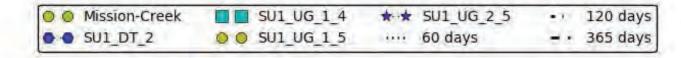
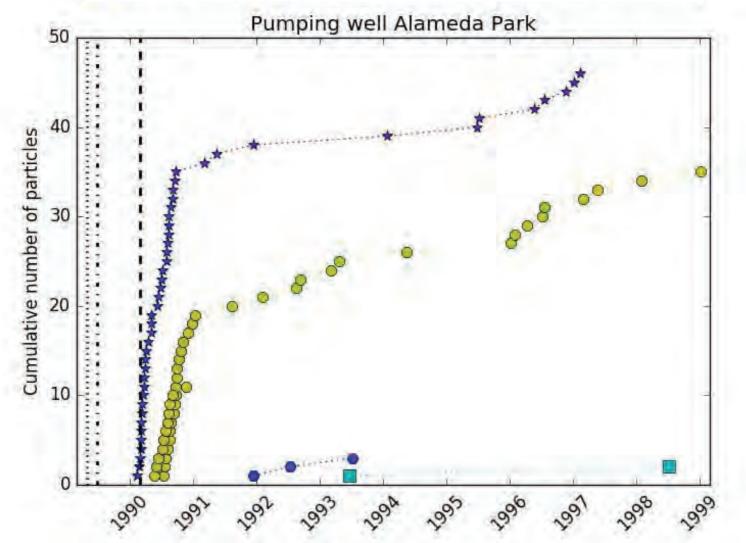
Appendix D: Groundwater Model Particle Tracking Graphs for Alternative 1B

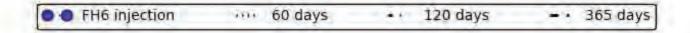
The following particle tracking graphs show arrival times at IPR recovery wells and production wells for recycled water applied at individual sites (surface recharge reaches and IPR injection wells) as simulated by the groundwater model. The graphs provide a visual means of comparing simulated arrival times at pumped wells for fully advanced treatment (FAT) recycled waters applied via injection wells and tertiary treated recycled waters applied via surface recharge reaches to the required residence times for each (60 days residence required for FAT water, 365 days required for tertiary treated water).

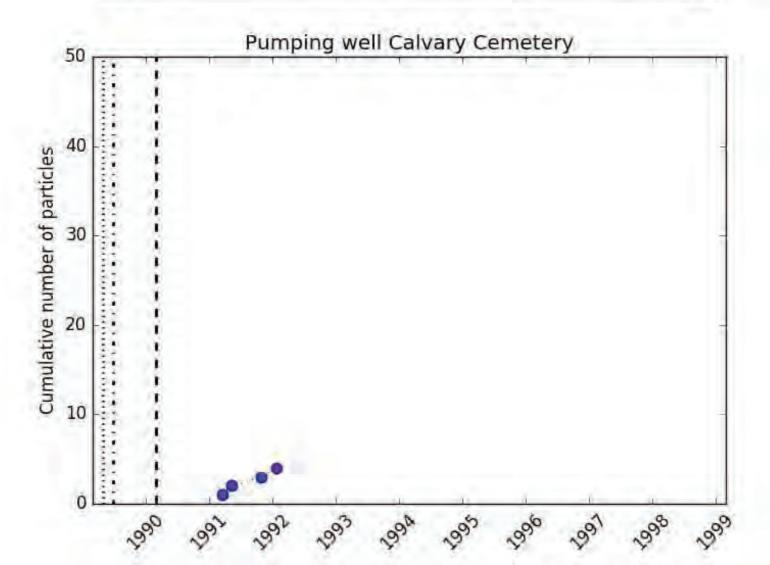
For example, the graph for "Pumping well SU1_4" can be read as follows:

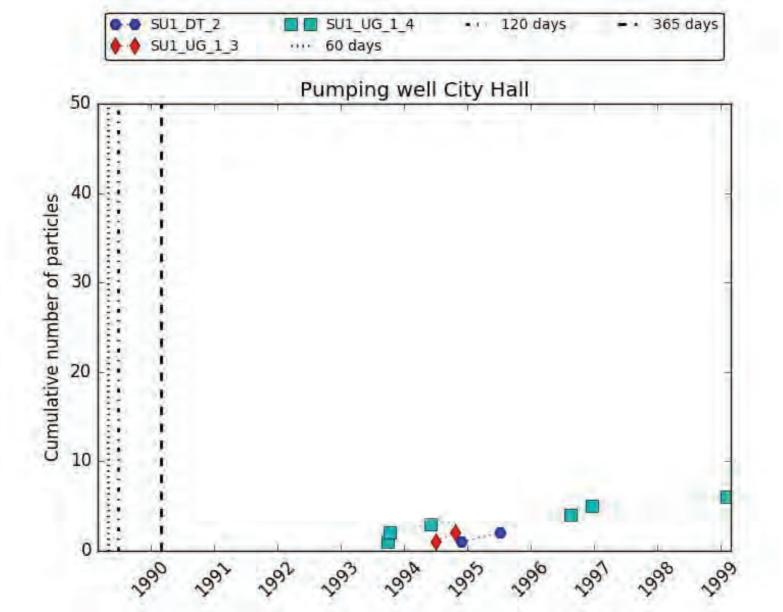
- The first 'particle' of water from IPR injection well SU1_UG_2_7 arrives just after 120 days of residence time. The rest of the water 'particles' arrive shortly thereafter. Because FAT water would be used for injection, the required residence time of at least 60 days is satisfied.
- The first 'particle' of water from IPR injection well SU1_UG_2_6 arrives after approximately 365 days of residence time. Again, the rest of the water 'particles' arrive shortly thereafter. Because FAT water would be used for injection, the required residence time of at least 60 days is satisfied.
- The first 'particle' of water applied via surface recharge in Mission Creek arrives after more than 1.5 years of residence time. The rest of the water 'particles' arrive slowly over the next several years. Because tertiary treated water would be used for surface recharge, the required residence time of at least 365 days is satisfied.
- Only one 'particle' of water arrives from injection well SU1_UG_2_5 after more than 2 years of residence time.

