipe	Jackson Street	From Dr Carreon Boulevard to Jackson Park	2	8	1,800
P-16	Pipe	Dr Carreon Boulevard	From Jackson Street to Riverside County Fairgrounds	2	30	2,400
P-17	Pipe	Dr Carreon Boulevard	From Riverside County Fairgrounds to Monroe Street	2	30	3,300
P-18	Pipe	Monroe Street	From Dr Carreon Boulevard to Avenue 48	2	30	2,700
P-19	Pipe	Monroe Street	From Avenue 48 to El Dorado Polo Club	2	30	5,200
P-20	Pipe	Monroe Street	From El Dorado Polo Club to Plantation Golf Club	2	12	2,700
Storage Tanks and Booster Pumps						
PS-1	Pump Station	WWTP Booster Station Phase 1	WWTP Pump Station Phase 1	1	6.0 mgd	-
T-2	Storage Tank	Indio Municipal Storage/ Pump Station	At Indio Municipal Golf Course	1	4.0 MG	-
PS-2	Pump Station	Indio Municipal Storage/ Pump Station	At Indio Municipal Golf Course	1	7.6 mgd	-
PS-1.2	Pump Station	WWTP Booster Station Phase 2	WWTP Booster Station Phase 2	2	9.5 mgd	
T-3	Storage Tank	Polo Storage Tank	Polo Storage Tank	2	6.5 MG	-
PS-3	Pump Station	Polo Storage Tank Pump Station	Polo Storage Tank Pump Station	2	16.5 mgd	-
	Land Acquisition	Polo Storage Tank Pump Land Acquisition	Polo Storage Tank Pump Land Acquisition	2	2.0 acres	-
ASR Pipeline Upsizing and Wells						
ASRP-1	Pipe	Van Buren Street, Avenue 45	From WWTP Connection to Commerce Street	1	30	1,400
ASRP-2	Pipe/Casing	State Highway 10 Crossing	From Avenue 45 to Indio Springs Drive	1	36/60	1,100
ASRP-3	Pipe	Indio Springs Drive, Golf Center Parkway	From Indio Springs Drive to Avenue 44	1	30	3,100
ASRP-4	Pipe	Golf Center Parkway	From Avenue 44 to Avenue 42	1	30	4,000
ASRP-5	Pipe	Avenue 42	From Golf Center Parkway to Posse Park	1	30	1,300
ASRW-1	Wells	ASR Wells Phase 1	ASR Wells at Posse Park	1	2	-
ASRW-2	Wells	ASR Wells Phase 2	ASR Wells at Posse Park	2	2	-
ASRT-1	Treatment	ASR Wells Phase 1 RO Treatment	ASR Wells at Posse Park	1	2	-
ASRT-2	Treatment	ASR Wells Phase 2 RO Treatment	ASR Wells at Posse Park	2	2	-

6.0 CAPITAL IMPROVEMENTS PROGRAM

The cost estimates presented in this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo's experience on other projects. The costs are based on an Engineering News Record Construction Cost Index (ENR CCI) 20-City Average of 9,035 (September 2011).

6.1 Cost Estimating Accuracy

The cost estimates presented in the CIP have been prepared for general planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as: preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The Association for the Advancement of Cost Engineering (AACE) defines an Order of Magnitude Estimate, deemed appropriate for master plan studies, as an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent. This section presents the assumptions used in developing order of magnitude cost estimates for recommended facilities.

6.2 Construction Unit Costs

The construction costs are representative of recycled water system facilities under normal construction conditions and schedules. Costs have been estimated for public works construction, either as new construction in existing developed areas, or new construction in undeveloped areas.

Recycled water system pipeline projects range in size from 12-inches to 30-inches in diameter. Pipe casings up to 30-inches in diameter are included for major crossings (e.g. creeks, canals, highways, railroad) of the transmission mains. Pipeline unit costs are shown in Table 11. The construction cost estimates are based upon these unit costs. The unit costs are for "typical" field conditions with construction in stable soil.

Construction of pipelines in undeveloped areas is anticipated to cost less than those constructed in developed areas, such as downtown. The unit costs in Table 11 are discounted by 30 percent for pipelines that will be built in undeveloped areas. This discount is based on review of bid tabulations from recent projects that were constructed in developed and undeveloped areas. Pipelines built in undeveloped areas ranged from 30 to 50 percent less than pipelines built in developed areas.

Table 11 Unit Construction Cost Recycled Water Master Plan Indio Water Authority	
Category	**Unit Construction Cost**
Pipelines	**$/lineal ft**
6-inch diameter	$60
8-inch diameter	$75
12-inch diameter	$95
16-inch diameter	$110
18-inch diameter	$120
20-inch diameter	$140
24-inch diameter	$165
30-inch diameter	$225
36-inch diameter	$250
Special Pipeline Construction	**Markup ($ / lineal ft)**
Jack-and-Bore Crossings	$600
Booster Pumping Stations	**$/hp**
<100	$4,500
100-500	$4,000
Storage Tanks	**$/gallon**
Per MG	$0.50
Land Acquisition	**$/acre**
per acre	$200,000
ASR Wells	**$/well**
Per Well	$1 million
RO Treatment	**$/mgd**
Tertiary Effluent with MF/RO	$2.25 million

Construction unit costs were developed for the storage tanks with booster pumps. The unit cost for the storage tank and pump stations were based on completed projects of similar size. The unit cost ranged from a low of $3,500 per horsepower (hp) to a high of $5,500 per horsepower, with $4,500/hp representing a typical value for motors under 100 hp and $4,000/hp for motors between 100-500 hp.

Acquisition of property, easements, and right-of-way (ROW) may be required for some of the recommended projects, but not all. Pipeline corridors or easements are assumed to be in public ROW. For this reason, the land acquisition cost for recycled water pipelines was assumed to be zero. However, land acquisition may be required for storage tank sites. The land costs were assumed to equal $200,000 per acre.

6.3 Project Costs and Contingencies

6.3.1 Baseline Construction Cost

The baseline construction cost is the total estimated construction cost, in dollars, of the proposed improvement. Pipeline, storage tank, and booster pump station Baseline Construction Costs were developed using the following criteria:

- Pipelines: Calculated by multiplying the estimated length (ft) by the unit cost ($/ft)
- Storage Tanks: Calculated by multiplying the tank volume (gal) by the unit cost ($/gal)
- Booster Stations: Calculated by multiplying the capacity (hp) by the unit cost ($/hp)

6.3.2 Estimated Construction Cost

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. Consequently, it is appropriate to allow for uncertainties associated with the preliminary layout of a project. Such factors as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which it is wise to make allowances in preliminary estimates. To assist the IWA in making financial decisions for these future construction projects, contingency costs will be added to the planning budget as percentages of the total construction cost, divided into two categories: Estimated Construction Cost and Capital Improvement Cost.

Since knowledge about site-specific conditions of each proposed project is limited at this stage, a 25 percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. A 25 percent contingency to account for unknown site conditions such as poor soils, unforeseen conditions, environmental mitigations, and other unknowns is typical for planning level estimates. The Estimated Construction Cost for the proposed distribution system improvement consists of the Baseline Construction Cost plus the 25 percent construction contingency.

6.3.3 Total Capital Improvement Cost

Other project construction contingency costs are divided into three subcategories, totaling 30 percent: 10 percent engineering, 10 percent construction phase professional services, and 10 percent project administration. Engineering services associated with new facilities include preliminary investigations and reports, ROW acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to equal 10 percent of the Estimated Construction Cost.

Construction phase professional services cover such items as construction management, engineering services, materials testing, and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction phase professional services expenses will equal approximately 10 percent of the Estimated Construction Cost.

Finally, there are project administration costs, which cover such items as legal fees, environmental/CEQA compliance requirements, financing expenses, administrative costs, and interest during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that project administration costs will equal 10 percent of the Estimated Construction Cost.

The Capital Improvement Cost is the total of the Estimated Construction Cost (including contingency) plus the other costs discussed in the previous paragraphs.

As shown in the following sample calculation of the Capital Improvement Cost, the total cost of all project construction contingencies (construction, engineering services, construction management, and project administration) is 62.5 percent of the Baseline Construction Cost. Note that contingencies were not applied to land acquisition costs. Calculation of the 62.5 percent is the overall mark-up on the baseline construction cost to arrive at the capital improvement cost. It is not an additional contingency.

Example:

Baseline Construction Cost	$1,000,000
Construction Contingency (25%)	250,000
Estimated Construction Cost	1,250,000
Engineering Cost (10%)	125,000
Construction Management (10%)	125,000
Project Administration (10%)	125,000
Capital Improvement Cost	$1,625,000

A summary of the capital project costs is presented in Table 12. This table identifies the projects, provides a brief description of the project, identifies facility size (e.g. pipe diameter and length), and the capital improvement cost. The table also shows the possible phase in which the project would be implemented. The implementation timeframe was based on the priority to serve future recycled water customers.

Table 12 also includes the optional cost for the addition of ASR wells and associated treatment and pipeline improvements required to supply water to the ASR wells. The construction of ASR wells will require the addition of RO treatment prior to recharge. The capital cost for small scale RO treatment plants are estimated at $2.25/mgd.

Table 12 Capital Improvement Program Summary
Recycled Water Master Plan
Indio Water Authority

Category	System Improvements ($ million)(1)		
	Phase 1	Phase 2	Total
Distribution Pipes	5.5	8.8	14.3
WWTP Booster PSs	2.0	3.3	5.2
Storage and Booster PSs	5.1	8.3	13.4
Optional ASR Pipes(2)	1.0	0.0	1.0
Optional ASR Wells(3)	3.3	3.3	6.5
Optional RO treatment	16.8	16.8	33.7
Totals without ASR	**12.6**	**20.4**	**32.9**
Total with ASR	**33.7**	**40.5**	**74.1**

Notes:
(1) All capital cost estimates were based on the unit construction costs listed in Table 10.
(2) Differential cost for upsizing pipelines between WWTP and Posse Park from 24", 20", and 18" to 30" in diameter.
(3) Cost for the construction of 2 and 2 ASR wells in Phase 1 and 2, respectively.

Table 13 correlates the planning level costs to the incremental increase in recycled water demand per phase. The purpose of this is to assist the IWA in quantifying the unit cost per acre-foot per year of water for implementation and expansion of a recycled water distribution system.

Table 13 Capital Cost Analysis
Recycled Water Master Plan
Indio Water Authority

Implementation Phase	Demand (afy)	Capital Cost/Phase ($ million)	Capital Cost(1) ($/afy)
1 (2011 - 2025)	3,356	$12.6	$146
2 (2026 – 2040)	5,887	$20.4	$134
Optional ASR	8,000	$41.2	$200
Total wo/ASR	**9,243**	**$32.9**	-
Total w/ ASR	**17,243**	**$74.1**	-

Notes:
(1) Based on amortized capital cost using 3 percent interest and a 50-year depreciation period. Unit costs do not include operation and maintenance cost.

6.4 Project Prioritization

Future development of a recycled water distribution system will require the construction of transmission system to serve potential existing and future customers. The implementation of these improvements will depend on the proximity to the WWTP, feasibility of chosen segments, as well as the City's growth patterns. The phasing of the improvements identified in this study was developed based on the phasing of improvements in the Valley Sanitation District Wastewater Treatment Plant Master Plan and proximity to the WWTP, as appropriate. Table 14 and associated Figure 11 show the proposed recycled water CIP. The improvements are broken down into two phases:

- Phase 1 Near-Term (Years 2011 through 2025)
- Phase 2 Build-Out (Years 2026 through 2040)

In general, improvements to service existing customers in the northern area of the City were given a higher priority than improvements to service existing customers in the southern end of the City based on the location of the City owned Indio Municipal Golf Course. The Indio Municipal Golf Course is considered an essential location to supply recycled water due to the possible construction of injection wells for recycled water recharge.

6.4.1 Phase 1 Existing Projects (2010-2025)

The Phase 1 projects form the backbone of the recycled water distribution system and are intended to service the majority of the existing potential recycled water customers north of the WWTP. These projects include a transmission main ranging from 30-inches down to 18-inches in diameter (P-1 through P-11) that extends from the WWTP north on Van Buren Street to Avenue 42. Then down Avenue 42 to the Indio Municipal Golf Course. Other smaller, 8-inch diameter distribution system mains (P-6) were targeted for implementation in Phase 1 to service potential customers in the vicinity of the transmission main (ie: Indio Terrace Park, Posse Park).

Other projects targeted for the first implementation phase include:

WWTP Recycled Water Pump Station (WWTP-1). This pump station serves as the sole source of supply to the recycled water system through build-out. It is assumed that the pump station will be designed to accommodate build-out demands, although the installation of individual pumps may be staged based on the incremental increase in recycled water demand.

Indio Municipal Golf Course Pump Station and Tank (T-1 and P-1). This pump station supplies flows to meet the difference between MDD and PHD for the northern portion of the City. This pump station should be constructed on City-owned property at the Indio Municipal Golf Course.

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Table 14 Proposed Recycled Water Capital Improvements Plan
Recycled Water Master Plan
Indio Water Authority

Figure No.	Description/ Street	New Size/ Diam. (in)	Length (ft)	Capital Improvement Cost(1),(2) ($)	Capital Improvement Phasing Phase 1 2011-2020 ($)	Phase 2 2021-2030 ($)
Pipelines						
P-1	WWTP	30	400	$ 146,000	$ 146,000	
P-2	Van Buren Street, Avenue 45	24	1,400	$ 375,000	$ 375,000	
P-3	State Highway 10 Crossing	20/30	1,100	$ 1,073,000	$ 1,073,000	
P-4	Indio Springs Drive, Golf Center Parkway	20	3,100	$ 705,000	$ 705,000	
P-5	Avenue 44	18	2,900	$ 566,000	$ 566,000	
P-6	Hopi Avenue	8	600	$ 73,000	$ 73,000	
P-7	Golf Center Parkway	20	4,000	$ 910,000	$ 910,000	
P-8	Terra Lago Parkway	18	2,700	$ 527,000	$ 527,000	
P-9	Golf Center Parkway	20	1,200	$ 273,000	$ 273,000	
P-10	Avenue 42	20	1,300	$ 296,000	$ 296,000	
P-11	Avenue 42	20	2,500	$ 569,000	$ 569,000	
P-12	Van Buren Steet	30	2,600	$ 951,000		$ 951,000
P-13	Rairoad Crossing	36/60	600	$ 585,000		$ 585,000
P-14	Dr Carreon Boulevard	30	4,600	$ 1,682,000		$ 1,682,000
P-15	Jackson Street	8	1,800	$ 219,000		$ 219,000
P-16	Dr Carreon Boulevard	30	2,400	$ 878,000		$ 878,000
P-17	Dr Carreon Boulevard	30	3,300	$ 1,207,000		$ 1,207,000
P-18	Monroe Street	30	2,700	$ 988,000		$ 988,000
P-19	Monroe Street	30	5,200	$ 1,901,000		$ 1,901,000
P-20	Monroe Street	12	2,700	$ 418,000		$ 418,000
			Pipeline Subtotals=	**$ 14,342,000**	**$ 5,513,000**	**$ 8,829,000**
Storage Tanks and Booster Pumps						
WWTP-1	WWTP Booster Station	6.0 mgd	-	$ 1,950,000	$ 1,950,000	
T-1	Indio Municipal Storage/ Pump Station	3.5 MG	-	$ 2,844,000	$ 2,844,000	
PS-1	Indio Municipal Storage/ Pump Station	7.6 mgd	-	$ 2,275,000	$ 2,275,000	
WWTP-2	WWTP Booster Station Phase 2	9.5 mgd	-	$ 3,250,000		$ 3,250,000
T-2	Monroe Storage Tank	5.5 MG	-	$ 4,469,000		$ 4,469,000
PS-2	Monroe Storage Tank Pump Station	16.5 mgd	-	$ 2,800,000		$ 2,800,000
	Monroe Storage Tank Pump Land Acquisition	2.0 acres	-	$ 200,000		$ 200,000
			Storage/ Pump Statoin Subtotals=	**$ 17,788,000**	**$ 7,069,000**	**$ 10,719,000**