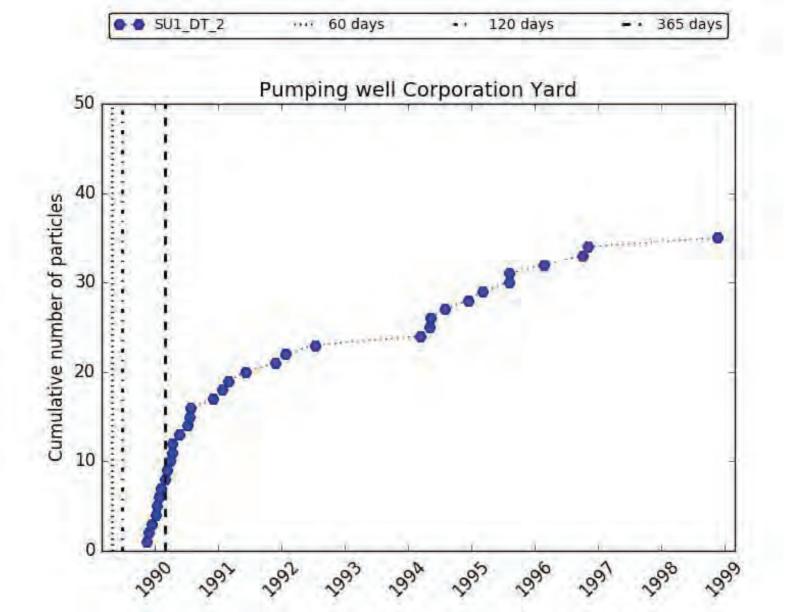


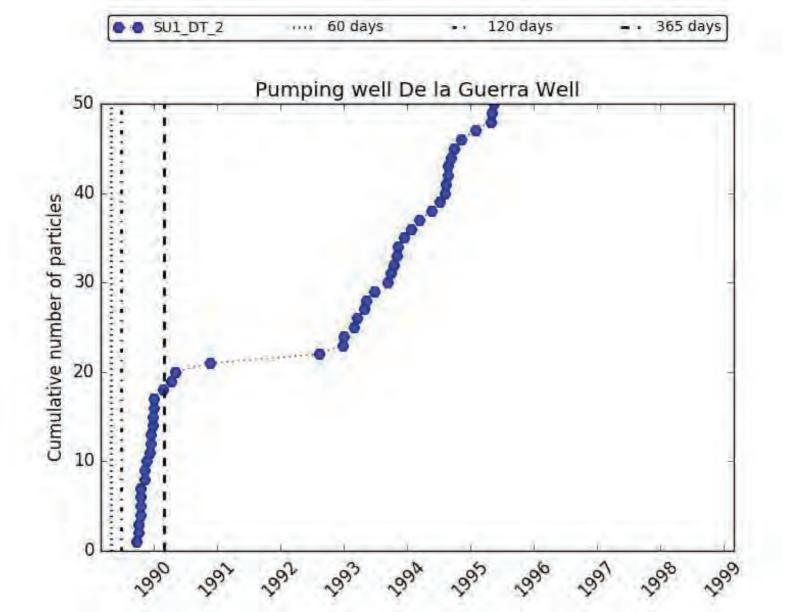


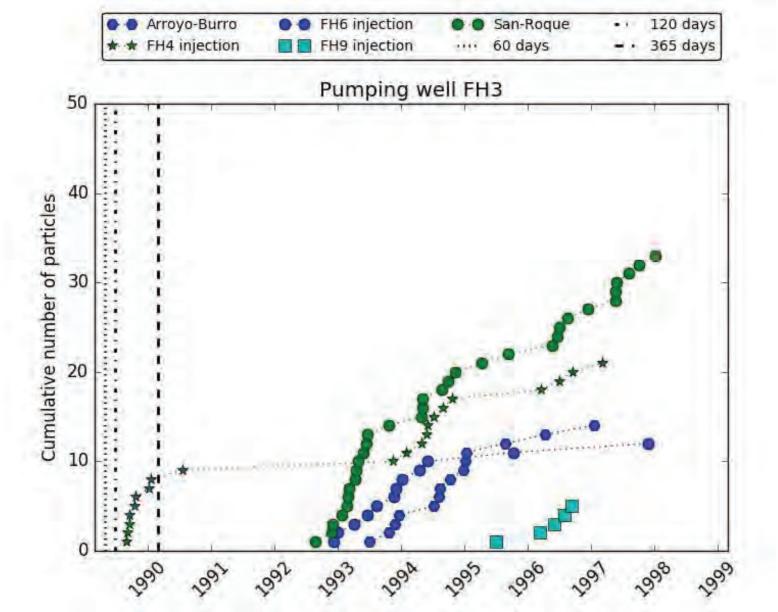


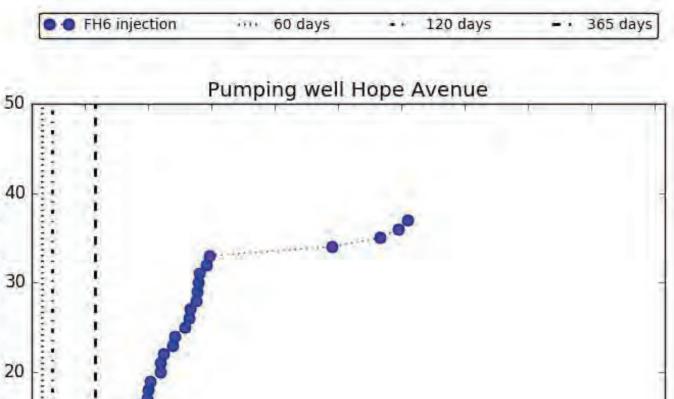


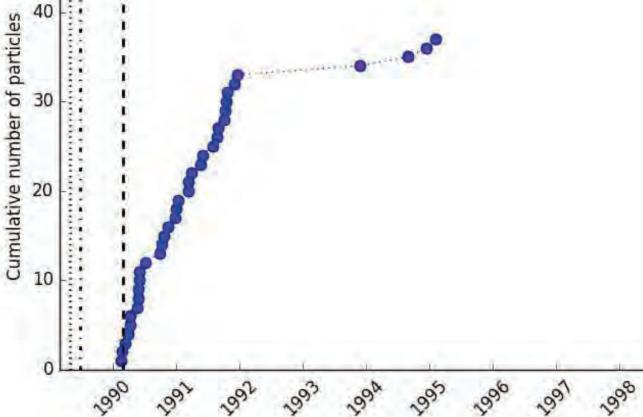


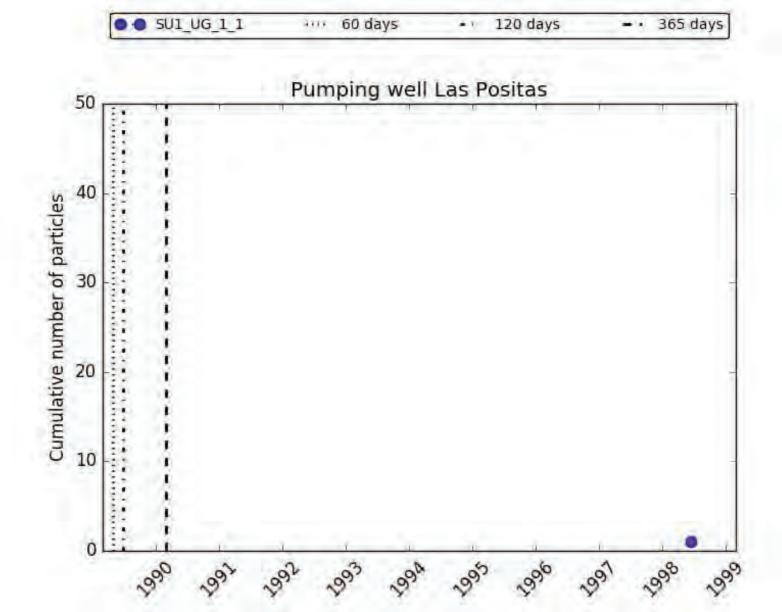


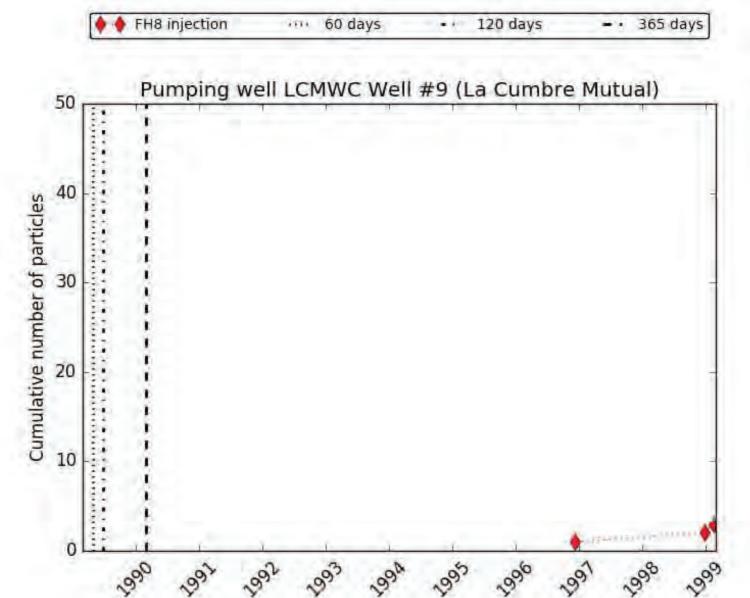


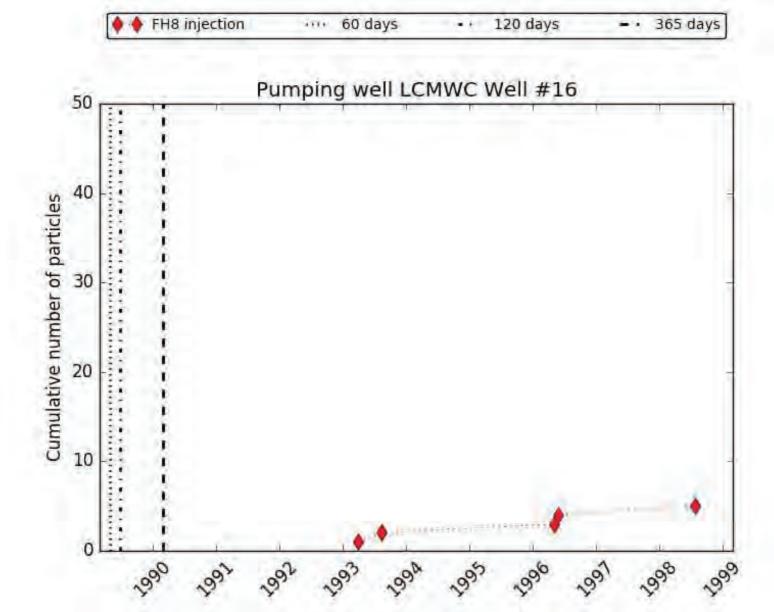


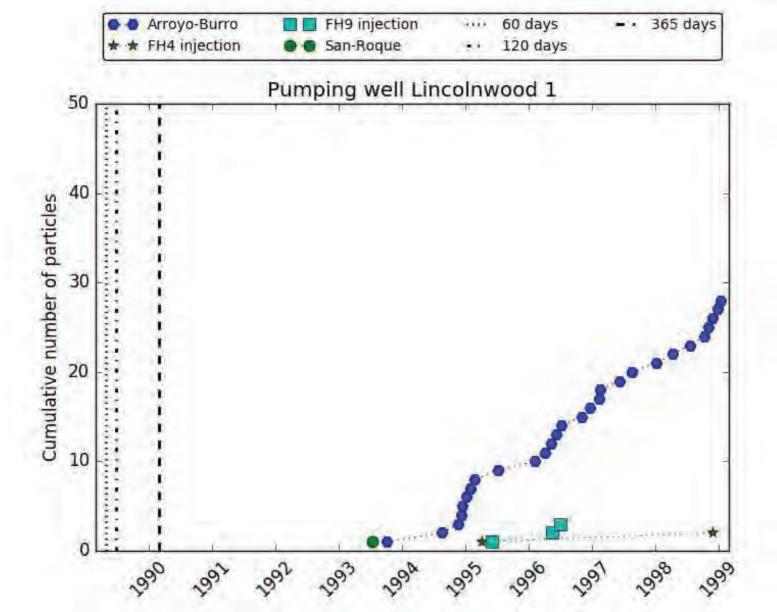


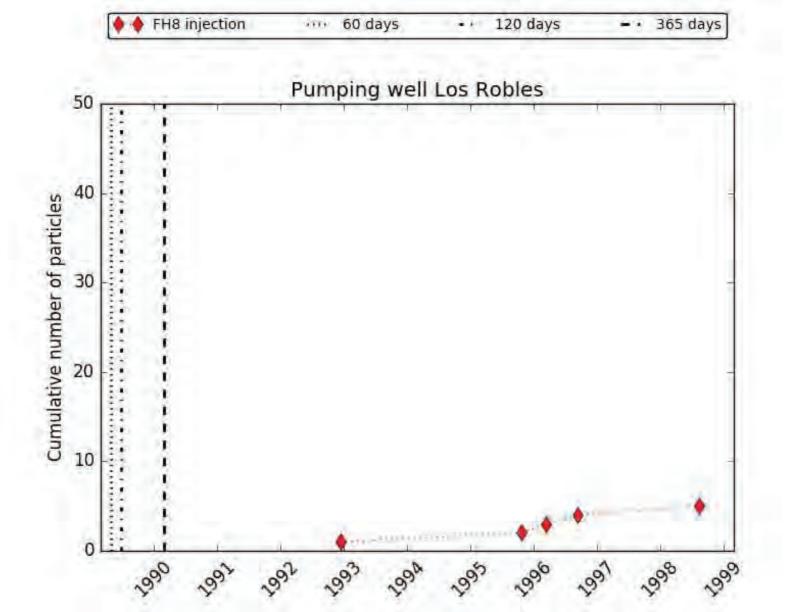


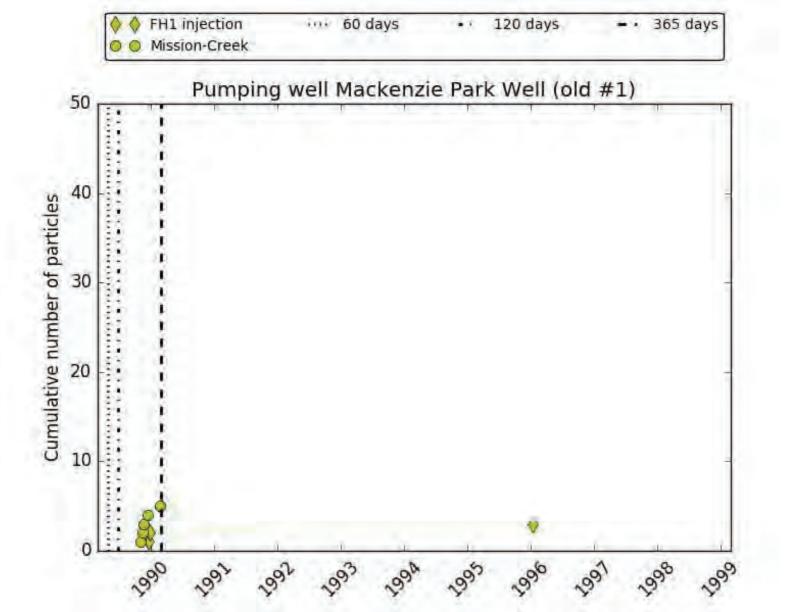


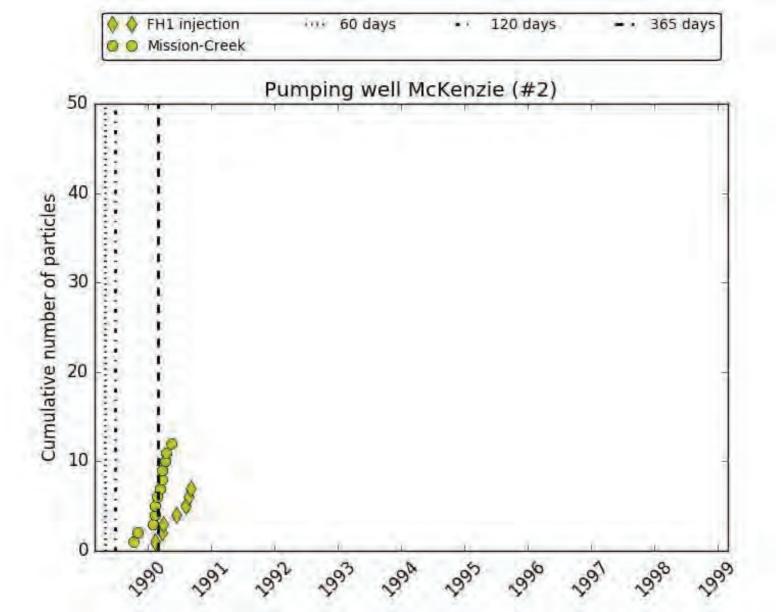


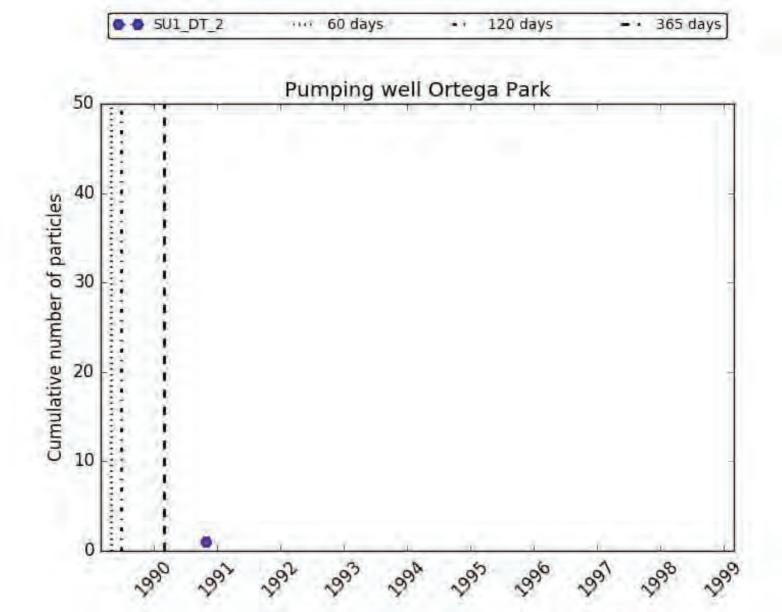


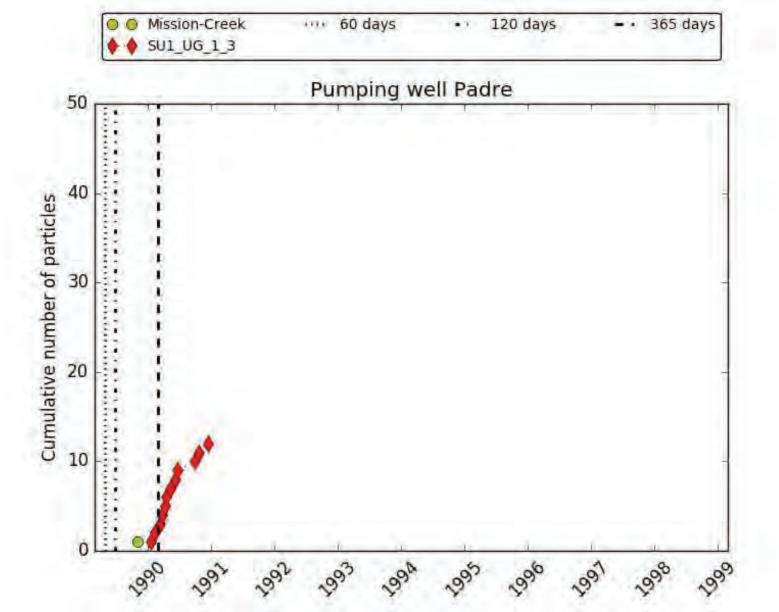


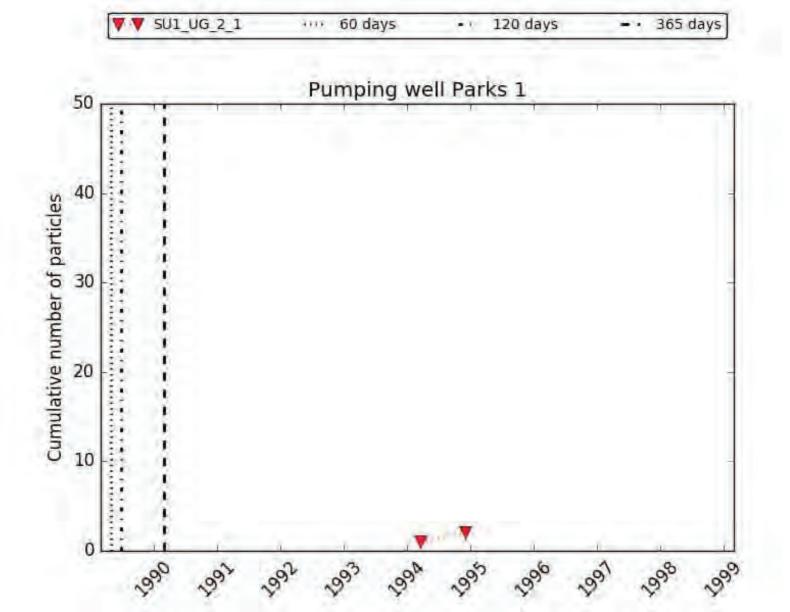


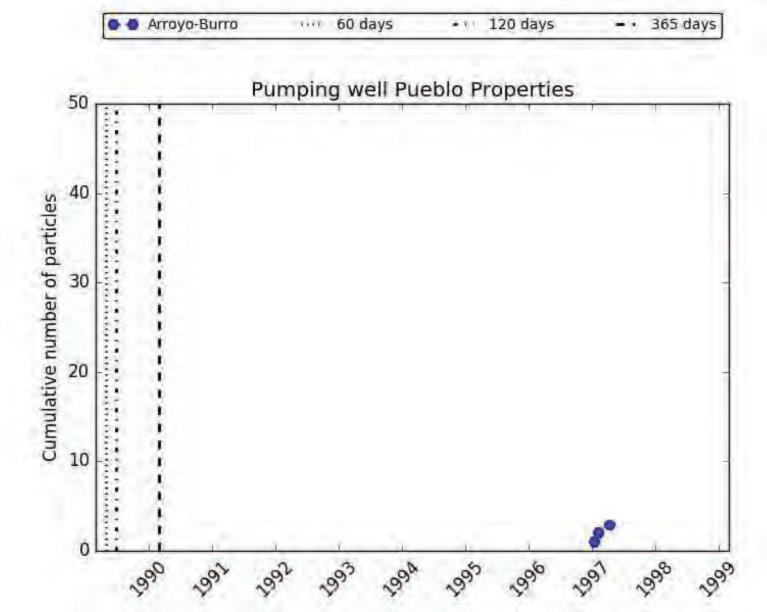


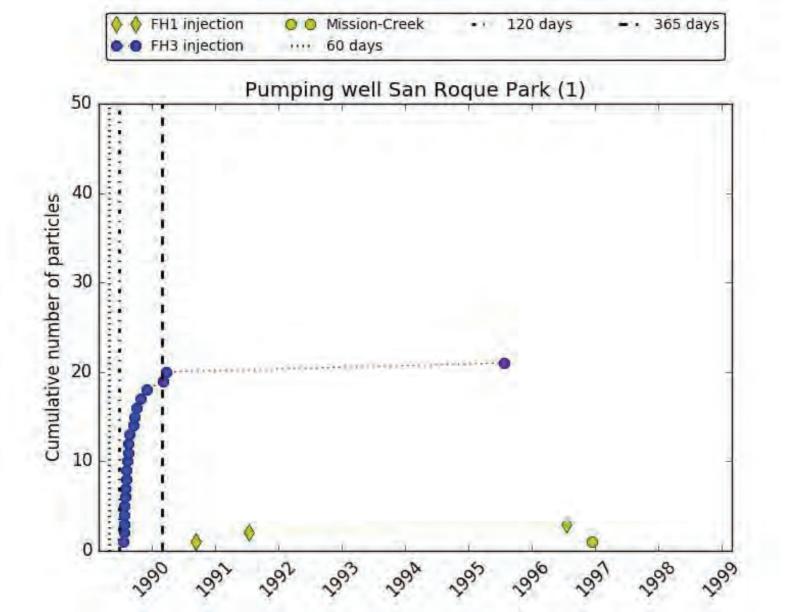


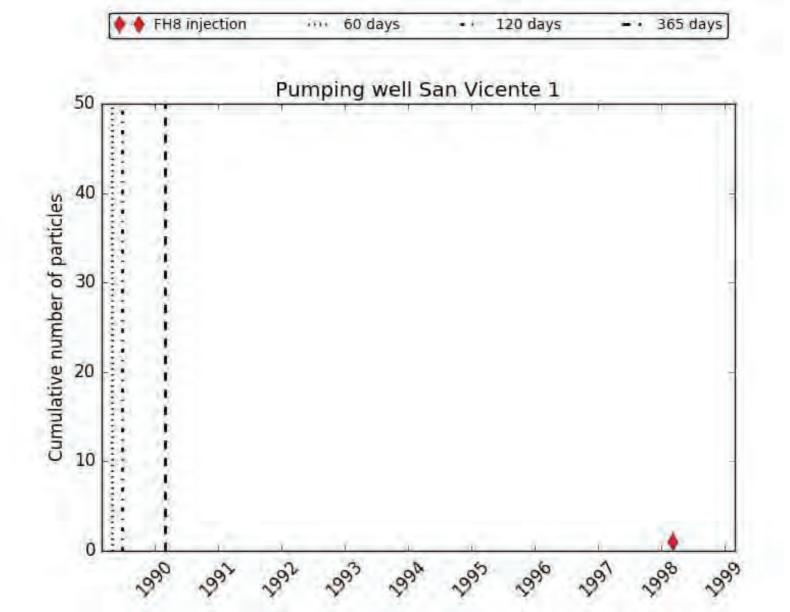


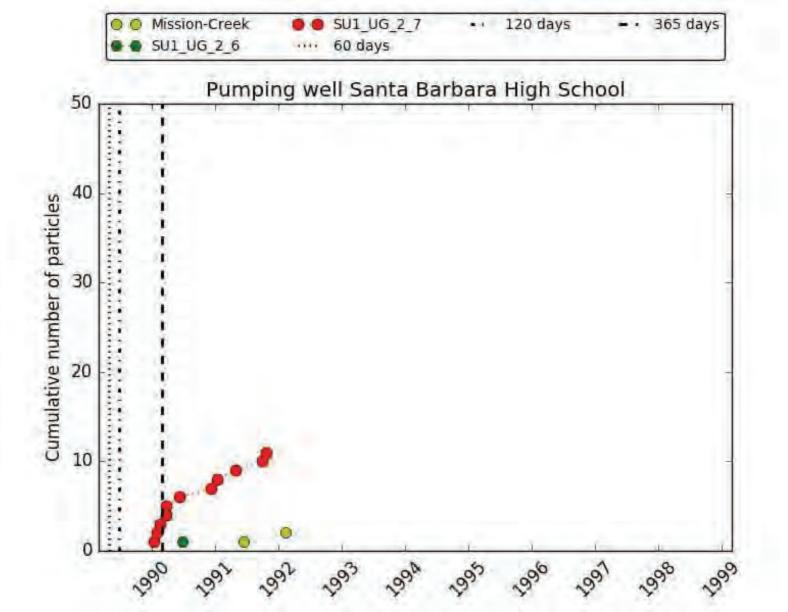


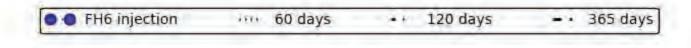


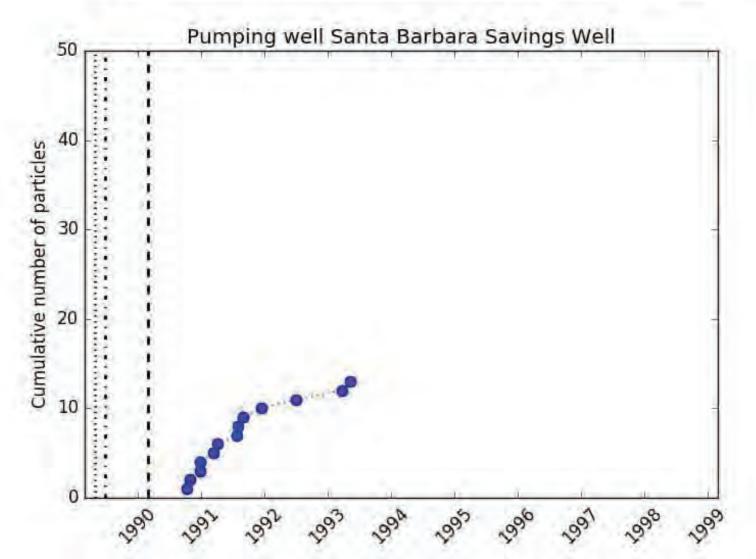


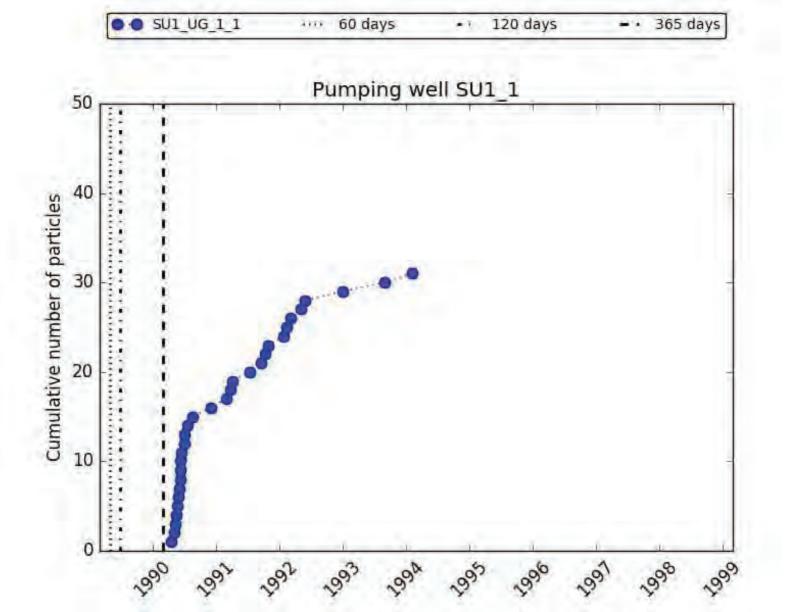


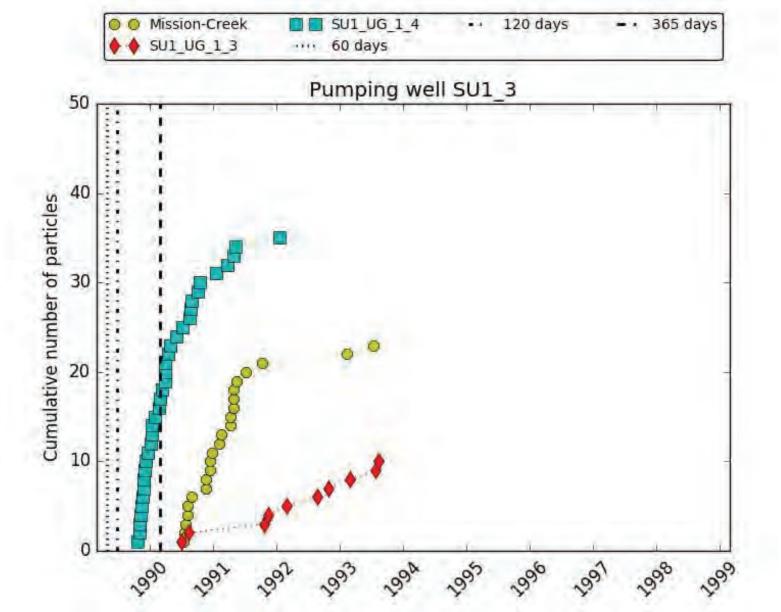


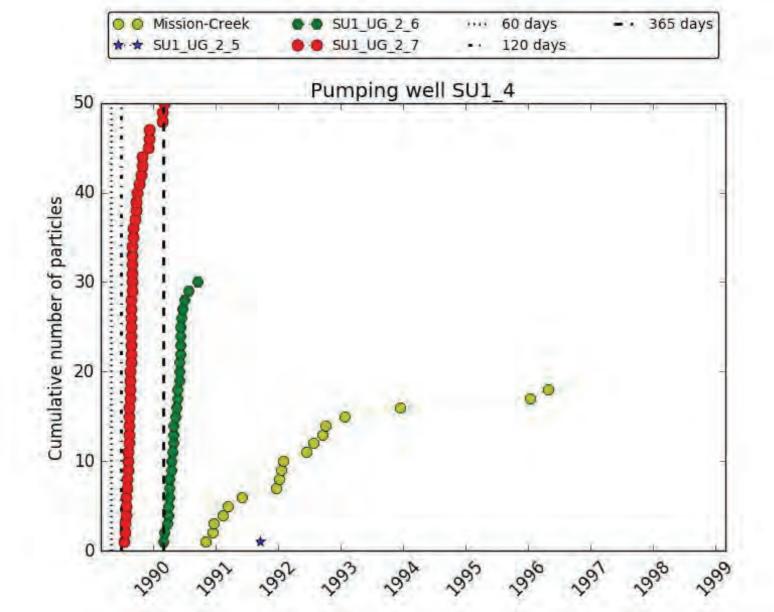


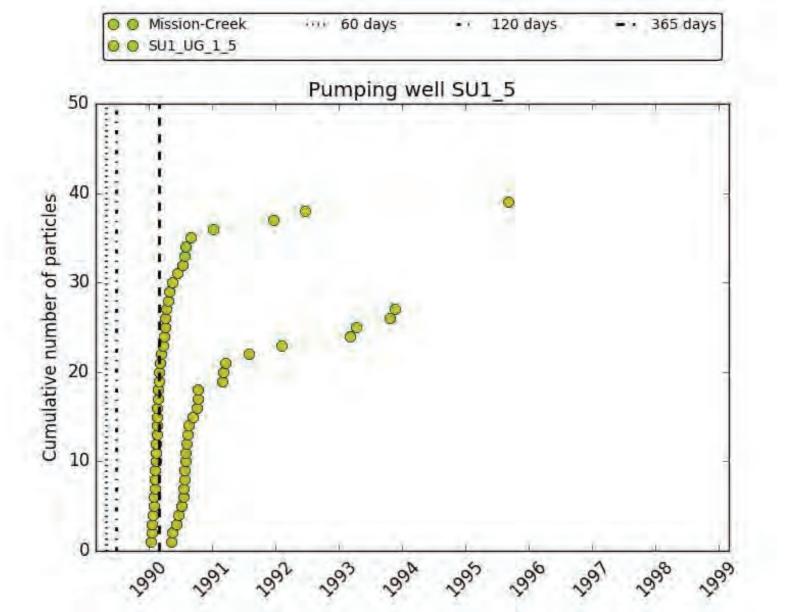