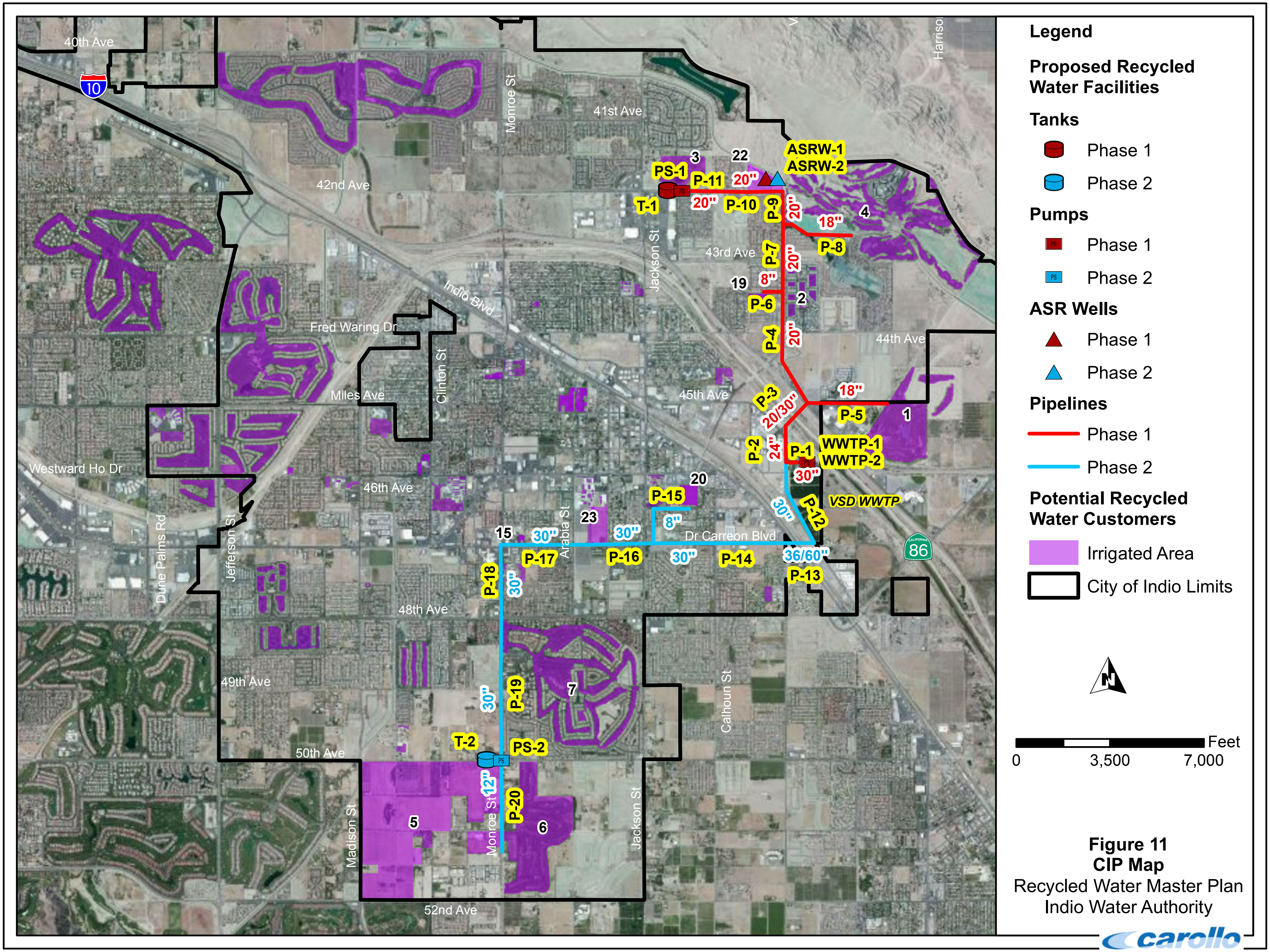


Figure 11
CIP Map
Recycled Water Master Plan
Indio Water Authority

carollo

Optional ASR Wells and Pipeline Upgrades (ASRP & ASRW). This includes the construction of two (2) Aquifer Storage Recovery wells at Posse Park. This will require upsizing some of the Phase 1 pipelines to handle increased flows. These pipeline upgrades are indicated by the projects ASRP-1 through ASRP-5.

Optional ASR Well RO Treatment (ASRT-1). This includes RO treatment facilities for the two ASR wells.

6.4.2 Phase 2 Build-Out Projects (2026-2040)

The Phase 2 projects are intended to extend recycled water service to existing customers throughout the Southern Portion of City. This includes one user from the northern portion of the City and customers that are located southwest of the WWTP, which represent the single largest group of potential recycled water customers in the study area.

These projects include a 24-inch diameter transmission mains (P-12 through P-20) that extends from the WWTP south on Van Buren Street to Dr Carreon Boulevard. Then down Carreon Boulevard to Monroe Street. Then From Monroe Street to Plantation Golf Course.

Other projects targeted for the second implementation phase include:

WWTP Recycled Water Pump Station (WWTP-2). This pump upgrade will be required to meet Phase 2 potential demands.

Recycled Water Storage Tank 3 and Booster Pumps (T-2 and PS-2). This storage tank meets peak demands associated generally with the Phase 2 potential recycled water customers.

Optional ASR Wells (ASR-2). This includes the construction of two (2) additional Aquifer Storage Recovery wells at Posse Park.

Optional ASR Well RO Treatment (ASRT-2). This includes RO treatment facilities for the two (2) additional ASR wells.

APPENDIX A

APPENDIX A

TECHNICAL MEMORANDUM NUMBER 1

CITY OF INDIO
INDIO WATER AUTHORITY
WATER RECLAMATION FACILITIES FOR REUSE AND GROUNDWATER RECHARGE – PHASE 1 ENVIRONMENTAL PROGRAM

TECHNICAL MEMORANDUM NO. 1
MARKET AND DEMAND ASSESSMENT

January 2010

7888 MISSION GROVE PKWY SO, # 100 • RIVERSIDE, CA 92508 • (951) 776-3955 • FAX (951) 776-4207

CITY OF INDIO / INDIO WATER AUTHORITY
WATER RECLAMATION FACILITIES FOR
REUSE AND GROUNDWATER RECHARGE – PHASE 1 ENVIRONMENTAL PROGRAM

TECHNICAL MEMORANDUM NO. 1

MARKET AND DEMAND ASSESSMENT

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This technical memorandum (TM) is prepared for the Indio Water Authority (IWA) in partial fulfillment of the agreement between the IWA and Carollo Engineers entitled "Water Reclamation Facilities for Reuse and Groundwater Recharge – Phase I Environmental Program. This TM presents the results of a market and demand assessment of the potential large recycled water customers that could use recycled water produced by the Valley Sanitary District (VSD) wastewater treatment plant (WWTP). Task 2 of the scope of work is accomplished with this TM and includes the tasks summarized below:

- Task 2.1 – Identify major turf irrigation customers that may become reuse irrigation customers.
- Task 2.2 – Quantify the amount of water that is used by these potential recycled water customers.
- Task 2.3 – Conduct a field investigation of the major customers to identify issues that may need to be addressed to provide recycled water, and to identify potential connection locations.
- Task 2.4 – Prepare a map showing IWA and VSD boundaries, potential large reuse customer locations, and the location of a backbone piping system to deliver the recycled water.

2.0 POTENTIAL CUSTOMERS

Large water users for irrigation in Indio include golf courses, polo clubs, parks, and homeowner's associations (HOAs). Potential recycled water customers were obtained by reviewing customer lists from previous studies, dicussions with IWA staff, and reviewing aerial photographs. A list of possible large recycled water users was developed, and site visits were made to those water users who responded to telephone inquiries. In addition to the customers that have been identified in this TM, there are several turf areas at schools that are large enough to be considered potential small recycled water customers. Table 1 lists the potential large customers and their contact information, where available.

Table 1 Potential Recycled Water User Contact Information

Name	Contact Name	Telephone Number	Address	Golf Course Size
Heritage Palms Golf Club1	Robert (Bob) White	**760-265-7447** 760-772-7334	44-291 Heritage Palms Drive South, Indio, CA 92201-2713	18-hole, 6,727 yards
Indio Municipal Golf Course	Kerry Lee	**760-578-9241** 760-347-9156	83-040 Avenue 42 Indio, CA 92201	18-hole, 3,004 yards
Rancho Casa Blanco Country Club & HOA	Mr. Stone	**760-342-9866** 760-347-1999	84-136 Avenue 144, Indio, CA 92203	18-hole, 1,302 yards
Terra Lago Golf Club	Tom Russell	**760-464-8151**, 760-775-2000	84-000 Landmark Parkway, Indio, CA 92203	36-hole, 14,352 yards
Indian Palms Country Club		**760-342-3432**, 760-775-4448	48-630 Monroe Street, Indio, CA 92201	27-hole, 10,061 yards
Indian Springs Country Club	Alfredo Alcocer	**760-772-4077** 760-200-8988	79-940 Westward Ho Drive, Indio, CA 92201	18-hole, 6,404 yards
Plantation Golf Club	Scott Sandals	**760-342-4363** 760-775-3688	50994 Monroe Street, Indio, CA 92201	18-hole, 7,093 yards
Bermuda Dunes Golf Course and Country Club	Darin Carlyle	760-902-3132	42-360 Adams Street, Bermuda Dunes, CA 92203	27-hole
Eagle Falls Golf Course	Willie Maples, or Sergio	760-423-9107, 760-238-5635	840245 Indio Springs Parkway, Indio, CA 92203	18-hole
Shadow Hills Golf Course (Sun City)		760-200-3375	80-875 Avenue 40, Indio, CA 92203-9439	18-hole
Empire Polo Club	David Nolasco, Robert E. del Mas	760-347-7448	81-800 Avenue 51, Indio, CA 92201	N/A
Eldorado Polo Club	Jan Hart	760-342-2223 x224, 760-702-6911	50950 Madison Street, Indio, CA 92201	N/A
Indio Parks including Posse Park	Paul Stalma	760-391-4140	N/A	N/A
Desert Shores RV Lot Resales HOA		760-775-9808	48170 Hjorth Street Indio, CA 92201	N/A
Outdoor Resort Indio HOA		760-775-7255	80-394 Avenue 48 Indio, CA 92201	18-hole
Unknown HOA				N/A

3.0 WATER DEMANDS FOR POTENTIAL RECYCLED WATER CUSTOMERS

Water supply and irrigation demand information was obtained from interviews and discussions with golf course and other staff where possible. Where water usage information could not be obtained directly, estimates were made based on the water usage of other similar water users.

Table 2 shows the estimated irrigation water demand and peak flow rate for each potential customer. Water sources currently used by these potential customers have been identified where known. Most golf courses have their own well(s) and some use water from the Coachella Canal to supplement well water use. The Coachella Canal is a branch of the All-American Canal conveying Colorado River Water.

Peak flows have been identified where known. Peak flows are important to size pipes and pumping facilities. Where the pumping capacity of the pump stations at the golf courses is known, this pumping capacity is used for the peak flow rate. Where the pumping capacity is not known, the peak flow is estimated by calculating the peak daily irrigation demand and assuming that this volume of water is applied during the 11 hour period per day that golf course irrigation systems typically operate.

Seasonal demand information was obtained for typical water use on golf courses in the arid southwestern United States where overseeding takes place in the fall. Figure 1 shows this estimated seasonal water usage pattern. The average annual water usage is multiplied by the demand factor associated with a particular month to predict the water usage for that month. Figure 1 also shows the normalized VSD recycled water supply for a 12-month period to show that water supply availability does not correspond to water demands. Seasonal aquifer storage would be required to effectively utilize all recycled water for irrigation. Table 3 shows the demand factors used for Figure 1.

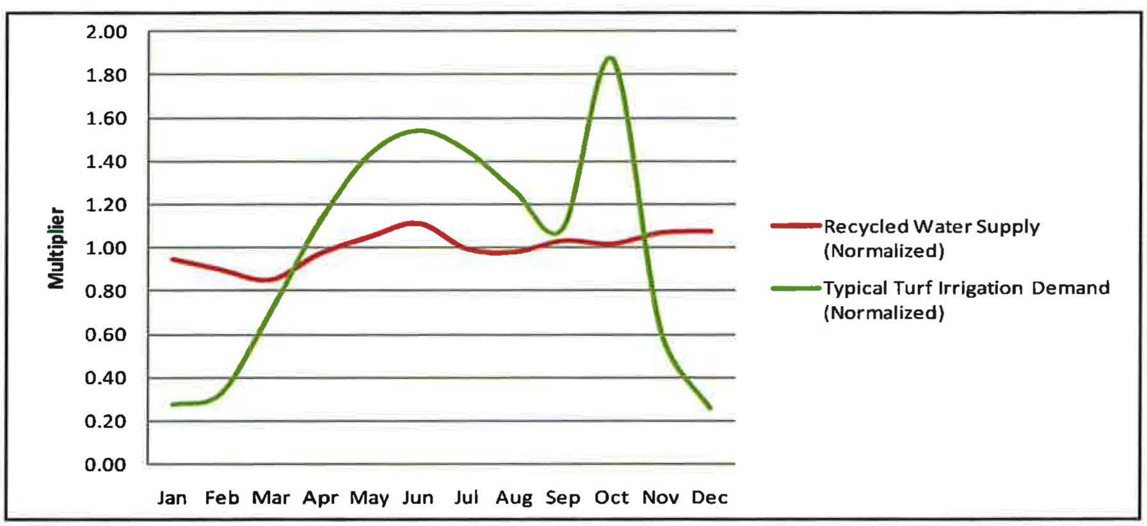


Figure 1 ***Monthly Irrigation Demand Pattern for Turf in the Arid Southwest with Fall Overseeding Compared to Valley Sanitary District Recycled Water Supply***

Table 2 Water Demands and Current Water Sources for Potential Recycled Water Customers

Name	Current Water Source			Area	Estimated Water Consumption			
	City Potable Water	Private Well	Coachella Canal	Acres	Annual Water Use, acre-ft.	Annual Water Demand	Maximum hours/day for Irrigation	Maximum Flow Rate
Heritage Palms Golf Club	minor	October	11 months	175	1,600	9.14 ft.	12	2,700 gpm
Indio Municipal Golf Course	No	Yes	No	38	358	11.20 ft.	8	700 gpm
Rancho Casa Blanco Country Club & HOA	No	Yes	No	13	117	9.00 ft.	8	200 gpm
Terra Lago Golf Club	No	No	Yes	192	1,728	9.00 ft.	12	2,700 gpm
Indian Palms Country Club	No	2 private wells	None	210	1,865	8.90 ft.	10	3,200 gpm
Indian Springs Country Club	No	Yes	Not Now, Yes in future	125	750	6.00 ft.	5	1,500 gpm
Plantation Golf Club	No	Yes	Yes, 90%	180	972	5.4 ft. from canal, 9.0 ft. total (approx.)	7	3,600 gpm
Bermuda Dunes Golf Course and Country Club	No	Yes	No	180	1,260	7 ft.	10	3,500 gpm
Eagle Falls Golf Course	No	Yes	Unknown	123	1,107	9 ft.	10	3,000 gpm
Shadow Hills Golf Course (Sun City)	No	Unknown	Yes	220	1,760	8.00 ft.	10	2,700 gpm
Empire Polo Club	No	Yes	Yes	421	2,950	7 ft.	10	4,200 gpm
Eldorado Polo Club	No	Yes	Yes			7 ft.	10	4,200 gpm
Indio Parks including Posse Park	Yes	No	No	83	500	6 ft.	10	1,000 gpm
Desert Shores Resales HOA	Unknown	Unknown	No	20	140	7 ft.	10	400 gpm
Outdoor Resort Indio HOA	Unknown	Unknown	No	24	168	7 ft.	10	475 gpm
Unknown HOA	Unknown	Unknown	No	16	112	7 ft.	10	320 gpm
Total					**15,387**			

Table 3 Monthly Water Supply and Irrigation Demand Peaking Factors used on Figure 1		
Month	**Monthly Recycled Water Supply Peaking Factor**	**Irrigation Demand Seasonal Peaking Factor**
Jan	0.95	0.28
Feb	0.90	0.33
Mar	0.85	0.71
Apr	0.97	1.13
May	1.05	1.43
Jun	1.11	1.54
Jul	0.99	1.45
Aug	0.98	1.26
Sep	1.03	1.09
Oct	1.02	1.87
Nov	1.07	0.61
Dec	1.08	0.26

Table 4 shows a comparison of the volume of recycled water that is available currently, and anticipated at buildout. VSD delivers 1 mgd to the wetlands treatment system located at the plant site. Required minimum discharge flows to the drainage channel have not been established, but are currently estimated to be 2 mgd. Therefore, the current average flow rate that may be available for irrigation is 3.3 mgd. Peak flow rates are expected to be as high as 4 mgd.

Table 4 Recycled Water Supply Compared with Potential Irrigation Demand				
Flow Condition	**Current, mgd**	**Current, acre-ft/yr**	**Ultimate, mgd**	**Ultimate, acre-ft/yr**
Average Annual Flow Rate from the VSD WWTP	6.3	6,984	16	17,924
Wetlands Treatment Project	1	---	1	---
Assumed Minimum VSD WWTP Discharge to the Channel	2	---	2	---
Available Average Recycled Water Irrigation Flow Rate	3.3	3,697	13	14,563
Estimated Peak Daily Recycled Water Irrigation Flow Rate (Average * 1.2)	4.0	---	15.6	---
Potential Average Annual Irrigation Water Demand	---	15,387	---	15,387

Note:
Peak irrigation flow rates are a function of the specific customers that are scheduled to use water at any given time, and would need to be managed within the limits of both water supply and water delivery infrastructure.

discharged to the channel. Therefore, the Coachella Canal and groundwater will still provide irrigation supply even when recycled water is available.

4.0 FIELD RECONNAISSANCE

4.1 Interview Notes

The following is a summary of the discussions with potential recycled water customers that responded to requests for information.

1. **Heritage Palms Golf Club** – This golf club is interested in using recycled water. The golf course has ponds that can be filled from a well or from the Coachella Canal. The ponds are designed such that most of the canal sediment is removed in a small pond before the water moves to a large storage pond adjacent to the golf course fairways. A water level monitoring system automatically controls the amount of canal water that enters the pond. Although these ponds can be used to store recycled water for irrigation, a preferred method of delivery would be to provide recycled water that is pressurized to approximately 95 psi so that re-pumping would not be necessary. The preferred location for a connection to the irrigation system would be where the sediment pond and pump station are co-located. Recycled water contains nitrogen and phosphorous that improves turf growth, but may create undesirable algae growth in storage ponds. Well water is used primarily for overseeding because the well water has lower salt levels so the new grass grows more readily. Although good turf can be grown in this area by applying 7 acre-ft/acre/year of water, 9 acre-ft/acre/year is applied at this golf course for salt leaching.
2. **Indio Municipal Golf Course (i.e., Posse Park located adjacent to the east of golf course)** – The irrigation system in this golf course is old, and the City plans to upgrade the irrigation system in 2010 (Note: this has not happened as of December 2011), so the City could install a purple pipe system for recycled water at that time. The current pumping rate of the existing pump station is less than desired, so a larger pump station would be preferred. In addition to the 32 irrigated acres, the city has approximately 10 acres of un-developed land around the golf course that could be used to place ASR (aquifer storage and recovery) wells. Chlorine levels in the recycled water are a concern, particularly if superchlorination is a possibility, because the chlorine will kill or damage some plant life. Although recycled water could be introduced into the pond on this golf course, the pond already has problems with algae blooms and other undesirable plant growth and recycled water would exacerbate the problem. A pressurized system is preferred to eliminate re-pumping. The preferred location for recycled water to be delivered would be at the pond.
3. **Rancho Casa Blanca Country Club and HOA** – Phone calls were not returned, and staff were not available at the time of the visits.

4. **Terra Logo Golf Club** This golf course is not interested in using recycled water because of the cost of this water and because nitrate levels would cause algae blooms in ponds and lakes. Due to a lack of interest, golf course staff did not meet with our team.
5. **Indian Palms Country Club** – A site visit was made, but staff could not be reached at that time. A subsequent brief telephone conversation with the golf course superintendent revealed that the preferred method of delivery to the golf course would be into the two lakes on the golf course.
6. **Indian Springs Country Club** – This golf course currently uses well water exclusively. However, an agreement with the CVWD has been made that when the CVWD adds a pipeline to service a nearby school, the golf course would begin taking canal water. The water usage for this golf course is lower than for other golf courses because of careful monitoring and tight management, and because exclusive use of well water eliminates the need for leaching to reduce salinity levels. Although most of the golf course is inside the City of Indio boundaries, a portion of the golf course is outside the City. The preferred connection location would be into the two golf course lakes.
7. **Plantation Golf Club** – In 2009, this golf course plans to use 90 percent canal water, and in recent years the percentage of canal water usage has varied between 35 and 40 percent. Canal water deliveries are reported to be difficult to manage because the water ordered does not correspond well to the water delivered. There is no automatic monitoring system to deliver water like the Heritage Palms golf course. Canal water deliveries are based on a "take or pay" agreement, which sometimes leads to inefficiencies in golf course irrigation practices. Well water is used when canal water deliveries are not adequate, and for overseeding. Recycled water delivery to the golf course ponds is preferred. This golf course expects recycled water usage to be mandated in the future.
8. **Shadow Hills Golf Course (Sun City)** – This golf course already uses recycled water from the CVWD water reclamation plant located north of the golf course, so a visit was not made to this potential customer since calls were not returned.
9. **Bermuda Dunes Golf Course** – This golf course is not in Indio, but is located near two other Indio golf courses. The golf course has interest in discussions to investigate using recycled water. There are no ponds that could be used to store recycled water deliveries. Currently the golf course uses well water only.
10. **Eagle Falls Golf Course** – This golf course is owned and run by an Indian community. Calls for information were not returned, and staff were not available at the time of the visit.
11. **City of Indio Parks** – Information on water use at the parks was not available. Estimates have been made for the water use. Some of the parks are small, so recycled water irrigation may only be feasible at the larger parks located near the recycled water transmission system.

12. **Empire and El Dorado Polo Clubs** – Staff were not available at the time of a site visit, and phone calls have not been returned. At the time of the visit, one large field was being irrigated with several very large sprinklers. Another field was set up to be irrigated using solid set sprinkler pipes. The polo clubs would need a large flow for these sprinklers, and irrigation also appears to take place during the day, which is different from the golf course nighttime irrigation schedules.
13. **HOA Sites** – Several HOA sites appear to have significant irrigated areas, but these sites were not visited.

4.2 Items to Consider in a Recycled Water Program, Based on Customer Interviews

The following is a list of items that were discussed in the interviews with golf course superintendants. These items are issues that will probably need to be considered and addressed in some way or another when implementing the recycled water program.

1. The City of Indio golf course may be a viable first candidate for recycled water use. If injection wells are selected to be a part of the recycled water program, then the wells would be constructed just east of the golf course in Posse Park.
2. The City may choose to establish a policy of recycled water usage in portions of the City where the infrastructure that delivers the recycled water could be constructed at a lower cost. Recycled water supplies may not be adequate to serve all potential customers.
3. Some golf course customers would be satisfied with a low pressure system that delivers water to ponds or lakes, while other customers would prefer water delivered at 90 – 95 psi to avoid re-pumping. The City would need to decide which approach to use.
4. The recycled water delivery system could potentially be divided into two different zones to deliver water at different hydraulic gradelines. The line going north under Interstate 10 could operate at a different gradeline than a line going south and west to serve other customers at a lower elevation.
5. If recycled water needs to be delivered in purple pipes to satisfy legal requirements that recycled water systems be distinguished from potable systems, then the City may need to adopt a policy regarding distinguishing the use of recycled water in sprinkler systems in golf courses and parks that are already constructed (i.e., signage, etc.).
6. Golf courses typically irrigate between the hours of 7:00 pm and 6:00 am, so storage needs to be provided to balance the difference between recycled water availability and irrigation demands or supplement with other water.
7. Seasonal variations in demand and recycled water delivery would require some form of aquifer storage and recovery to maximize recycled water use.
8. Interest was expressed in receiving recycled water mixed with canal water, using the same conduits that canal water is currently received.
9. The City would need to establish and implement a set of irrigation times throughout a week for each customer.

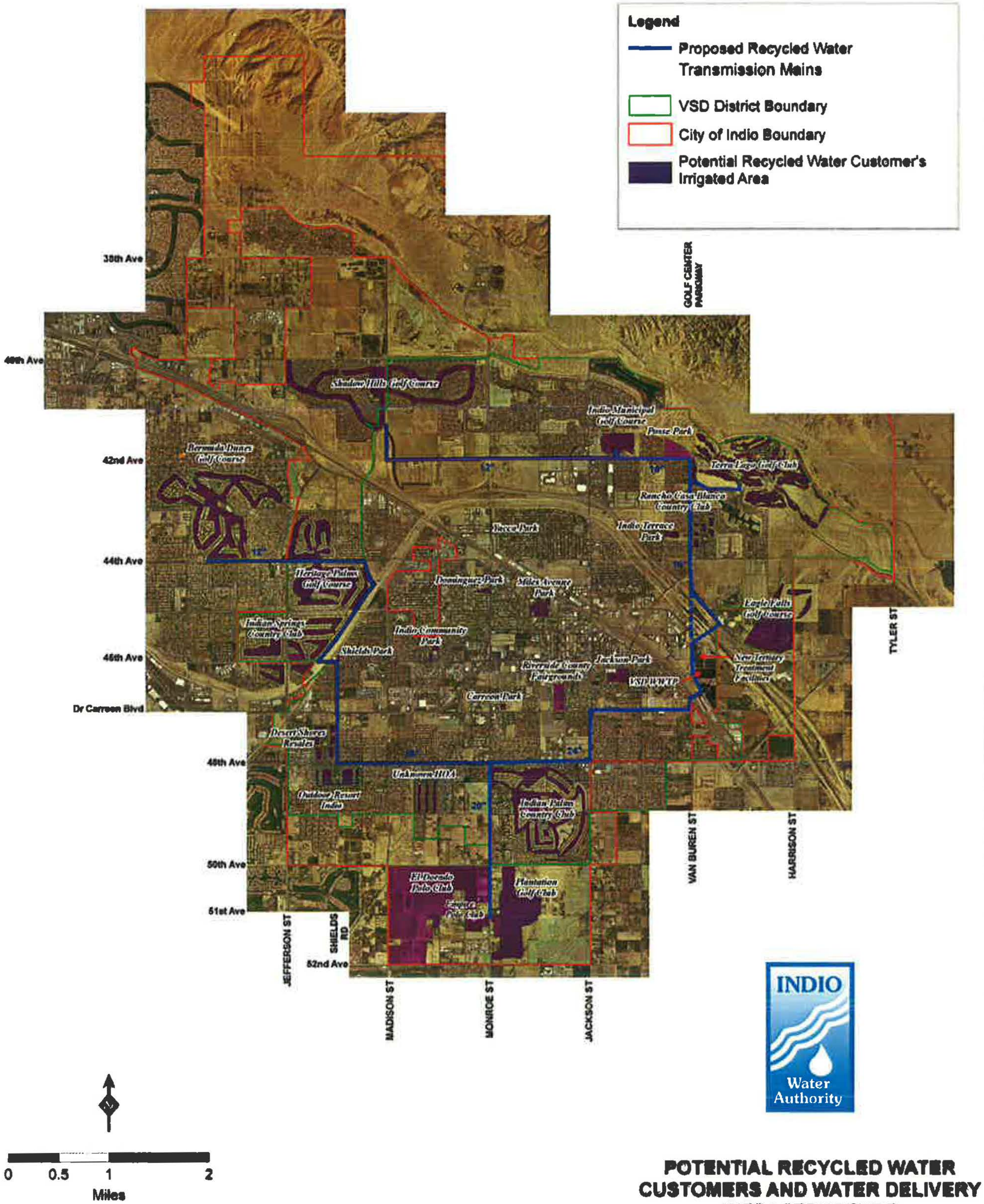
10. Recycled water nitrate and phosphorous levels can cause undesirable algae blooms in golf course ponds and lakes using current treatment at VSD. The City will probably need to address this issue to make recycled water more appealing to golf course owners.
11. Golf courses can obtain well water for a cost of $17 per acre-ft (Note: $31/af in 2011). plus the cost of pumping, and canal water can be obtained for a price of $30 per acre-ft. plus pumping costs. Golf courses are not likely to use recycled water exclusively. They will instead add recycled water to the mix of well and canal water that is already being used. The City will need to establish policies and strategies that encourage the desired amount of recycled water use, at an appropriate cost. If the primary objective of the recycled water system is to reduce groundwater pumping, then this objective is not achieved merely by replacing surface water with recycled water.
12. If the legal framework was in place to recharge recycled water then pump an equivalent amount of water from the golf course wells, then the infrastructure and management costs of the recycled water system would be significantly reduced.

5.0 CONCEPTUAL RECYCLED WATER DELIVERY SYSTEM

Figure 1 shows a map of the VSD and IWA boundaries, potential recycled water customer locations, and a conceptual pipeline route. To minimize infrastructure and pumping costs, the IWA may choose to deliver water at a pressure that is sufficient only to supply golf course ponds. The golf courses would then pump from the ponds to pressurize their irrigation systems. Recycled water pipelines would then be sized to deliver up to the maximum daily flow rate and not the peak flow rate from the irrigation pumps. Smaller recycled water users such as HOAs and City parks may need to provide booster pumping facilities to pressurize their irrigation systems to use recycled water. A phased program would add these smaller users as the recycled water transmission mains are extended to larger users.

The first portion of the recycled water delivery system would be to construct a pipeline from the VSD WWTP north across Interstate 10 to the Posse Park and Indio Municipal Golf Course. It may be easier to establish service to the City golf course and establish policies first based on experience with this customer. If the IWA chose to construct injection wells in Posse Park, then the pipeline infrastructure would be in place for these wells. Other customers that would utilize this pipeline could then be persuaded to connect to the recycled water system. A 16-inch line would provide up to 4.9 mgd and would be sufficient to supply all of the prospective customers north and east of Interstate 10. It is assumed that well injection in low irrigation demand periods.

The second portion of the water delivery system would be to run a line south and west of the VSD WWTP to serve the Indian Palms Country Club, Plantation Golf Club, and the Polo Clubs. This line may also be used to serve several of the City's parks. If the maximum daily flow rate will actually occur based on projected flows, then this pipe segment should be 24-inches in diameter. The polo clubs will require a higher flow rate than any of the golf courses, so a decision about requiring these clubs to use recycled water should be made before this pipeline is sized.