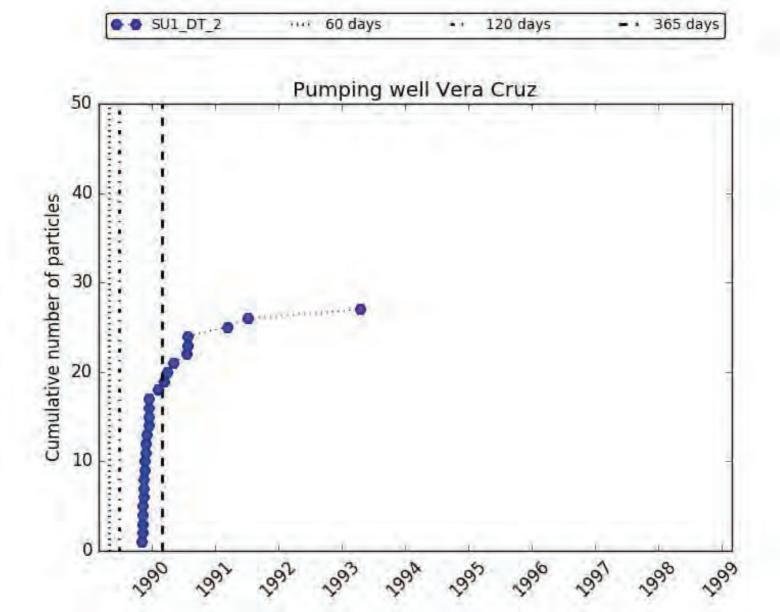












Appendix E: Groundwater Pumping Rates from Specific Wells

The following tables show annual groundwater pumping rates for specific wells as simulated by the groundwater model.

	Alameda	City Hall	Corp Yard 1	Hope Ave	Los Robles	San Roque1	SB High School	Vera Cruz
*1986	0.00	454.78	435.39	0.00	161.60	0.00	0.00	403.09
1987	0.00	174.64	154.69	0.00	249.56	0.00	0.00	59.75
1988	0.00	144.38	135.41	0.00	460.42	0.00	0.00	11.69
1989	0.00	483.16	430.44	0.00	458.85	0.00	0.00	510.31
1990	0.00	620.76	420.60	0.00	390.04	0.00	0.00	772.20
1991	2.19	3.08	11.34	55.98	163.27	4.59	0.00	6.12
1992	1.85	4.34	7.92	4.56	1.70	0.96	0.00	5.65
1993	2.81	12.31	173.31	5.99	4.02	0.00	0.00	5.72
1994	0.00	14.75	7.89	7.97	6.24	0.00	0.00	0.00
1995	0.00	3.53	3.58	1.80	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	24.19	0.00	0.00	122.58	60.81	0.00	0.00	0.00
1999	133.26	0.00	0.00	125.15	61.40	0.00	0.00	0.00
2000	90.50	0.00	0.00	131.95	95.63	0.00	0.00	0.00
2001	0.00	0.00	0.00	7.37	0.00	0.00	0.00	0.00
2002	36.72	166.95	59.53	30.70	30.68	0.00	0.00	0.00
2003	53.39	125.67	65.67	20.00	20.76	0.00	0.00	0.00
**2004	2.00	3.48	3.70	1.55	3.77	0.00	0.00	0.00
Total	346.91	2,211.81	1,909.46	515.61	2,168.76	5.55	0.00	1,774.52

Appendix E-1. Baseline Pumping Scenario (Alt 1A) – Annual Pumping Rates in Acre-Feet for Select City Owned Wells, Simulated by the Groundwater Model.

Notes: *1986 simulated only the months March-December **2004 simulated only the month of January

Appendix E-2. Increased Pumping Scenario (Alt 1B) – Annual Pumping Rates in Acre-Feet for Select City Owned Wells, Simulated by the Groundwater Model.

	Alameda	City Hall	Corp Yard 1	Hope Ave	Los Robles	San Roque1	SB High School	Vera Cruz
*1986	508.02	508.02	1,092.64	278.20	92.73	471.73	251.32	725.74
1987	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1988	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1989	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1990	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1991	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1992	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1993	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1994	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1995	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89

	Alameda	City Hall	Corp Yard 1	Hope Ave	Los Robles	San Roque1	SB High School	Vera Cruz
1996	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1997	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1998	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
1999	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
2000	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
2001	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
2002	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
2003	609.62	609.62	1,311.17	333.84	111.28	566.08	301.58	870.89
**2004	50.80	50.80	109.26	27.82	9.27	47.17	25.13	72.57
Total	10,922.37	10,922.37	23,491.76	5,981.30	1,993.77	10,142.20	5,403.39	15,603.38

Notes: *1986 simulated only the months March-December **2004 simulated only the month of January

Appendix E-3. Annual Pumping Rates in Acre-Feet for Proposed IPR Recovery Wells, Simulated by the Groundwater Model.