December 2009

carollo

POTENTIAL RECYCLED WATER CUSTOMERS AND WATER DELIVERY INFRASTRUCTURE

Figure 2

The third portion of the water delivery system would be a line from the intersection of Monroe Street and 48th Avenue to the Heritage Palms Golf Course and Indian Springs Country Club. This line could also serve HOAs and parks in the area. This pipeline would be 16-inches in diameter. If the Bermuda Dunes Golf Course (located outside the City limits) is served, then the pipeline would be 20-inches in diameter.

The Shadow Hills and Bermuda Dunes Golf Courses would be a lower priority for recycled water service. The Shadow Hills Golf Course is already using recycled water, and the Bermuda Dunes Golf Course is outside of the City boundaries. However, if the IWA had sufficient recycled water available that could not be used by other potential customers, then 12-inch pipelines could be constructed to deliver water to these customers as shown on Figure 2.

6.0 REFERENCES

Black & Veatch, 2008, *IWA Water Resources Development Plan Phase 2 Final Report*. Prepared for Indio Water Authority. August 2008.

Lee & Ro, Inc., 2006, *Valley Sanitary District Wastewater Treatment Plant Master Plan*. Prepared for Valley Sanitary District. October 2006.

APPENDIX B

APPENDIX B

TECHNICAL MEMORANDUM NUMBER 4

CITY OF INDIO
INDIO WATER AUTHORITY

WATER RECLAMATION FACILITIES FOR REUSE AND GROUNDWATER RECHARGE – PHASE 1 ENVIRONMENTAL PROGRAM

TECHNICAL MEMORANDUM NO. 4
RECYCLED WATER TREATMENT ALTERNATIVES AND DELIVERY CORRIDOR OPTIONS

January 2010

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CITY OF INDIO / INDIO WATER AUTHORITY
WATER RECLAMATION FACILITIES FOR
REUSE AND GROUNDWATER RECHARGE – PHASE 1 ENVIRONMENTAL PROGRAM

RECYCLED WATER TREATMENT ALTERNATIVES AND
DELIVERY CORRIDOR OPTIONS

TECHNICAL MEMORANDUM
NO. 4

TABLE OF CONTENTS

Page No.

LIST OF FIGURES

RECYCLED WATER TREATMENT ALTERNATIVES

1.0 INTRODUCTION

This technical memorandum (TM) is prepared for the Indio Water Authority (IWA) in partial fulfillment of the agreement between the IWA and Carollo Engineers; P.C. (Carollo) entitled "Water Reclamation Facilities for Reuse and Groundwater Recharge – Phase I Environmental Program." This TM describes the different treatment alternatives to produce recycled water, candidates for using recycled water, and potential corridors for delivering recycled water. This TM is intended to provide the essential information to compile the project description for a program environmental document that will be prepared and processed by the IWA for compliance with the California Environmental Quality Act (CEQA), and National Environmental Policy Act (NEPA).

2.0 TREATMENT ALTERNATIVES

Several treatment alternatives have been identified for the production of recycled water that meets California Title 22 requirements. Specifically, treatment alternatives to produce recycled water for irrigation and groundwater recharge were identified. For a detailed summary of California Title 22 requirements for irrigation and groundwater recharge, see Appendix A. The Title 22 treatment alternatives for irrigation include tertiary filtration (DynaSand®, Cloth Disk) and membrane bioreactors (MBR), while the groundwater recharge alternative will investigate microfiltration/reverse osmosis (MF/RO) combination. All alternatives will require disinfection as the final treatment step. The alternatives were developed based on conventional Title 22 treatment requirements and potential future treatment plant effluent requirements. The proposed alternatives are described in the following sections.

2.1 Tertiary Filtration

Tertiary filters are designed to remove total suspended solids (TSS) from secondary effluent by passing it through a filter media. There are several filter media options available including fine sand, dual media (anthracite/sand), and cloth. The filter options that will be evaluated for this project are continuous backwash, upflow, sand filters (DynaSand®) and cloth disk filters. Both of these filter technologies are approved for Title 22 treatment and are installed at numerous facilities producing Title 22 water.

Tertiary filtration is a proven lower cost option for the production of Title 22 irrigation water. If this option is selected, tertiary filters will be installed at the Valley Sanitary District (VSD) treatment plant. The facility could include a secondary effluent pump station, flocculation, tertiary filters, disinfection, irrigation water storage, and an irrigation water pump station. A process flow diagram (PFD) of the treatment train is shown on Figure 1. Because the tertiary filter only remove suspended solids, any requirement for nutrient removal need to be accomplished in the secondary treatment process.

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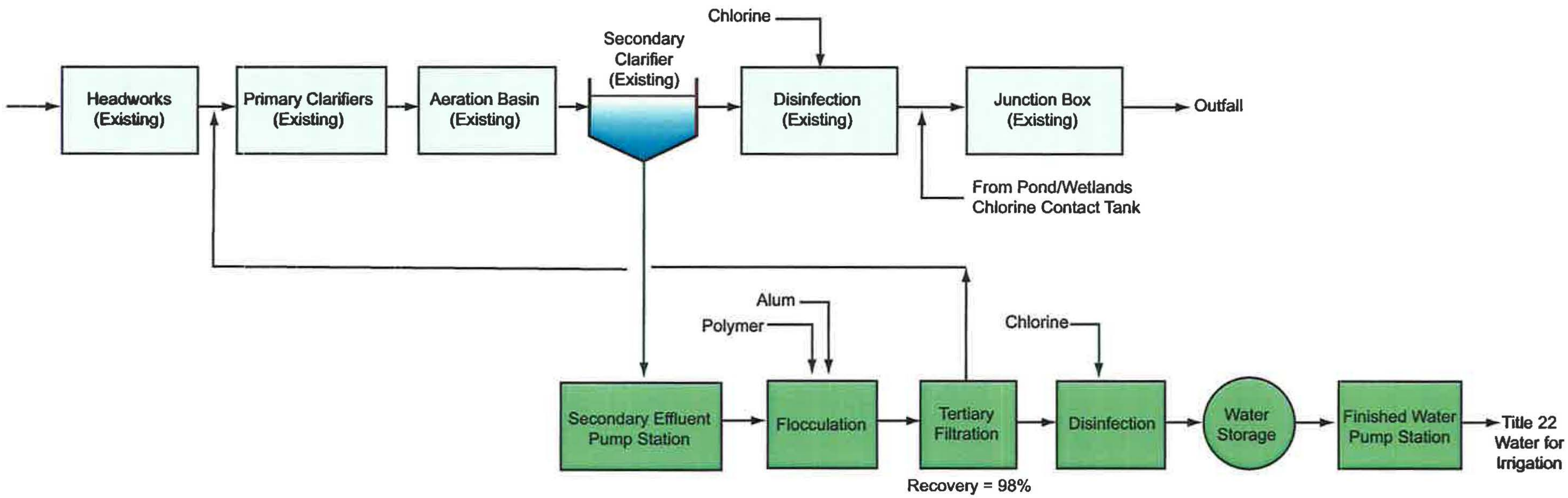

TERTIARY FILTRATION PFD

FIGURE 1

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2.1.1 DynaSand® Filters

The DynaSand® filter is available either as standalone package units or in a modular concrete design. The continuous backwash filter operates with an upflow, counter-current flow pattern and provides initial contact of unfiltered water with the dirtiest sand in the filter. The dirty sand moves downward away from the water's flow path to the air scour tube. The water's upward flow path passes through progressively cleaner filter media until it exits from the surface of the cleanest media. A typical filter cell includes the components of four filter modules within a reinforced concrete filter chamber. The filter's deep media bed allows it to handle high levels of suspended solids.

2.1.2 Cloth Filters

Cloth media filters are also available as standalone package units or in a modular concrete design. They are low-head systems and are designed to backwash automatically based upon water differential while maintaining continuous filtration during backwash. The typical backwash volume represents approximately 2 to 3 percent of the feed flow with a recovery time of less than 3 minutes, compared to other typical filters, which can take up to 20 minutes. The disks can be provided in tanks with various numbers of disks depending on the design flow.

2.1.3 Tertiary Filtration Title 22 Effluent Requirements

The Title 22 effluent requirements are similar for both filter technologies. In accordance with Title 22, the filter effluent turbidity must average less than or equal to 2 NTU for any 24-hour period, must not exceed 5 NTU longer than 15 minutes, and must never exceed 10 NTU. In the event the effluent turbidity exceeds 5 NTU for more than 15 minutes, automatic chemical addition must be implemented, or else the filter feed pumps must be shut down. Alum and polymer can be added to the filter influent and mixed using inline mixing or flocculation basins.

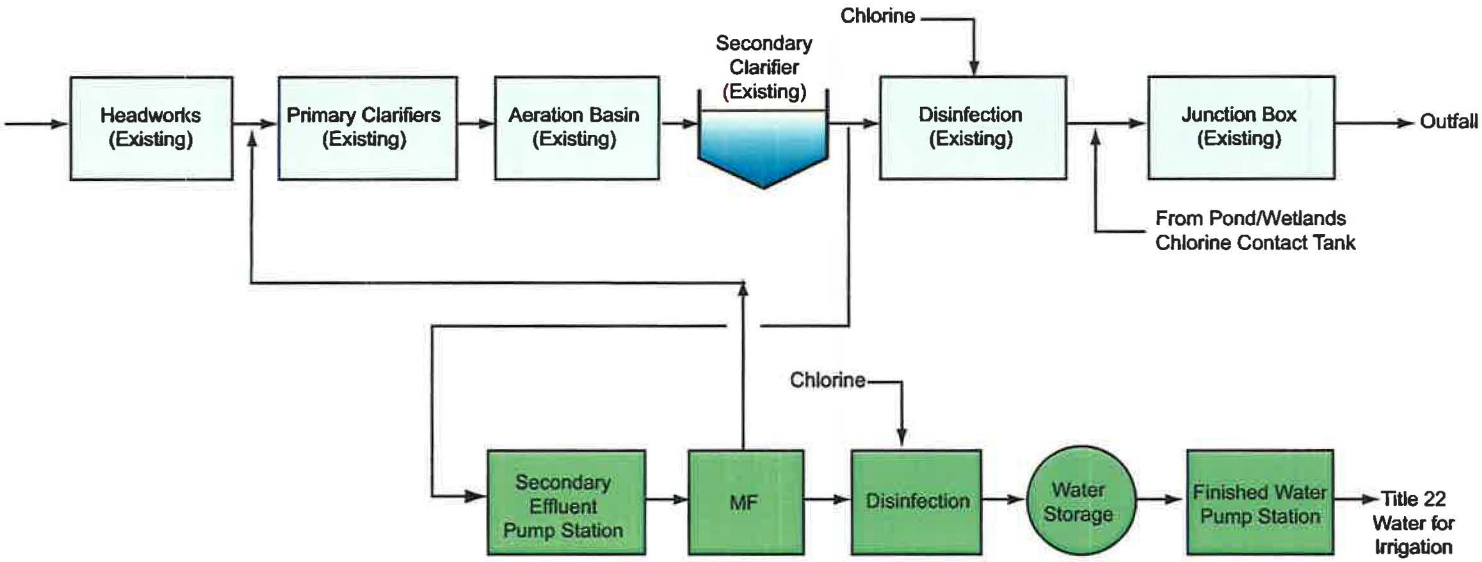
2.1.4 Tertiary Microfiltration

MF membranes are an efficient technology for particle removal and pathogen control. These technologies yield finished water turbidities consistently below 0.1 NTU, independent of feed water quality. Membrane filtration is a pressure-driven process that provides a near absolute barrier to suspended solids and microorganisms. MF membranes have a pore size ranging from 0.1 to 0.5 microns.

The MF process would provide greater flexibility for future groundwater recharge. If this option is selected, existing Chlorine Contact Tank No. 1 (abandoned) could be converted into a membrane tank. The Title 22 facility would include MF, disinfection, water storage, and an effluent water pump station. A PFD of the treatment train is shown on Figure 2.

2.1.5 Tertiary Microfiltration Title 22 Effluent Requirements

Title 22 requirements state that membrane treated effluent must have a turbidity that does not exceed 0.2 NTU more than 5 percent of the time in a given 24-hour period, and cannot exceed 0.5 NTU at any time.



TERTIARY MICROFILTRATION PFD

FIGURE 2

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2.2 Membrane Bioreactor

The MBR process is a biological process that uses MF or ultrafiltration (UF) membranes installed in membrane tanks to separate solids and produce a high-quality effluent. The MBR process is capable of achieving the nutrient removal requirements for effluent ammonia and nitrate to be compatible with future treatment requirements for groundwater recharge. Membranes used in MBR applications are typically polymeric (but may be ceramic) media with pore sizes in the range of 0.04 microns to 0.4 microns. The physical separation barrier provided by the membranes is the most effective and reliable treatment mechanism to meet recycled water requirements, and is less susceptible to process upsets. The MBR process is required by Title 22 to produce effluent with turbidity that does not exceed 0.2 NTU more than 5 percent of the time and not more than 0.5 NTU at any time.

The MBR process is a higher cost alternative, but has advantages over tertiary filtration. The MBR process will provide more flexibility for future groundwater recharge and increase plant capacity. If this option is selected, the existing Chlorine Contact Tank No. 1 (abandoned) could be converted into a membrane tank and fine screens could be installed upstream of the aeration basins. The Title 22 facility would include fine screens, MBR, disinfection, water storage, and an effluent water pump station. A PFD of the treatment train is shown on Figure 3.

2.2.1 MBR Title 22 Effluent Requirements

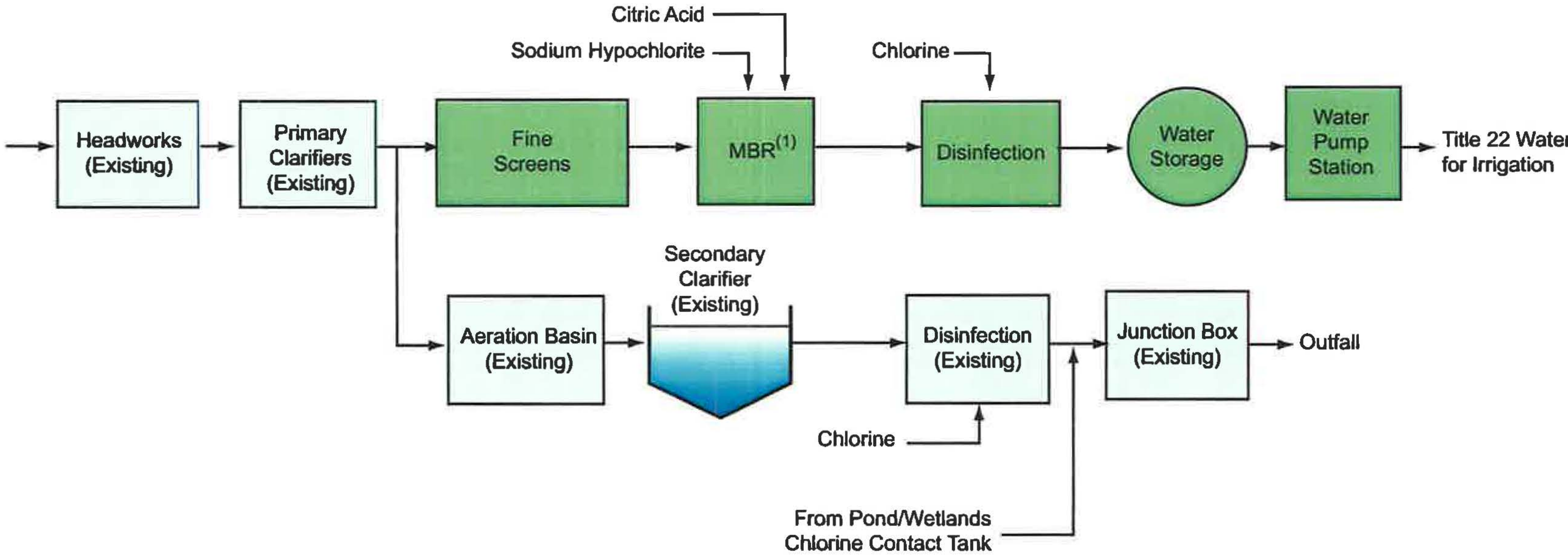
As previously mentioned, Title 22 requirements stipulate that membrane treated effluent must have a turbidity that does not exceed 0.2 NTU for more than 5 percent of the time in a given 24-hour period, and cannot exceed 0.5 NTU at any time.

2.3 Advanced Treatment for Ground Water Recharge

This section discusses the MF/RO membrane treatment process to provide demineralization for the production of recycled water for groundwater recharge. The MF process (this process could also be UF, MF has been used here for simplicity) is required as pretreatment for the RO, and the RO is responsible for demineralization and removal of dissolved organic compounds in the recycled water. The groundwater recharge treatment facility would also include an ultraviolet (UV) advanced oxidation process (AOP) using hydrogen peroxide to provide disinfection and oxidation of microconstituents. This process would be followed by a stabilization step to protect the distribution pipeline, finished water storage, and a finished water pump station. A PFD of this treatment train is shown on Figure 4.

2.3.1 Microfiltration

The MF process for advanced treatment would be similar to the tertiary MF previously described in this TM. As shown on Figure 2, the MF process requires a backwash that flows back to the headworks. As the satellite advanced treatment facility, this backwash flow would be discharged to the sewer to flow back to the treatment plant. MF can provide consistent pretreatment for RO systems and would be included in the design of a groundwater recharge treatment system if tertiary filters are chosen for Title 22 treatment.

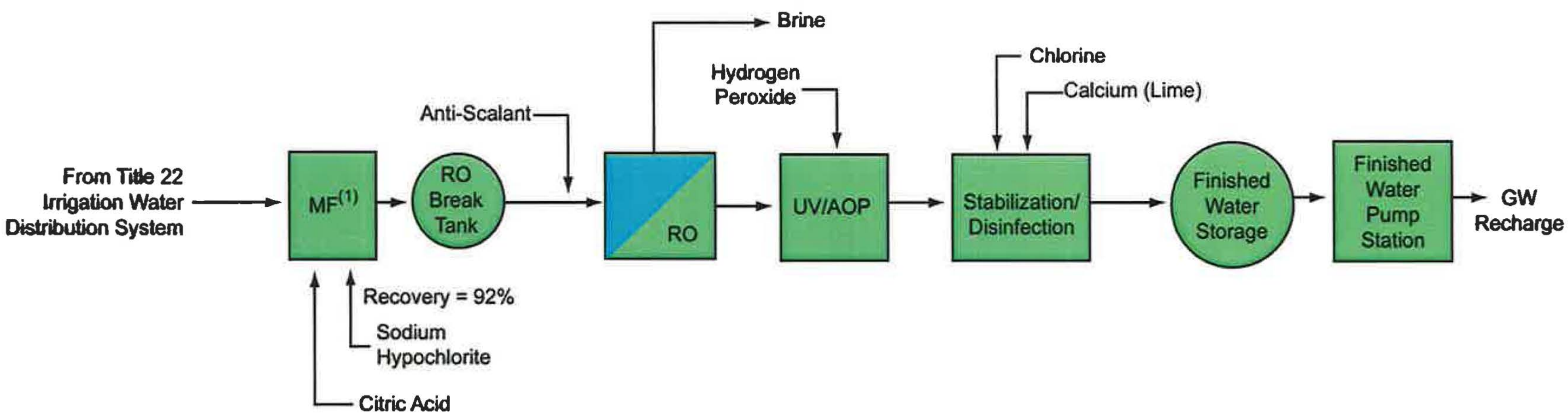


Notes:

(1) Modify existing aeration basins and retrofit abandoned chlorine contact tank 1.

MBR PFD

FIGURE 3



Notes:
(1) MF system is required if tertiary filtration is used for title 22 irrigation water.
(2) MF/RO system would be built near point of injection.

ADVANCED TREATMENT SYSTEM PFD[2]

FIGURE 4

2.3.2 Reverse Osmosis

High-pressure membrane processes such as RO are typically used for the removal of dissolved constituents including both inorganic and organic compounds. RO is a process in which the mass-transfer of ions through membranes is diffusion controlled. The feed water is pressurized, forcing water through the membranes concentrating the dissolved solids that cannot travel through the membrane. Consequently, these processes can remove salts, hardness, synthetic organic compounds, disinfection-by-product precursors, etc. However, dissolved gases such as H_2S and carbon dioxide, and some pesticides pass through RO membranes.

RO is considered a "high-pressure" process because it operates from 75 to 1,200 psig, depending upon the total dissolved solids (TDS) concentration of the feed water. Typical recoveries for RO plants operating on domestic wastewater are around 85 percent depending on the type and concentrations of sparingly soluble salts (calcium sulfate, calcium carbonate, silica, etc.) in the feed water.

One of the issues with the RO process is the discharge of the concentrated brine stream. For this site there are a few options: The brine from the RO unit could be sent to a large system of evaporation ponds, the brine could be further treated to increase finished water production and decrease brine volume reducing the size of the evaporation ponds, or there may be potential for a regional brine management plan consisting of large evaporation ponds. (Note: As of 2011, a regional brine line seems to be the preferred option).

2.3.3 Ultraviolet Advanced Oxidation Process

UV disinfection is a physical process that uses no toxic chemicals and produces no known toxic residuals or byproducts. The disinfection mechanism of UV light involves damage or destruction of an organism's genetic material due to the transference of electromagnetic energy (i.e., wavelength of 254 nanometers, or 254-nm) from a UV lamp to the genetic material. The lethal effects of this energy result primarily from the organism's inability to replicate. When coupling this system with a small dose of hydrogen peroxide, an advanced oxidation system results, in which hydroxyl radicals are produced which can attack and destroy many microconstituents.

3.0 SITE LAYOUT

Conceptual site layouts have been developed for the three Title 22 irrigation water treatment facilities and the groundwater recharge treatment facility. The site layouts are preliminary and show the general footprints of each unit operation on the project site. The footprints were developed for each unit operation based on an assumed ultimate system capacity of 12 mgd. The three alternatives for Title 22 irrigation water treatment are shown on the VSD treatment facility and the groundwater recharge facility is shown near the potential injection points at Posse Park. An aerial photograph of the existing site and facilities is presented on Figure 5.

EXISTING FACILITY SITE LAYOUT

FIGURE 5

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3.1 Tertiary Filtration

The tertiary filtration system would require the construction of several unit operations as described above. A Secondary Effluent pump station would be constructed near the existing Chlorine Contact Tank No. 3 and would pump secondary effluent to the tertiary filtration system located in the northwest corner of the treatment facility. A conceptual site layout of the tertiary filtration system is presented on Figure 6.

Figure 6 shows that the tertiary filtration system will be easily accommodated in the northwest corner of the site. This area was chosen because it does not interfere with the facility's master plan expansion of the secondary facilities and is in close proximity to a 14-inch line which crosses the channel and highway.

3.2 Tertiary Microfiltration

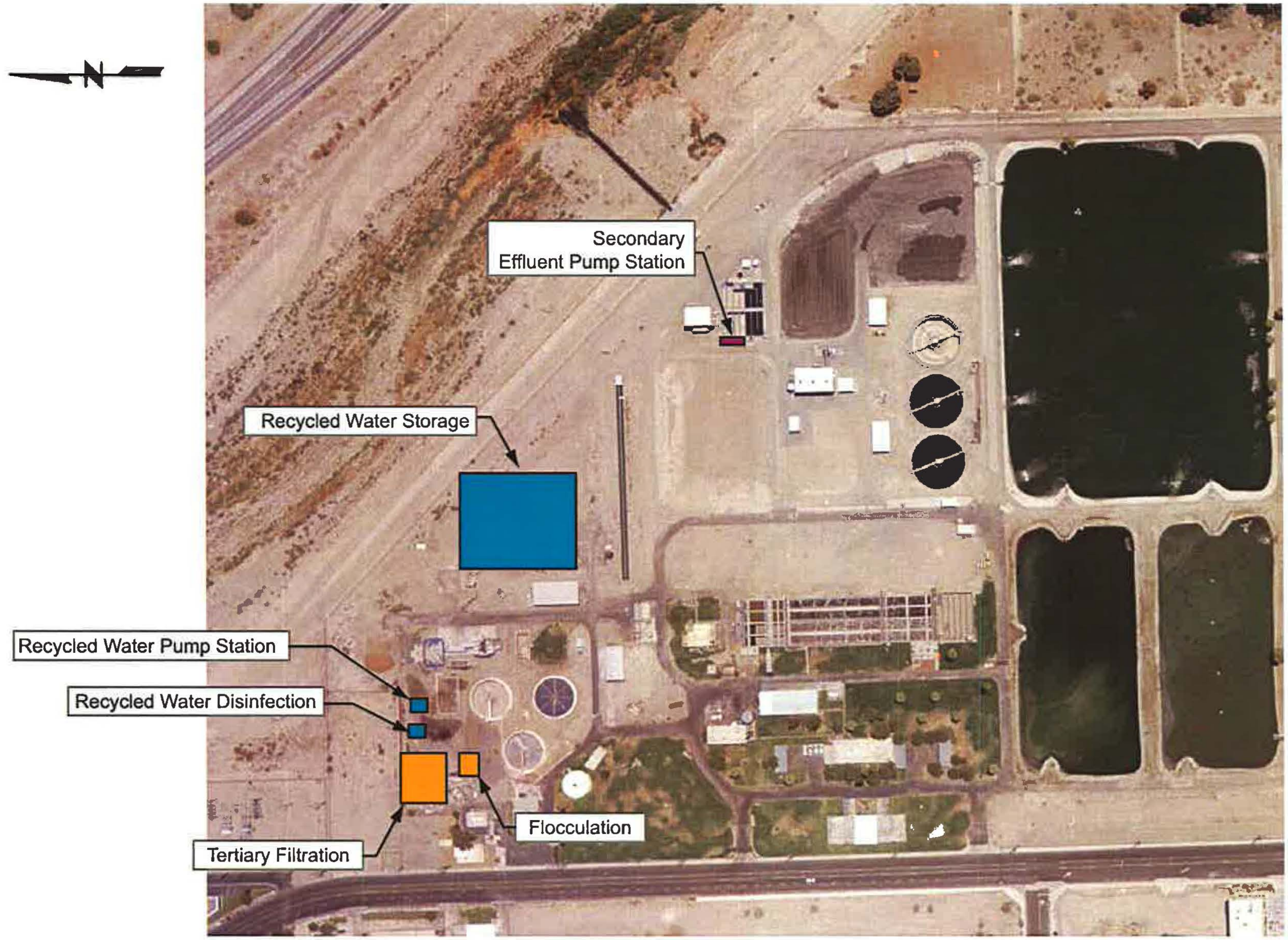
The tertiary MF system would require less of a footprint than the tertiary filtration option. The required unit operations are described above. The existing (abandoned) Chlorine Contact Tank No. 1 structure could be modified to function as a membrane tank. The membrane permeate would be pumped from the membrane tank to the disinfection system and Effluent Pump Station located on the north side of the facility near the channel and highway crossing. A preliminary conceptual site layout of the tertiary MF system is shown on Figure 7.

3.3 Membrane Bioreactor

The MBR system would require less of a footprint than the tertiary filtration option. The required unit operations are described above. The existing aeration basin could be converted to an MBR by modifying the existing (abandoned) Chlorine Contact Tank No. 1 structure to function as a membrane tank. The membrane permeate would be pumped from the membrane tank to the disinfection system and Effluent Pump Station located on the north side of the facility near the channel and highway crossing. A conceptual site layout of the MBR system is shown on Figure 8.

3.4 Advanced Treatment System (Posse Park)

The MF/RO and UV/AOP advanced treatment system would be designed to treat water for groundwater recharge and would not be located at the VSD treatment facility, but could be located near the potential recharge location at Posse Park. The system would take water from the Title 22 irrigation water distribution system for further treatment and recharge. This would allow the City to produce two qualities of recycled water. One for general irrigation use, and the second, a much higher water quality, for ground water injection. Such an approach would be less costly than producing a single high quality that could be used for either irrigation or injection. The Advanced Treatment System would consist of the unit operations described earlier. The influent would first be treated using MF if the tertiary process installed at the VSD plant does not include a membrane treatment step. If an MBR options or a tertiary MF/UF alternative is used then MF would not be required. A break tank would be provided before the RO unit to ensure a stable influent flow. After RO treatment, the RO permeate would be pumped to the UV/AOP and stabilization processes. Then, the



PRELIMINARY TERTIARY FILTRATION SITE LAYOUT

FIGURE 6

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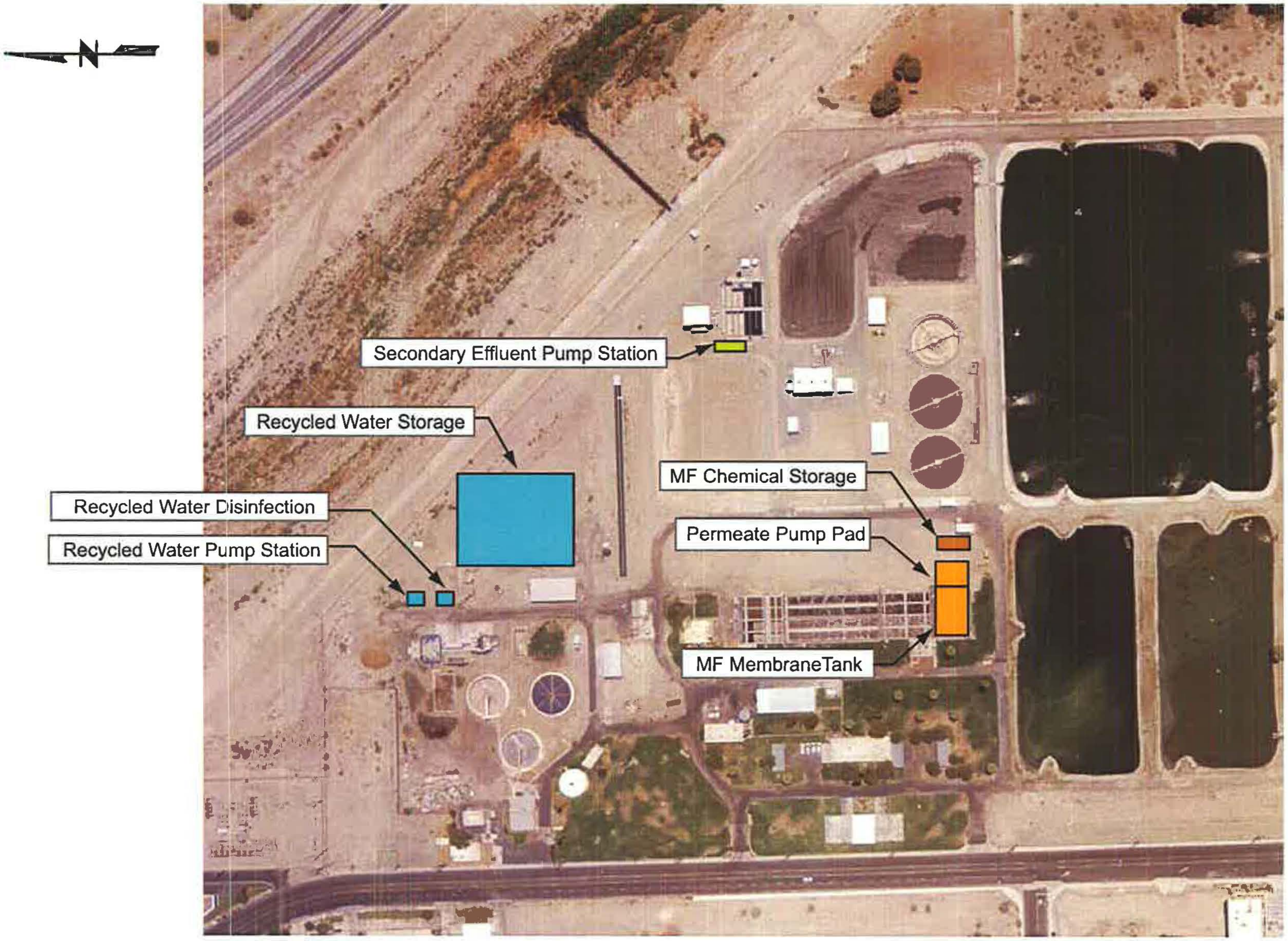