	SU1_1	SU1_3	SU1_4	SU1_5	FH_2	FH_3
*1986	311.97	516.24	427.33	503.70	752.74	1,020.46
1987	374.36	619.48	512.80	604.44	903.28	1,224.56
1988	374.36	619.48	512.80	604.44	903.28	1,224.56
1989	374.36	619.48	512.80	604.44	903.28	1,224.56
<i>1990</i>	374.36	619.48	512.80	604.44	903.28	1,224.56
1991	374.36	619.48	512.80	604.44	903.28	1,224.56
1992	374.36	619.48	512.80	604.44	903.28	1,224.56
<i>1993</i>	374.36	619.48	512.80	604.44	903.28	1,224.56
1994	374.36	619.48	512.80	604.44	903.28	1,224.56
1995	374.36	619.48	512.80	604.44	903.28	1,224.56
1996	374.36	619.48	512.80	604.44	903.28	1,224.56
1997	374.36	619.48	512.80	604.44	903.28	1,224.56
1998	374.36	619.48	512.80	604.44	903.28	1,224.56
1999	374.36	619.48	512.80	604.44	903.28	1,224.56
2000	374.36	619.48	512.80	604.44	903.28	1,224.56
2001	374.36	619.48	512.80	604.44	903.28	1,224.56
2002	374.36	619.48	512.80	604.44	903.28	1,224.56
2003	374.36	619.48	512.80	604.44	903.28	1,224.56
**2004	31.20	51.62	42.73	50.37	75.27	102.05
Total	6,707.29	11,099.10	9,187.65	10,829.49	16,183.83	21,939.97

Notes: *1986 simulated only the months March-December **2004 simulated only the month of January

	Calvary Cemetery	El Sueno	LCMWC Well#9	LCMWC Well#16	Lincoln- wood 1	MacKenzie #1	MacKenzie #2	Pueblo Properties	San Roque Park #2	San Vincente 1	San Vincente 2	SB Savings	Sunset Mutual	Westpac Shelter
*1986	29.10	3.21	0.00	284.67	10.11	0.00	492.28	3.21	0.00	28.36	28.36	0.74	16.77	0.00
1987	34.92	3.85	0.00	331.30	12.13	0.00	587.25	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1988	34.92	3.85	0.00	280.48	12.13	0.00	426.10	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1989	34.92	3.85	0.00	248.37	12.13	0.00	224.36	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1990	34.92	3.85	0.00	208.62	12.13	0.00	113.46	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1991	34.92	3.85	0.00	173.31	12.13	0.00	80.42	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1992	34.92	3.85	0.00	222.21	12.13	0.00	2.42	3.85	0.00	34.03	34.03	0.89	20.12	0.00
1993	0.00	0.00	0.00	177.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	355.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	362.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	334.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	328.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	384.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	346.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	336.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	128.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	287.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	184.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
**2004	0.00	0.00	0.00	23.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	238.61	26.29	0.00	4,997.46	82.91	0.00	1,926.28	26.29	0.00	232.54	232.54	6.07	137.50	0.00

Appendix E-4. Annual Pumping Rates in Acre-Feet for Non-City Owned Wells, Simulated by the Groundwater Model.

Notes: *1986 simulated only the months March-December **2004 simulated only the month of January

Appendix F: Contaminated Sites Located within 1 Mile of IPR Facilities

GeoTracker ID	Site Name	<u>COCs¹</u>	<u>Status</u>	Status Date
	FESS PARKER			
SL0608309049	WATERFRONT HOTEL	MTBE, Arsenic	Open - Remediation	1/24/2013
	SANTA BARBARA		Open - Verification	
SL0608328911	DISTRIBUTION BASE	Cyanide, PAHs	Monitoring	2/14/2001
			Open - Site	
SL0608336671	MCCORMIX CORPORATION	Diesel	Assessment	10/1/2003
	FORMER PRINTING		Open - Site	
SL0608371607	IMPRESSIONS	PCE, TCE	Assessment	10/26/2015
	FIVE POINTS SHOPPING		Open - Verification	
SL0608378294	CENTER	PCE	Monitoring	6/26/2014
	FORMER SCHAUER		Open - Verification	
SL0608395538	PRINTING	PCE	Monitoring	4/1/2014
	MISSION		Open - Assessment &	
	INDUSTRIES/AMBASSADOR	PCE, TCE, Vinyl	Interim Remedial	
SL203061244	LAUNDRY	chloride	Action	5/13/2009
	Santa Barbara			
SL203341272	Manufactured Gas Plant	TPH, PAHs, BTEX	Open - Remediation	1/1/2003
	CARRILLO PLAZA (former		Open - Verification	
SLT3S0241288	Norvell-Bass Dry Cleaner)	PCE	Monitoring	4/25/2014
	Tecknit/ Tube Holding			
SLT3S0391292	Company	TCE, PCE	Open - Remediation	4/1/1994
			Open - Site	
SLT3S0491297	GOLDBERG/GOSS-JEWETT	PCE	Assessment	5/11/2009
		PCE, MTBE / TBA /	Open - Assessment &	
		Other Fuel	Interim Remedial	
SLT3S0511299	DUTCH MAID CLEANERS	Oxygenates	Action	5/11/2009
	SANTA BARBARA CITY		Open - Verification	
SLT3S2371349	PARKING LOT #12	PCE, TCE, TCA	Monitoring	6/17/2003
			Open - Site	
T0608300020	S.B. City Police Station	Gasoline	Assessment	4/25/2013
T0608300026	Park's Texaco Market	Gasoline	Open - Remediation	2/17/1990
			Open - Assessment &	
	American Contracting		Interim Remedial	
T0608300139	Service	Gasoline	Action	3/15/2013
			Open - Verification	
T0608300183	Mobil Oil	Gasoline	Monitoring	12/26/1996
			Open - Site	
T0608300216	Ingram Paper	Gasoline	Assessment	4/20/1989
T0608300489	Dougs Bougs	Gasoline	Open - Remediation	6/1/2007
			Open - Verification	
T0608300587	Mobil Oil Station #11-KRA	Gasoline	Monitoring	4/10/2015
		Gasoline, Waste Oil /		
	ExxonMobil Oil Corp	Motor / Hydraulic /		
T0608300588	ss#18-KFK	Lubricating	Open - Remediation	8/14/2013
T0608300624	Shell - Turnpike	Gasoline	Open - Remediation	9/21/2015
			, · · ·	

Appendix F-1. Open Contaminated Sites Affecting Groundwater Located within 1 Mile of IPR Facilities

FINAL DRAFT Technical Feasibility Evaluation Hydrogeologic Analysis of Potable Reuse Alternatives

GeoTracker ID	Site Name	COCs ¹	<u>Status</u>	Status Date
		MTBE / TBA / Other		
		Fuel Oxygenates,		
T0608300676	Canon Perdido Car Wash	Gasoline	Open - Remediation	3/31/2014
T0608300695	Porter Auction Company	Gasoline	Open - Remediation	5/30/2015
T0608300749	Seaside Shell - UST Spill	Gasoline	Open - Remediation	2/12/2012
		MTBE / TBA / Other		
		Fuel Oxygenates,		
T0608316772	Educated Car Wash	Gasoline	Open - Remediation	7/1/2013
		Gasoline, Stoddard		
		solvent / Mineral	Open - Site	
T0608323816	Petre Industries	Spirits / Distillates	Assessment	12/17/2002
T0608348535	Gold's Gym	Gasoline	Open - Remediation	7/1/2013
		MTBE / TBA / Other		
		Fuel Oxygenates,	Open - Site	
T0608368725	Former Chevron Station	Gasoline	Assessment	3/1/2003
			Open - Site	
T0608374511	FORMER UNOCAL #0957	Gasoline	Assessment	12/2/2003
			Open - Site	
T0608374992	Pep Boys Store #623	Gasoline	Assessment	5/11/2009
T0608386520	MOBIL OIL #11-EP9	Gasoline	Open - Remediation	7/20/2015
			Open - Assessment &	
			Interim Remedial	
T1000000578	Regal Dry Cleaners	PCE	Action	5/13/2010
	In & Out Paint and			
T10000001599	Collision Center	PCE, TCE, Lead	Open - Remediation	3/4/2010
			Open - Assessment &	
740000000770		Constinue	Interim Remedial	5 (A (201 A
T10000002779	Former Shell Station	Gasoline	Action	5/1/2014
	Sri Padma LLC (formerly known as City Block and	Other Solvent or Non- Petroleum	Open Site	
T10000003790	Phantom Cargo)	Hydrocarbon	Open - Site Assessment	5/19/2012
11000003730			Open - Site	5/19/2012
T10000003938	PRIVATE RESIDENCE	Lead	Assessment	5/26/2012
110000003338	CHASE PALM PARK	TPH, PCE, Lead,	Open - Site	5/20/2012
T10000005202	EXTENSION PROJECT	Arsenic	Assessment	7/1/2015
.10000000202	Former Standard Oil Bulk		Open - Site	., _, _, _, _, _, _, _,
		ТРН		9/19/2014

Notes: ¹ BTEX = benzene, toluene, ethylbenzene, and xylenes, MTBE = methyl tert-butyl ether, PAHs = polynuclear aromatic hydrocarbons, PCE = tetrachloroethylene, TBA = terbuthylazine, TCA = 1,1,1-trichloroethane, TCE = trichloroethylene, TPH = total petroleum hydrocarbons