PRELIMINARY TERTIARY MF SITE LAYOUT

FIGURE 7

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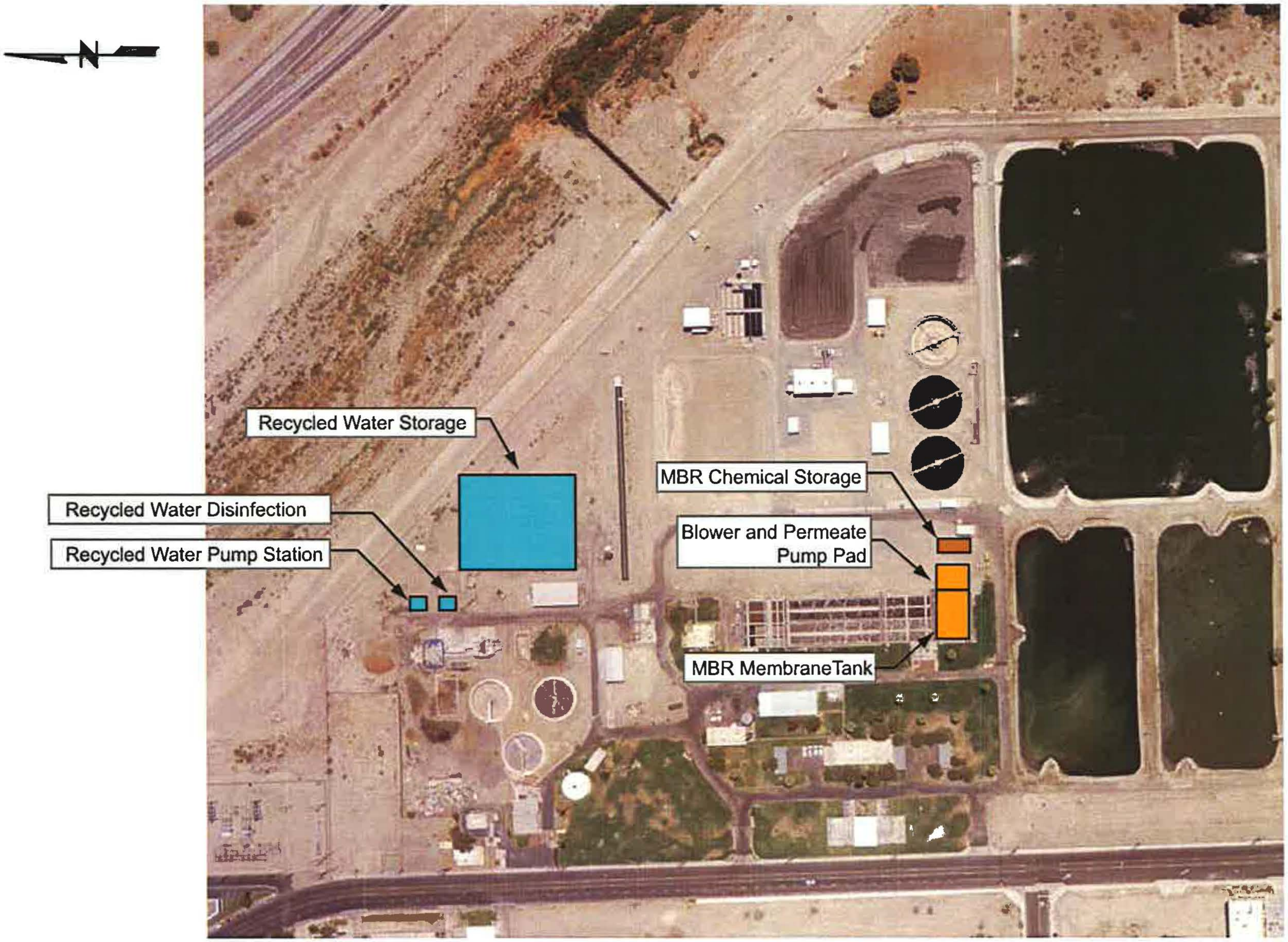

PRELIMINARY MBR SITE LAYOUT

FIGURE 8

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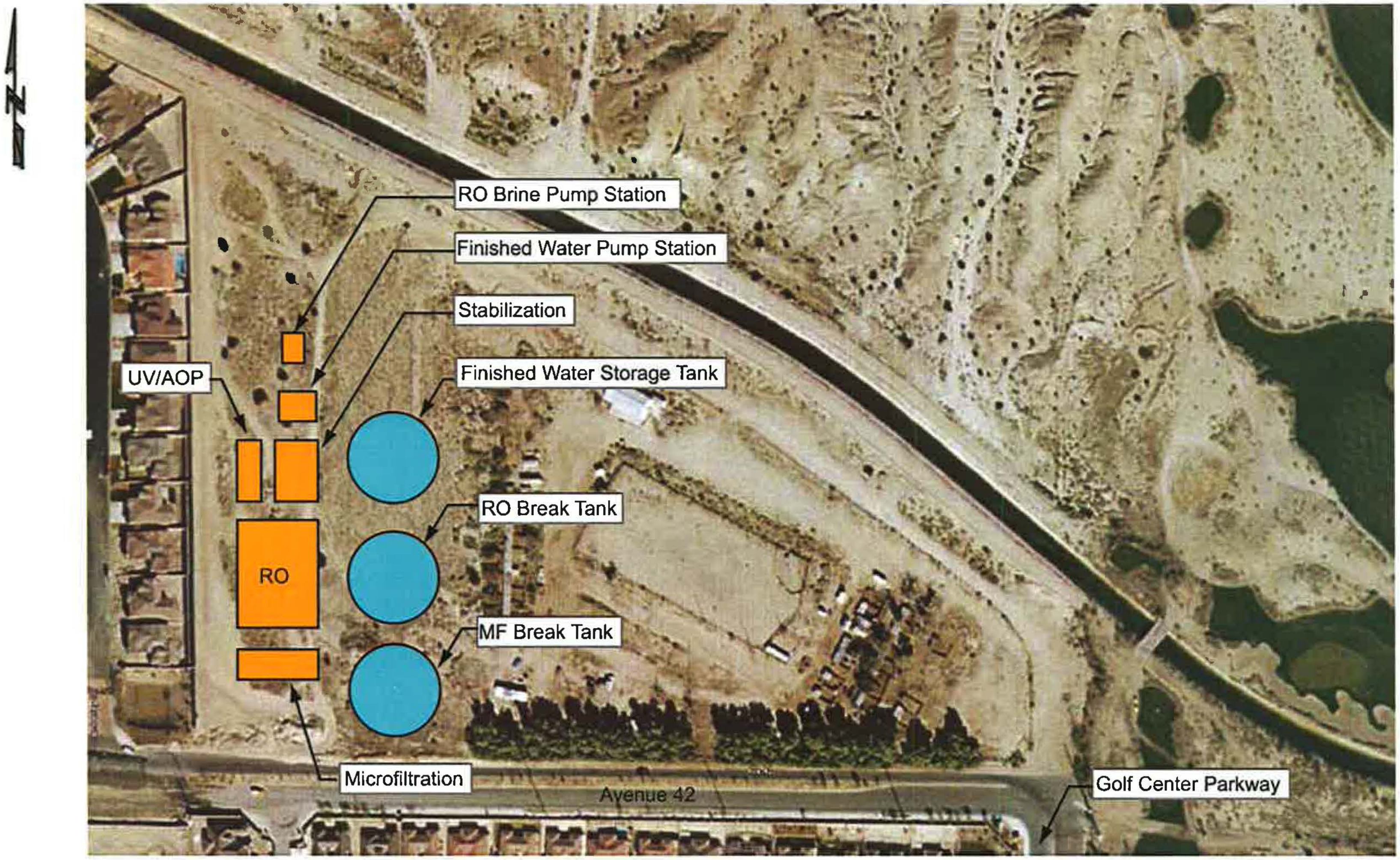
Finished water would be pumped to storage or to recharge wells near Posse Park. A preliminary conceptual layout of the groundwater recharge treatment facility is shown on Figure 9, which indicates that there is adequate space at this site to accommodate the facility. Figure 9 includes footprint requirements for MF to provide a conservative site layout.

4.0 CONCEPTUAL RECYCLED WATER DELIVERY CORRIDOR OPTIONS

The recycled water delivery system is a key component of the overall recycled water program for the IWA. Figure 10 shows a map of the VSD and IWA boundaries, potential large recycled water customer locations, and a conceptual backbone pipeline route. To minimize infrastructure and pumping costs, the IWA may choose to deliver water at a pressure that is sufficient only to supply golf course ponds. The golf courses would then pump from the ponds to pressurize their irrigation systems. Recycled water pipelines would then be sized to deliver up to the maximum daily flow rate and not the peak flow rate from the irrigation pumps. Smaller recycled water users such as HOAs and City parks may need to provide booster pumping facilities to pressurize their irrigation systems in order to use recycled water. A phased program would add these smaller users as the recycled water transmission mains are extended to the larger users.

The first portion of the recycled water delivery system would be to construct a pipeline from the VSD WWTP north across the Coachella Valley Stormwater Channel and Interstate 10 to the Posse Park and Indio Municipal Golf Course. It may be easier to establish service to the City-owned facilities and establish policies with connections to other golf courses based on this experience. If the IWA chooses to construct injection wells in Posse Park, then the pipeline infrastructure would be in place for these wells. Other customers that would utilize this pipeline could then be persuaded to connect to the recycled water system. A 16-inch line would provide up to 4.9 mgd and would be sufficient to supply all of the prospective customers north and east of Interstate 10. It is assumed that well injection would occur in low irrigation demand periods.

Crossing of the channel and freeway is both expensive and risky. Several alternatives exist to accomplish this task. An extra 14-inch pipeline (Mainero, Smith and Associates, 2004) currently exists in the 54-inch casing that also contains three depressed sewer lines. However, on December 8, 2009, Rex Sharp pointed out that the existing capacity of the three sewers excluded any area north of Terra Lago. If VSD provides treatment, under contract to the City, for the Dillon Road Corridor from Avenue 44 to the north, then the extra 14-inch diameter pipeline would be needed or another depressed sewer line would need to be installed. A second alternative would be to install the proposed pipeline by horizontal direction drilling beneath the channel and conventional jack and bore construction under Interstate 10, but this would be an expensive option. A third alternative that was studied by Dudek and Associates, Inc. in July of 2004 was to convert an abandoned 15-inch diameter VCP depressed sewer beneath the channel to a pressure pipe utilizing Duraliner™ which results in an inside diameter of 13.5 inches. From the north side of the channel the recycled water would be transported across Interstate 10 by slip lining the abandoned 18-inch diameter VCP sewer with a 16-inch diameter fusible PVC pipe, which



PRELIMINARY MF/RO SITE LAYOUT AT POSSE PARK

FIGURE 9

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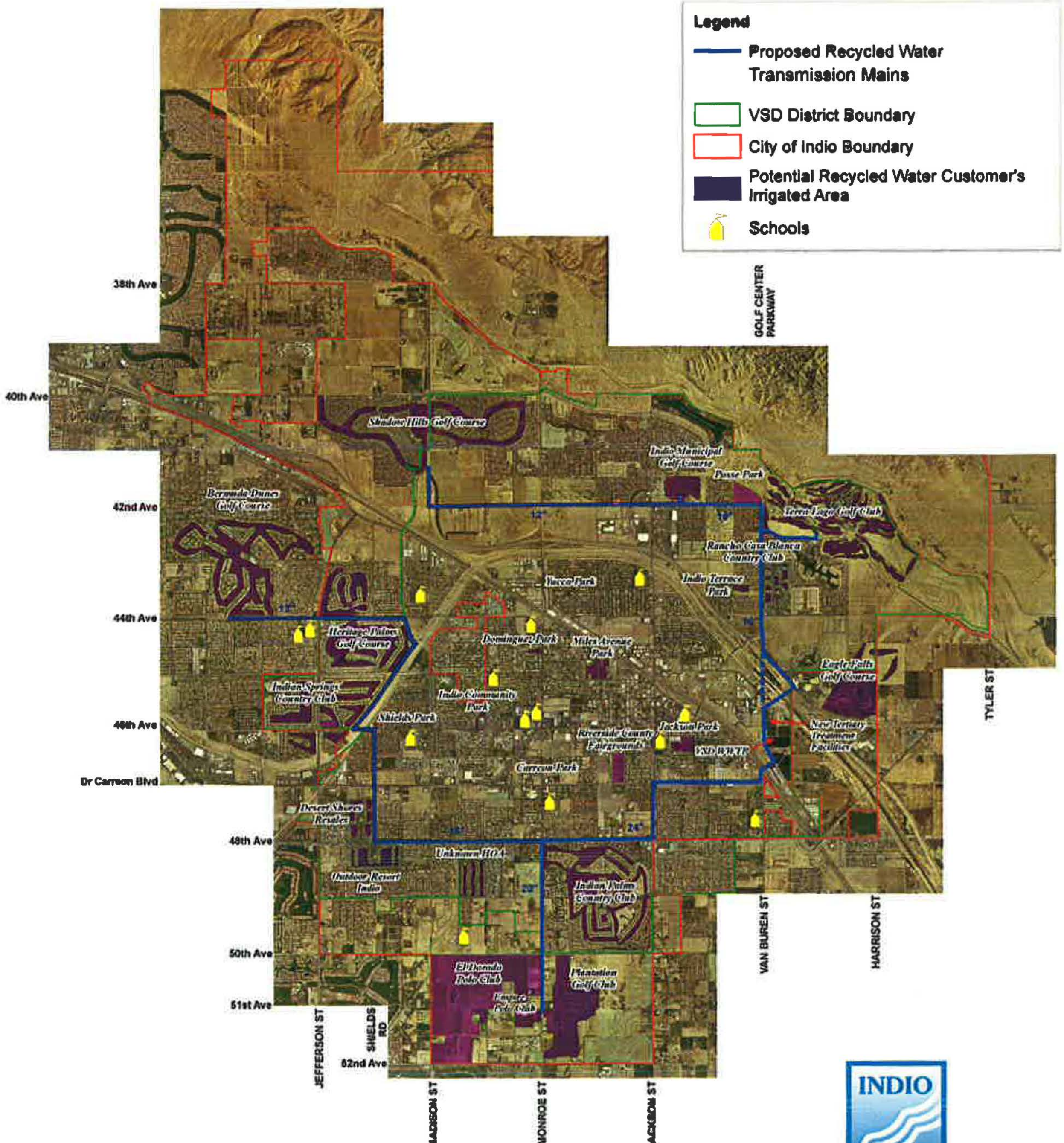

0 0.5 1 2
Miles

December 2009

POTENTIAL RECYCLED WATER CUSTOMERS AND WATER DELIVERY INFRASTRUCTURE

Figure 10

has an inside diameter of 15 inches. These three (3) alternatives will be studied further in the next phase of this project.

From Interstate 10 the transmission main would run north in Golf Center Parkway to 42nd Avenue then west to the Indio Municipal Golf Course. At this point the 16-inch diameter pipeline would reduce to 12 inches and ultimately continue west on 42nd Avenue to Madison then north to Shadow Hills Golf Course.

The second portion of the water delivery system would be to run a transmission main south and west of the VSD WWTP to serve the Indian Palms Country Club, Plantation Golf Club, and the Polo Clubs. This line may also be used to serve several of the City's parks. If the maximum daily flow rate would occur based on projected flows, then this pipe segment should be 24-inches in diameter.

The 24-inch diameter transmission main would be constructed in Van Buren Street to the south and then across the railroad and Indio Boulevard by jack and bore construction. Continue south on Van Buren Street to Dr. Carreon Boulevard and then west to Jackson Street then south on Jackson Street to 48th Avenue then west to Monroe Street. Continue south on Monroe Street with a 20-inch diameter pipeline to Indian Palms Country Club, Plantation Golf Club, Empire Polo Club, and El Dorado Polo Club. Laterals can also be provided to serve Jackson Park, Riverside County Fairgrounds and Carreon Park.

5.0 REFERENCES

Black & Veatch, 2008, IWA Water Resources Development Plan Phase 2 Final Report. Prepared for Indio Water Authority. August 2008.

Dudek, 2004, Recycled Water Feasibility Study – Phase 1. Prepared for Valley Sanitary District. July 14, 2004.

Lee & Ro, Inc., 2006, Valley Sanitary District Wastewater Treatment Plant Master Plan. Prepared for Valley Sanitary District. October 2006.

Mainero, Smith and Associates, 2004, Valley Sanitary Sewer District Shadow Hills Service Area Sewer Improvement Plans – Phase 1 Construction. Prepared for Valley Sanitary District. July 2004.

REGULATORY REQUIREMENTS FOR RECYCLED WATER

State Water Resources Control Board

The SWRCB establishes general policies governing the permitting of recycled water projects based on its role of protecting water quality and sustaining water supplies. The State Board reviews the permitting practices of the RWQCB and is also responsible for developing a general permit for irrigation uses of recycled water.

California Department of Public Health

The CDPH is responsible for protection of public health and drinking water supplies. It is also responsible for developing uniform water recycling criteria appropriate to particular uses of water. The latest version of the Regulations Related to Recycled Water is dated January 1, 2009. The latest update of the Draft Groundwater Recharge Reuse Regulations is dated August 5, 2008. The Regional Boards rely on CDPH to establish permit conditions for recycled water projects that will protect human health.

Regional Water Quality Control Boards

The RWQCBs are responsible for protecting the surface and groundwater resources of the State. They are also responsible for issuing permits that implement CDPH recommendations for each recycled water project.

Recycled Water for Irrigation

Chapter 3 of Division 4 of Title 22 of the California Code of Regulations defines the Water Recycling Criteria and uses and water quality requirements for recycled water. These criteria are commonly referred to as "Title 22".

In terms of required water quality, recycled water used for irrigation of:

1. Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop,
2. Parks and playgrounds,
3. School yards,
4. Residential landscaping, and
5. Unrestricted access golf courses,

shall be "disinfected tertiary recycled water". Such water is defined as a filtered and subsequently disinfected wastewater that meets the following criteria for disinfection:

1. Includes a chlorine disinfection process following filtration that provides a CT value of not less than 450 mg-min/L at all times, with a modal contact time of at least 90-min based on peak dry weather design flow; or

2. Includes a disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent (5-log reduction) of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of demonstration.

In addition, the median concentration of total coliform bacteria measured in the disinfected effluent must not exceed an MPN of 2.2 per 100 mL utilizing the bacteriological results of the last seven days for which analyses have been completed. Also, the number of total coliform bacteria must not exceed an MPN of 23 per 100 mL in more than one sample in any 30-day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

For the recycled water to be considered as filtered, it must be an oxidized wastewater that is either filtered through a membrane or other filter media, and in either case meets the criteria below:

1. For non-membrane filters, the recycled water has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:
   a. At a rate that does not exceed 5 gpm/ft^2 of surface area in mono, dual or mixed media gravity, upflow or pressure systems, or does not exceed 2 gpm/ft^2 of surface area in a traveling bridge automatic backwash filter; and
   b. So that the turbidity of the filtered wastewater does not exceed any of the following:
      1) An average of 2 NTU within a 24-hour period
      2) 5 NTU more than 5-percent of the time within a 24-hour period, and
      3) 10 NTU at any time.
      (Note that several filtration systems - other than media filters - have received "Title 22 approval" for which specific filtration rates are defined in order for the systems to meet the required turbidity limits shown above.)

2. For membrane filters, the recycled water has passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:
   a. 0.2 NTU more than 5-percent of the time within a 24-hour period, and
   b. 0.5 NTU at any time.

Recycled Water For Groundwater Recharge

The regulations for using recycled water for groundwater recharge are significantly different to those for using recycled water for irrigation. Since the groundwater basins are aquifers used for potable purposes, the regulations are designed to protect the beneficial uses of each specific aquifer. Prior to making its recommendations to the RWQCB for the initial permit to operate a Groundwater Recharge Reuse Project (GRRP) the CDPH will hold a Pubic Hearing.

Recharging an aquifer with recycled water that will later be withdrawn and used for potable purposes is called Indirect Potable Reuse (IPR). In this way, the aquifer presents a natural barrier and also acts as a large storage area so that changes in water quality are more gradual. There are two ways in which recycled water can be used to recharge a groundwater basin, either by spreading the recycled water in a recharge basin and allowing natural infiltration to take place, or by injecting the recycled water directly into the underground basin. Minimum treatment requirements for spreading and injection are different and are discussed later.

Because recycled water originates from wastewater, the regulations are focused on controlling several key water quality parameters. Each is discussed briefly below:

1. **Control of Pathogenic Organisms**
   In order to meet the requirements for control of pathogenic organisms:
   a. The recycled water must meet the requirements of disinfected tertiary recycled water (defined above) – 450 CT, or 5-log virus reduction; and the total coliform limits.
   b. The aquifer must allow for a minimum of 6-months retention time of the water underground before it is extracted as a drinking water supply from the closest well.
   c. The GRRP must demonstrate within 3-months of commencing operation that the minimum retention time to the closest drinking water well has been met. This must be done by using a tracer study. Until the tracer study is applied, other minimum detention periods apply (calculated by applying a safety factor to the minimum 6-month period, resulting in detention periods varying between 9 and 24-months) depending on the method initially used to establish the aquifer detention period:
      1) Tracer study using an added chemical tracer (6-months)
      2) Tracer study using intrinsic tracer, such as TDS (9-months)
      3) Calibrated 3-D numerical model (12-months)
      4) Developed analytical method to determine distance (24-months)

      Monitoring wells need to be established, per CDPH requirements, in order to establish tracer movement.

2. **Control of Nitrogen Compounds**
   There are three methods for controlling nitrogen:

   a. Method 1 sets a low average concentration of total nitrogen (5 mg/L) and sampling twice weekly, with the rationale that if the recycled water is applied at this concentration then there is very little chance of the drinking water MCL for NO_2 or NO_3 ever being exceeded.

   b. Method 2 sets a maximum total nitrogen limit of 10 mg/L with more intensive sampling, with the rationale that the low limit of total nitrogen will result in a low risk of exceeding a drinking water MCL.

   c. Method 3 relies on compliance monitoring and is only for projects that have been in operation for more than 20-years. Monitoring points are set up between the recharge area and the down gradient domestic wells with relatively frequent sampling. Method 3 relies on the demonstration over a long period of time that nitrogen contamination in the drinking water wells has not been a problem, and that the NO_2 and NO_3 drinking water MCLs have been met.

3. **Control of Total Organic Carbon (TOC)**
   Due to the fact that recycled water contains organic material that originated from wastewater, CDPH's approach is to limit the amount of recycled water TOC that enters a groundwater basin. This is done by setting a Recycled Water Contribution (RWC) value for each GRRP. The RWC is the amount of recycled water applied at the GRRP divided by the total amount of water recharged into the basin (recycled water plus diluent water). Diluent water is defined as water that does not contain organic material of wastewater origin. Examples of diluent water include raw surface water, groundwater, and storm water.

   For example, if 1,000 AF of recycled water is combined with 4,000 AF of diluent water, the RWC would be 1,000/5,000 = 0.20 or 20%. The RWC is calculated on a 60-month average.

   The maximum TOC concentration permissible in the recycled water used for a GRRP is calculated using the following equation:

$$TOC_{max} = \frac{0.5 \text{ mg/L}}{RWC_{proposed}}$$

   Thus, for a GRRP with a proposed RWC of 20%, the TOC_{max} concentration for the recycled water would be 2.5 mg/L For an RWC of 50%, the TOC_{max} would be 1.0 mg/L. The TOC concentration limit for the GRRP is calculated on a 20-week average basis. Monitoring requirements have been established for TOC.

   For each GRRP, CDPH will establish an <u>initial</u> RWC to be used for the project. This value will be based on review of the Engineer's Report and information obtained during the public hearing, but will not exceed the following limits:

   - 20% for surface spreading projects
   - 50% for groundwater injection
   - 50% for surface spreading projects that include RO

For projects that require additional treatment to meet the desired RWC, then advanced treatment with RO followed by an advanced oxidation process (AOP) are to be provided. The AOP process (UV/H_2O_2, Ozone/H_2O_2) must provide:

- 1.2 log NDMA reduction, and
- 0.5 log 1,4 Dioxane reduction

4. **Control of Emerging Contaminants**
   |Standards for these compounds do not yet exist and it is anticipated that it will be some time before such standards are established. Each GRRP is to propose a monitoring program for emerging contaminants. These include endocrine disrupting compounds (EDCs) and pharmaceuticals and personal care products (PPCPs). Work is being done in this area to identify surrogates that can be used to monitor the most critical compounds in the vast array of existing chemicals that fall into this category.

5. **Source Control**
   A source control program needs to be in place to regulate contaminants entering the sewer system.

Salt/Nutrient Management Plans

The SWRCB's Recycled Water Policy includes a requirement that Salt and Nutrient Management Plans be established for every groundwater basin/sub-basin in California. In some areas of the state, basin plans already exist that stipulate both nutrient and salt limits. If the planned GRRP produces a recycled water that meets the requirements of the existing plan, then additional work may not be needed. However, if no plan exists, then one needs to be developed, and if the proposed project exceeds the limits of an existing plan then modifications to the plan may be needed; both of which may include significant effort. Where new plans need to be developed, these are to be complete within five year of the adoption of the Recycled Water Policy, which is by February 3, 2014.

The Salt and Nutrient Management Plans shall also include provisions for annual monitoring of emerging contaminants / constituents of emerging concern.

APPENDIX C

RECYCLED WATER FEASIBILITY STUDY – PHASE 1

DUDEK
& ASSOCIATES, INC.
Professional Teams for Complex Projects

Engineering, Planning,
Environmental Sciences and
Management Services

Corporate Office:
605 Third Street
Encinitas, California 92024

760.942.5147
Fax 760.632.0164

July 14, 2004

3992-02

Mr. Rex Sharp
Valley Sanitary District
45-500 Van Buren Street
Indio, CA 92201

Re: Recycled Water Feasibility Study – Phase I

Dear Mr. Sharp:

At your request, Dudek and Associates, Inc. have completed the first phase of the Valley Sanitary District (VSD) Recycled Water Feasibility Study. The Phase I Study evaluates the potential to convert the existing 15-inch diameter sewer siphon under the storm channel into a recycled water distribution main. Potential recycled water customers are identified that could be supplied from the converted siphon and demand estimates are made and compared with the pipeline transmission capacity. A planning level cost estimate is also provided for siphon conversion project.

Background

The VSD Wastewater Treatment Plant (WWTP) provides full secondary treatment, sludge handling, and disposal to the Whitewater Storm Channel. The current permitted capacity of the WWTP is 8.5 MGD and existing wastewater flows average approximately 5.6 MGD. Approximately 1.0 MGD of the plant influent is diverted through a wetlands area before being discharged to the Whitewater Storm Channel. It is assumed that the wetlands enhancement project will continue in the future. If tertiary treatment facilities are constructed at the existing WWTP, up to 7.5 MGD of recycled water could be available for irrigation purposes. Based on the ultimate capacity of the WWTP, the supply of recycled water could potentially increase to 16 MGD.

A Water Management Plan for the Coachella Valley was prepared by the Coachella Valley Water District (CVWD) in 2002. In this plan, Colorado River water supplied from the Coachella Branch of the All-American Canal (canal water) or recycled water is recommended for golf course irrigation. VSD is within Improvement District 1 of the CVWD's Colorado River Service area, and the All-American Canal runs through the VSD service area. Low-cost canal water is therefore available, and most golf courses currently irrigate with canal water or with a combination of canal water and groundwater pumped from private wells. The cost of canal water is currently $17.25 per acre-feet plus a $10.50 per day gate charge. When the supply of water from the Colorado River was cutback back by the federal government in 2003, the CVWD gave water use for agriculture a higher priority than golf course irrigation, and deliveries of canal water to golf courses were cut off or curtailed. There is therefore a high interest among the golf course management staff contacted for this study in having recycled water available for golf course irrigation.

Potential Reuse Customers

Recycled water produced at the VSD WWTP would be used to supply golf course irrigation demands. The highest concentrations of existing and planned golf courses near the WWTP are located north of Interstate 10 (I-10). The locations of golf course developments that have been identified as potential water reuse customers are shown on Figure 1. Table 1 lists the potential recycled water demands. Water demands and irrigated acreage estimates for existing golf course developments were obtained from telephone conversations with golf course superintendents or management staff. The unit water demands vary from approximately 4.5 to 9.5 acre-feet per year per acre (afy/ac). Irrigation demands for planned facilities are based on an estimate of irrigated acreage and a unit water demand of 7.5 afy/ac.

Table 1
Potential Recycled Water Demands

Facility	Map Ref. No.	Approx Size (acres)	Estimated Demands AAD (afy)	AAD (mgd)	MDD (mgd)	MDD (gpm)	Max Day PF	Existing supply
Existing:								
Rancho Casa Blanca - 18 holes	①	40	180	0.16	0.40	281	2.5	wells, water use is decreasing
Landmark Golf Club - 27 holes	②	210	2,000	1.8	5.0	3,472	2.8	canal water
Indio Golf Club - 18 holes, exec	③	30	170	0.15	0.24	167	1.6	well water & canal water (summer)
Subtotal Existing		**280**	**2,350**	**2.1**	**5.6**	**3,919**		
Planned:								
Sun City Shadow Hills, 18 holes	④	220	1,650	1.5	3.7	2,558	2.5	
Cabazon GC & resort - 18 holes	⑤	200	1,500	1.3	3.3	2,326	2.5	
Subtotal Planned		**420**	**3,150**	**2.8**	**7.0**	**4,884**		
Total Existing and Planned		**700**	**5,500**	**4.9**	**12.7**	**8,803**		

Based on the information in Table 1, the maximum day irrigation demand of existing potential recycled water users is 5.6 MGD. A 16-inch diameter pipeline would deliver this flow rate at a velocity of 6.2 feet per second (fps). A pipeline of approximately 24-inches in diameter would be required to delivery the projected ultimate maximum day demand.

The projected ultimate average annual demand for potential recycled water customers north of I-10 is 4.9 MGD, or approximately 5,500 acre-feet per year (afy). Using the current cost of canal water and daily gate charges, the five identified golf courses would collectively pay approximately $114,000 a year for water. This equates to an effective rate of approximately $21 per acre-feet considering daily gate charges.