Bold and Italic indicates site located within 1,500 feet of Proposed IPR Well

GeoTracker ID	Site Name	<u>COCs¹</u>	<u>Status</u>	Status Date
SLT3S0381291	FENN, FORMER DRY CLEANERS	PCE	Open - Verification Monitoring	3/17/2004
T10000005551	El Estero Turtle Pond (A.K.A. El Estero Drain)	Arsenic, Lead, Mercury, PAHs, TPH	Open - Remediation	1/8/2014
T10000005625	City of Santa Barbara Former Parking Lot 6	Lead, TPH, pesticides, PAHs	Open - Site Assessment	2/11/2002
T10000006176	TRANSITION HOUSE PROJECT	Arsenic, Lead, Other Metal	Open - Remediation	12/12/2010
T1000006182	BLACKSMITH SHOP	Lead, TPH	Open - Remediation	8/12/2015
T1000006225	HWY 101 EXPANSION PROJECT	Lead	Open - Site Assessment	3/1/2007
T1000006234	BOYS & GIRLS CLUB OF SANTA BARBARA	PAHs	Open - Remediation	1/1/2013
T1000006273	MTD FACILITY	Cyanide, TPH	Open - Verification Monitoring	3/16/2016
T1000006339	TPG Chapala Tanks	Gasoline	Open - Verification Monitoring	4/19/2016
T10000006599	411 Quarantina St, N - USTs	Gasoline, MTBE / TBA / Other Fuel Oxygenates, BTEX, TPH	Open - Site Assessment	3/26/2015
T1000007248	Miratti Trust Property	Gasoline, TPH	Open - Site Assessment	8/10/2015
T10000007909	Fire Training Facility	ТРН	Open - Assessment & Interim Remedial Action	10/27/2015
T1000007943	City Desalination Plant	ТРН	Open - Assessment & Interim Remedial Action	11/6/2015
T1000008825	Arlington Village	ТРН	Open - Active	2/26/2016

Appendix F-2. Open Contaminated Sites Affecting Soil Located within 1 Mile of IPR Facilities

Notes:

¹ BTEX = benzene, toluene, ethylbenzene, and xylenes, MTBE = methyl tert-butyl ether, PAHs = polynuclear aromatic hydrocarbons, PCE = tetrachloroethylene, TBA = terbuthylazine, TPH = total petroleum hydrocarbons

Bold and Italic indicates site located within 1,500 feet of Proposed IPR Injection Well

City of Santa Barbara

APPENDIX D – CONCEPTUAL DESIGNS

Table 1Process Flow RatesSubsurface Desalination	•		bility Studies
City of Santa Barbar	a		
Description		Direct Pota	
Description	Units	Capad	cities
Source and Finished Water Flows			~ ~
City Secondary Effluent	AFY	8,6	
City Secondary Effluent	gpm (mgd)	5,369	(7.7)
Process Flows: AWTF/NPR			
Microfiltration	0/	04	0/
	%	94	
Permeate Flow	gpm (mgd)	5,369	(7.7)
Feedwater Flow ¹	gpm (mgd)	5,712	(8.2)
Backwash Flow	gpm (mgd)	343	(0.5)
Pre RO UV System			
Process Flow	gpm (mgd)	5,369	(7.7)
Process Flows: East NPR			
Flow to East NPR System ²	gpm (mgd)	444	(0.6)
Process Flows: AWTF			
Reverse Osmosis			
Recovery	%	80	%
Permeate Flow	gpm (mgd)	3,940	(5.7)
Feedwater Flow	gpm (mgd)	4,925	(7.1)
Brine Flow	gpm (mgd)	985	(1.4)
UV / AOP			
Process Flow	gpm (mgd)	3,940	(5.7)
Total Finished Water Flows			· ·
Total NPR Flow	gpm (mgd)	444	(0.6)
Total DPR Flow	gpm (mgd)	3,940	(5.7)
Total Usable Flow	gpm (mgd)	4,384	(6.3)
Total NPR Flow	AFY	71	
Total DPR Flow	AFY	6,3	
Total Usable Flow	AFY	7,0	
Recovery of WWTP Effluent	%	82	
Notes:			

Notes:1) MF backwash is recycled to head of WWTP. Instantaneous flow is higher than permeate flow.2) After MF and UV, flow is diverted to satisfy East NPR demand.

Table 2 DPR - Microfiltration Feed P		
Subsurface Desalination Inta City of Santa Barbara	ake and Potable Re	use Feasibility Studies
Description	Units	Criteria
MICROFILTRATION FEED PUMPS		
Number of Pumps		
In-Service	No.	4
Reliability	No.	1
Total	No.	5
Type: Vertical Turbine		
Capacity		
Total	gpm	5,712
Per Pump	gpm	1,428
Total Dynamic Head Required (TDH)		
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	63
Selected	hp	100
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS		
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	984
Maximum (1.5*Flux Rate)	gpm	1,582
Total Dynamic Head Required (TDH)	0.	
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

Table 2DPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara						
Description	Units	Criteria				
INFLUENT WET WELL						
Number of Wet Wells	No.	1				
Wet Well Dimensions (each)	Wet Well Dimensions (each)					
Depth	ft	15				
Length	ft	62				
Width	ft	18				
Volume	ft ³	16,740				
Volume	gallons	125,215				
Storage Time						
Design Flow	Minutes	22				

Table 3 DPR - Strainer / Pre-Screen	Design Criteria					
Subsurface Desalination Int	ake and Potable Reuse Fe	easibility Studies				
City of Santa Barbara	City of Santa Barbara					
Description	Units	Criteria				
Type: Filter (Strainer-type) w/ Automatic Clear	ning Mechanism					
Materials: Stainless Steel						
Filter Rating	micron	250				
Maximum Pressure Drop						
Clean Filter ⁽¹⁾	psi	3				
Before Backwash ⁽²⁾	psi	7				
Number of Filters						
In-Service	No.	2				
Reliability	No.	1				
Total	No.	3				
Capacity (Total)	gpm	5,712				
Capacity (per Screen)	gpm	2,856				
Filter Media Type:	-	Wedgewire				
Filter Material:	-	316 SST				
Maximum Backwash Flowrate	gpm	310				
Backwash Duration	min	1				
Total Backwash Waste	gal	310				
Housing Design Pressure	psi	150				
Motor Size						
Selected	hp	0.33				
Drive	type	CS				

Table 4 DPR - Microfiltration Train Design			_	
Subsurface Desalination Intake an City of Santa Barbara	id Potable Reuse	• Feasibility	Studies	
Description	Units	Crite	eria	
General Criteria				
Type: Pressurized, Polymeric hollow fiber Microfiltratio	n			
or Ultrafiltration ¹				
Operating Strategy: Dead end flow				
Number of Microfiltration Trains				
In-Service	No.	6		
Reliability	No.	1		
Total	No.	7		
Production Criteria				
Train Flux Rate				
Flux at Design Capacity (Net Production)	gfd	30)	
Flux at Design Capacity (Instantaneous)	gfd	35	5	
Train Recovery Rate (Permeate/Feed Flow)				
Minimum	percent	94	%	
Train Permeate Flow Rate				
Total	gpm (mgd)	5,369	(7.7)	
Design	gpm (mgd)	895	(1.3)	
Train Configuration				
Type: Open Platform (Non-proprietary)				
Membrane Manufacturer (No. 1)		Tor	ay	
Module Model Number		202	0N	
Membrane Area per Module		77	5	
Number of Installed Modules per Train	No.	56	6	
Number of Blank Modules per Train	No.	8		
Number of Total Module Spaces per Train	No.	64	1	
Backwash Criteria				
Type: Reverse Flow Followed by Simultaneous Air				
Scour and Drain				
Backwash Interval per Train				
Minimum	minutes	20		
Maximum	minutes	30)	
Backwash Supply Flow Rate (Water)			_	
Flux	gfd	46		
Flow	gpm	1,5		
Backwash Duration	sec	sec 45		
Backwash Supply Flow Rate (Air)	scfm	44	8	
Volume of Wastewater Produced				
Per Backwash	gallons	1,1	87	

Table 4 DPR - Microfiltration Train Design (Criteria	
Subsurface Desalination Intake and	d Potable Reuse	Feasibility Stu
City of Santa Barbara		
Description	Units	Criteria
Maintenance Clean Criteria (Typically only hypo		
<u>clean)</u>		
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		

Membrane must demonstrate a minimum of 1 log virus removal.
 Calculated as 1.5 times the sodium hypochlorite dose. Stoichiometric demand is 1.34 mg sodium bisulfite per 1 mg of sodium hypochlorite.

gallons

gallons

mg/L

mg/L

mg/L

2,500 17,500

450

4,500

5,000

Per Train

Per Month

Notes:

<u>Chemical Neutralization Criteria</u> Sodium Bisulfite Dose MC²

Sodium Bisulfite Dose CIP²

Sodium Hydroxide CIP

Table 5 DPR - M	DPR - Microfiltration Backwash Air Scour Blowers Design Criteria		
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of S	Santa Barbara		
Description	Units	Criteria	
Type: Rotary Lobe			
Number of Blowers			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Discharge Pressure	psi	13	
Air Flow Rate	scfm		
Design	scfm	392	
Maximum	scfm	448	
Motor Size			
Required	hp	32	
Selected	hp	50	
Drive	type	VFD	

Table 6 DPR - Ultraviolet	t Disinfection Design Criteria		
Subsurface Des	alination Intake and Potable Reu	se Feasibility	Studies
City of Santa Ba	rbara		
Description	Units	Crite	eria
Process Type: Low Pressure High	Output Ultraviolet Light Reactor		
Manufacturer(s): Wedeco			
Model(s): spektron 4000e w/ 600 w	/att		
lamps			
Number of UV Reactors			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Flows			
Total Flow to Reactors	gpm (mgd)	5,369	(7.7)
Flow to Each Reactor	gpm (mgd)	5,369	(7.7)
UV Transmittance (UVT)	percent	90)
UV Dose ⁽¹⁾	mJ/cm ²	11	0
Note:			
1) Dose required to achieve 4-log viru	us and 4-log protozoa inactivation.		