Recycled Water Supply Options

To deliver recycled water to the potential demands listed in Table 1, recycled water must first be transported across I-10 and the adjacent stormwater channel. A water distribution system will need to be constructed to deliver recycled water to onsite golf course irrigation ponds. The private irrigation systems at the three existing golf course facilities pump water from existing ponds to

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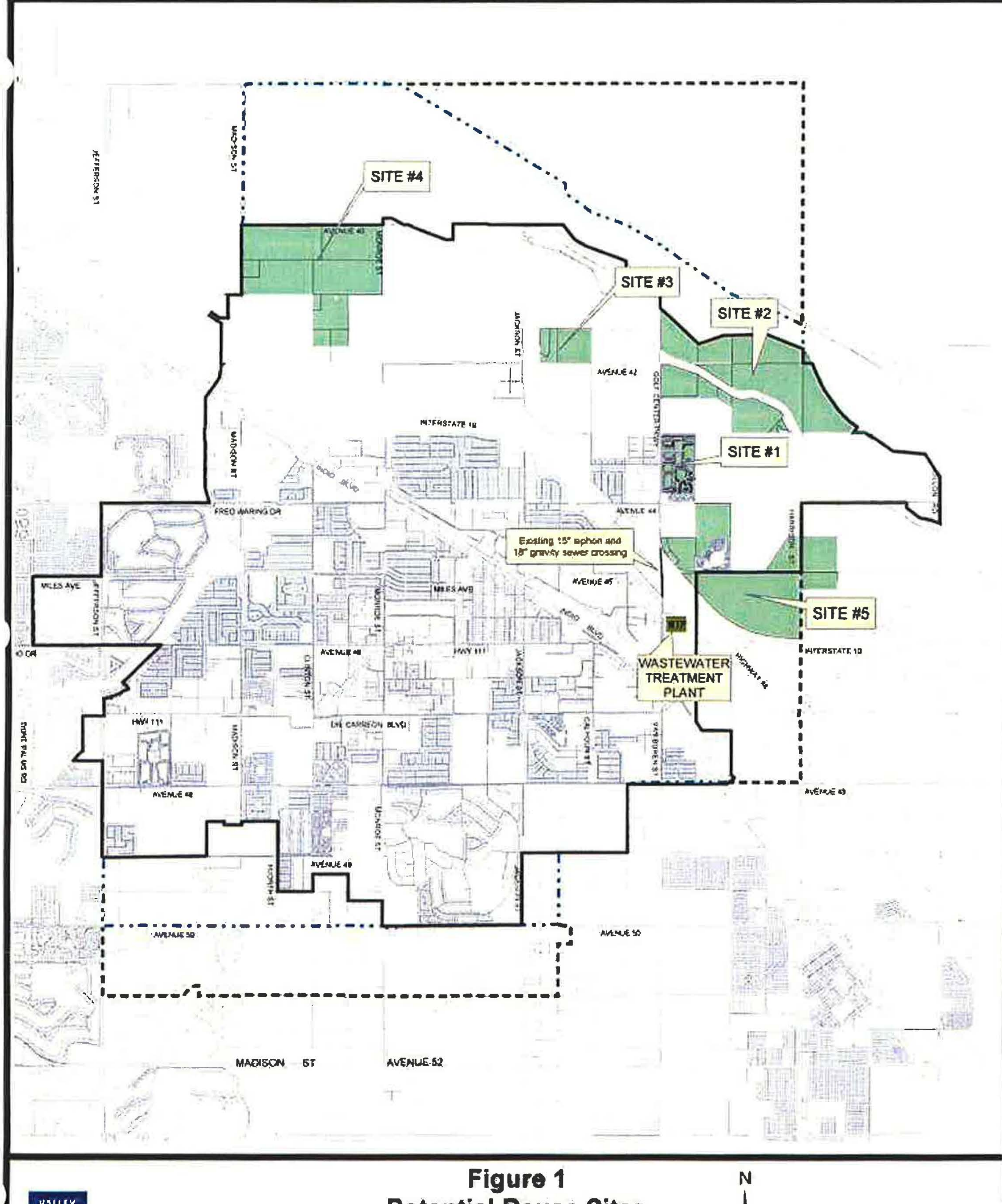

Figure 1
Potential Reuse Sites

1" = 5000'

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ValleySan03.mxd

pressurize their irrigation systems. It is therefore assumed that a future recycled water distribution system will be designed to operate at low pressures.

There are several options for transporting recycled water to the north side of I-10. A new pipeline could be constructed by micro tunneling under the stormwater channel and I-10, but this would be an expensive option. A new sewer interceptor siphon crossing under the stormwater channel and I-10 directly across from the WWTP is currently in design for the future Shadow Hills development. The siphon system will consist of a large diameter encasement pipe carrying several smaller individual HDPE pipelines of varying diameters to accommodate different flow rates. One of these pipelines could potentially be used to delivery recycled water. Once this siphon is constructed, the existing 15-inch diameter sewer siphon and 18-inch gravity pipeline crossing will no longer be needed. The existing siphon could potentially be converted to a recycled water transmission main. This option is discussed in more detail below.

Rehab of Storm Channel Crossing

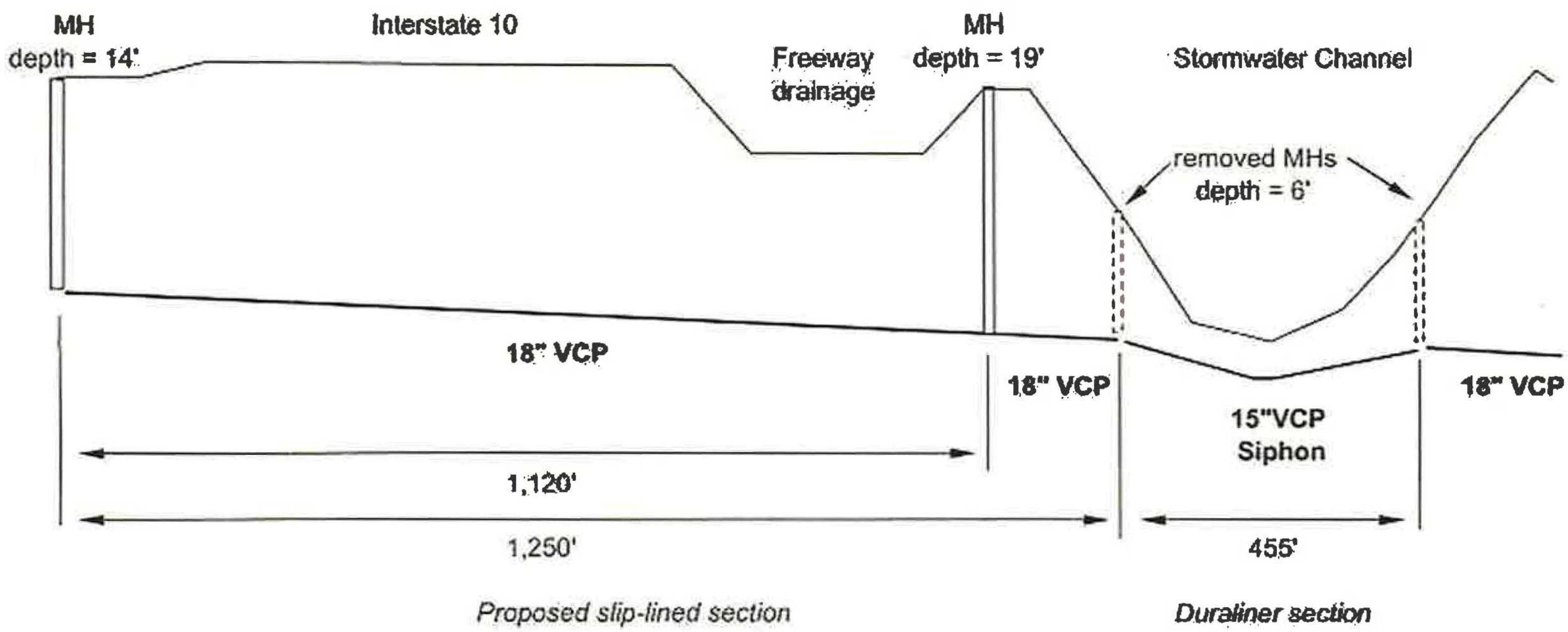
Sewer flows from development north of I-10 are currently conveyed to the WWTP in an 18-inch diameter gravity sewer under I-10 and a 15-inch diameter siphon under the adjacent stormwater channel. Rehabilitation methods were investigated to convert the sewer siphon for use as a recycled water transmission main.

Construction drawings from 1965 show parallel 10-inch and 15-inch diameter siphons which were designed to cross under the storm drain channel and two parallel 60-inch diameter culverts crossing the channel at an angle. The siphons span 455 feet between manholes on either side of the stormwater channel. There is a 26' long concrete encased section on the siphons where they cross under the culverts. District staff has stated that there is only one 15-inch diameter siphon under the stormwater channel. They also questioned whether the 60-inch culverts and concrete encased section on the siphon actually exist. In 1997 the manholes on both side of the storm channel were removed and 18" to 15" reducer fittings were installed. A new manhole was constructed between I-10 and the stormwater channel, approximately 130' upstream from the original manhole. A vent pipe was installed at the location of the original downstream manhole. Figure 2 provides a sketch of the existing siphon and upstream gravity pipeline crossing under I-10.

The 15-inch VCP siphon could be converted to a pressure pipe by installing a structural lining using an in-situ process. Slip-lining of the siphon was initially considered, as the resulting inside diameter would be less than 12 inches, providing limited capacity. Pipe bursting construction methods to install a larger diameter pipe are not an option because of the concrete encased potion. A Duraliner™ installation was identified as a viable relining method which would provide the highest flow capacity.

Duraliner™ is a pipeline relining method which results in a "stand alone" structural lining capable of handling internal operating pressures of up to 150 psi. The Duraliner™ system utilizes starting stock of 100% Polyvinyl Chloride (PVC) pressure pipe that is significantly smaller than the inside diameter of the host pipe. The starting stock pipe sections are fused together and inserted into the entire length of the host pipe. Heat and pressure are applied to expand the pipe tightly against the interior walls of the host pipe. This process realigns the PVC molecular structure and results in a stronger pipeline.

FIGURE 2
EXISTING STORMWATER CHANNEL/I-10 SEWER CROSSING



Ductile iron or cast iron mechanical joint fittings and ductile iron push on type fittings can be installed directly onto the Duraliner™ pipe.

The resulting interior diameter in the siphon with a Duraliner™ would be approximately 13.5 inches in diameter. The installation process would require excavation pits at the location of the original manholes. At a flow rate of 5.6 MGD (maximum day demand of existing golf courses), the velocity in the re-lined siphon would be approximately 8.7 fps. With a flow rate of 12.7 MGD (projected ultimate maximum day demand) the velocity in this section increases to approximately 19.7 fps, with a corresponding friction loss of approximately 14 psi.

From the north side of the stormwater channel, recycled water still needs to be transported across I-10. One option is to install a pipeline in the highway bridge crossing located a few hundred feet west of the siphon. There are pipeline chases on both sides of the bridge, but it is not know if the chases are currently being used or the maximum diameter pipeline that can be installed. Another option is to use the existing upstream 18-inch diameter gravity pipeline crossing under I-10. Based on the 1964 construction drawings, the gravity sewer has a constant slope and no bends. If the line is still straight and sags have not developed, the 1,250' long gravity pipeline could be slip-lined with a 16-inch diameter SCH 40 fusible PVC pipe, which has an inside diameter of 15 inches. The Duraliner™ system can also be used with a resulting larger diameter pipe, but the cost would be higher.

A planning level estimate of probable construction costs for rehabilitation of the sewer siphon and the upstream gravity pipeline to deliver recycled water is provided in Table 2. Construction estimates were obtained from a company which performs Duraliner™ installations and include pipeline video inspections and excavation of construction pits.

Table 2
Opinion of Probable Rehabilitation Costs

Item	length (feet)	Probable Cost
Install Duraliner™ in 15" VCP siphon under stormwater channel	455	$ 95,000
Slipline 18" VCP gravity sewer under I-10 with 16" PVC pipe	1,248	$ 129,000
Total		$ 224,000
Construction contingency @ 30%		$ 67,000
Total Probable Construction Costs		**$ 291,000**

The costs listed in Table 2 are construction costs only, and do not include engineering, administrative or legal costs. The maximum capacity of the rehabilitated sewer line is estimated at approximately 10 MGD based on a velocity of 15 fps in the original siphon section. It is noted that the probable construction cost of a new 18-inch diameter pipeline under I-10 and the stormwater channel is estimated at approximately $1,400,000.

Recycled Water Production and Delivery Costs

Capital costs associated with a recycled water distribution system will include the cost of tertiary treatment facilities, a distribution system pump station, and distribution system pipelines in addition to the I-10/stormwater channel crossing. A preliminary financial evaluation was performed for a future VSD recycled water distribution system. The recycled water system was sized to supply the five golf courses listed in Table 1. All costs were annualized and the projected cost of recycled water was then calculated in current dollars to cover operations and maintenance costs and the loan payment on capital costs. The assumptions utilized for the financial evaluation are as follows:

- Tertiary treatment facilities will be constructed at the WWTP to produce 7.5 MGD of recycled water, which is the existing plant capacity.

- The golf courses identified as future developments in Table 1 will be constructed by the time the recycled water system becomes operational.

- Effluent into the WWTP will average 7.5 MGD by the time the recycled water system becomes operational.

- Irrigation demands vary seasonally, and recycled water will be produced at a rate to match the projected water demands. In winter months, the production rate is assumed to be a minimum of one-half of the average annual demand (2.45 MGD). During summer months the supply of recycled water will be less than the irrigation demand. To make up the supply deficiency, it is assumed that canal water will be delivered directly to the irrigation ponds at each golf course.

- All costs are converted to net annual cost. The projected capital cost of the recycled water system is annualized based on an assumed loan payment with an amortization of 30 years at a rate of five percent.

- Electric power costs are assumed at $0.15 per kWh.

- Construction costs for transmission pipelines are based on a unit cost of $10 per diameter-inch per linear foot.

- The recycled water rate is set to equal the annual cost expressed as an initial year cost.

The results of the recycled water preliminary financial evaluation are summarized in Table 3.

Table 3
Planning Level Recycled Water Costs and Pricing

CAPITAL COSTS	
Tertiary treatment upgrade	$ 12,600,000
I-10/ storm channel crossing	$ 291,000
Distribution pipelines	$ 3,440,000
Distribution pump station	$ 750,000
Total Construction Cost	$ 17,081,000
Engineering, legal, & admin (35%)	$ 5,978,000
Total Capital Costs	**$ 23,059,000**
ANNUAL COSTS	
loan payment (5% for 30 yrs)	$ 1,500,021
Annual O&M*	$ 789,000
Total Annual Costs	**$2,289,021**
RECYCLED WATER COST	**$444 /AF**

* Includes O&M for pipelines, pump stations, tertiary treatment & power costs

The conceptual planning level costs presented above are very preliminary, and may change substantially upon further investigation and analysis. We appreciate the opportunity to assist the District in this Phase I planning effort for a recycled water system, and look forward to proceeding with the Phase II effort. The Phase II study includes a more detailed market analysis, the identification of tertiary treatment facilities, development of a conceptual distribution system, and a refined financial analysis. Please contact Karen Svet at (760) 479-4102 if you have any questions regarding the findings of this study.

Very truly yours,
Dudek & Associates, Inc.

Karen Svet, P.E.
Senior Engineer

Attachments

cc: Russ Bergholz, Dudek & Associates, Inc.