Table 7DPR - RO Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	4,925	
Per Pump	gpm	1,231	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	116	
Required (based on maximum discharge	_		
pressure)	hp	138	
Selected	hp	150	
Drive	type	VFD	
WET WELL			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time			
Design Flow	Minutes	18	

Table 8DPR - Reverse Osmosis Trains Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Cri	teria
Number of Reverse Osmosis Trains			
In-Service	No.		4
Reliability	No.		0
Total	No.		4
Train Flux Rate ⁽¹⁾	gfd		11
Recovery (Permeate/Feed Flow)	percent	8	0%
Total Permeate Flow	gpm (mgd)	3,940	(7.1)
Total Permeate Flow per Train	gpm (mgd)	985	(1.4)
Brine Flow per Train	gpm (mgd)	246	(0.35)
Number of Array Stages Per Train	No.		2
1st Stage			
Pressure Vessels per Train	No.	31	
Elements per Pressure Vessel	No.	7	
2nd Stage			
Pressure Vessels per Train	No.		16
Elements per Pressure Vessel	No.		7
Number of Elements			
Per Train	No.	3	29
Total (In-Service)	No.	,	316
Mambrana Manufaaturar(a) (2)			ilmTec,
Membrane Manufacturer(s) ⁽²⁾	_	•	uatics, or
		Toray BW30-400/34i,	
Membrane Model No. (2)		ESPA2-LD, or	
	-	TML20D-400	
Membrane Area ⁽²⁾			
Per Element	sq. ft.	4	00
Per Train	sq. ft.	131	,600
Total (In-service)	sq. ft.	526,400	

•	Booster Pump Design	
Subsurface Desalina City of Santa Barbara		e Reuse Feasibility Studies
Description	Units	Criteria
Type: Turbine assisted motorized boos	ter pump	
Manufacturer: FEDCO		
Model: LP-HEMI, LPH-240-125T		
LP-HEMI Units Per RO Train	No.	1
Total Number of Units	No.	4
Pump Data		
Stages	No.	1
Flow		
At 80 Percent RO Recovery	gpm	568
Minimum Total Dynamic Head ⁽¹⁾ Maximum Total Dynamic Head	ft	70
(2)	ft	120
Shaft Power		
Minimum Required	hp	13
Maximum Required	hp	22
Motor Data	-	
Drive	type	VFD
Position: Vertical		
Power Rating	hp	25
Notes:		
1) Clean-membrane (start-up) conditions.		
2) Fouled membrane (end of life), worst wa	ater quality conditions.	

Table 10	DPR - UV Disinfect	ion / AOP Design Criteria		
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
	City of Santa Barba	ara		
	Description	Units	Crite	eria
Process Type:	Low Pressure High Ou	tput Ultraviolet Light Reactor w	/ NaOCI AOP	
Manufacturer(s): Wedeco			
Model(s): k143	3 w/ 600 watt lamps			
Number of UV	Reactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow to	Reactors	gpm (mgd)	3,940	(5.7)
Flow to Each	Reactor	gpm (mgd)	3,940	(5.7)
UV Transmitta	nce (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	92	0
NaOCI Dose		mg/L	4	
Note: 1) Dose require process.	ed to achieve 6-log virus a	and 6-log protozoa inactivation usir	ng hypochlorite f	or the AOP

Table 11Direct Potable Reuse Train - Storage and Equalization Tanks Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Sente Perhans			
City of Santa Barbara Description	Units	Criteria	
ENGINEERED STORAGE TANKS	Unito	entona	
Product Flow	gpm	3,940	
Number of Tanks	No.	2	
Tank Dimensions	-		
Diameter	ft	70	
Height	ft	35	
Volume (each)	ft ³	134,696	
Volume (each)	gallons	1,007,524	
Volume (actual)	gallons	1,000,000	
Volume (total)	gallons	2,000,000	
Storage Time (w/ one tank out of service)	0	, ,	
Design Flow	Minutes	254	
Design Flow	Hours	4	
Storage Time (total)			
Design Flow	Minutes	508	
Design Flow	Hours	8	
Description	Units	Criteria	
EQUALIZATION TANKS			
Product Flow	gpm	5,369	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	82	
Height	ft	35	
Volume (each)	ft ³	184,836	
Volume (each)	gallons	1,382,570	
Volume (actual)	gallons	1,500,000	
Volume (total)	gallons	3,000,000	
Storage Time (each)			
Design Flow	Minutes	279	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	559	
Design Flow	Hours	9	

City of Santa Barbara Description	Units	Criteria
FINISHED WATER PUMPS TO GOLF COURSE PS	Units	Citteria
Number of Pumps		
In-Service	No.	3
	No.	1
Reliability Total	No.	4
	INO.	4
Type: Vertical Turbine Capacity		
Total	apm	3,940
Per Pump	gpm	1,313
Total Dynamic Head Required (TDH)	gpm	1,515
Head required to reach reservoir	feet	573
Average Pump TDH	feet	593
Maximum Pump TDH	feet	623
Average operating Required (based on maximum discharge pressure) Selected Drive GOLF COURSE PS TO LAURO CANYON RESERVOIR	hp hp hp type	246 258 275 VFD
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	3,940
Per Pump	gpm	1,313
Total Dynamic Head Required (TDH)	01	
Head required to reach reservoir	feet	346
Average Pump TDH	feet	366
Maximum Pump TDH	feet	396
Motor Size		
Average operating	hp	152
Required (based on maximum discharge pressure)	hp	164
Selected	hp	175
Drive	type	VFD

Table 13Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Sodium Hypochlorite Characteristics			
Concentration:	10.5 %		
Specific Gravity:	1.008		
Solution Strength:	0.88	lb/gal	
Parameters	Units	Criteria	
Ultraviolet Light / Advanced Oxidation Pr	OCESS		
Chemical Usage			
Location: RO Permeate Before UV Rea	ictors		
Process Flow	MGD	5.7	
Chemical Dose	mg/L	4.0	
Chemical Usage	lb/day	189	
Chemical Feed Rate	gpd	215	
Chemical Feed Rate	gph	9.0	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	9.0	
MF/UF Maintenance Cleans (MC)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	300	
Chemical Usage	lb/day	43.8	
Chemical Feed Rate	gpd	49.7	
MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	3,000	
Chemical Usage	lb/month	438.1	
Chemical Feed Rate	gpm	497.2	
Chemical Feed Rate	gpd	16.6	

Table 13Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara				
Parameters	Units	Criteria		
Bulk Storage Tanks				
Number of Tanks	No.	2		
Tank Capacity, each	gal	4,000		
Tank Capacity, total	gal	8,000		
UV/AOP Usage	gal/day	215		
MF/UF Maintenance Clean	gal/day	49.7		
MF/UF CIP	gal/day	16.6		
Total Usage	gal/day	281		
Storage Time	days	28		
Delivery Truck Full Load	gal	3,000		
Time Between Delivery	days	11		

Table 14 Sulfuric Acid Desig	gn Criteria	
Subsurface Desalir	nation Intake and	Potable Reuse Feasibility Studies
City of Santa Barba	ara	
Sulfuric Acid Characteristics		
Concentration:	93 %	
Specific Gravity:	1.83	
Solution Strength:	14.17	lb/gal
Parameters	Units	Criteria
DPR RO Pretreatment		
Chemical Usage		
Location: Reverse Osmosis Feed		
Process Flow	MGD	7.1
Chemical Dose	mg/L	115
Chemical Usage	lb/day	6,806
Chemical Feed Rate	gpd	480
Chemical Feed Rate	gph	20.0
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	20.0
Bulk Storage Tanks		
Number of Tanks	No.	2
Tank Capacity, each	gal	8,000
Tank Capacity, total	gal	16,000
Total Usage	gal/day	480
Storage Time	days	33
Delivery Truck Full Load	gal	3,000
Time Between Delivery	days	6

Table 15Lime Slurry Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara				
Lime Characteristics				
Lime Purity	%	97%		
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30		
Concentration:	%	35%		
Specific Gravity:		1.271		
Solution Strength:	lb/gal	3.70		
Parameters	Units	Criteria		
DPR Post Treatment				
Chemical Usage				
Location: Before Treated Water Wet Well				
Process Flow	MGD	5.7		
Chemical Dose	mg/L	25		
Chemical Dose (as stored weight)	mg/L	26		
Chemical Usage	lb/day	1,220		
Chemical Feed Rate	gpd	329		
Chemical Feed Rate	gph	13.7		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	13.7		
Lime Storage Silos				
Number of Silos	No.	1		
Silo Capacity, each	cu ft	2,500		
Silo Capacity, each	lbs	75,000		
Silo Capacity, total	Tons	37.5		
Silo Diameter, each	ft	13		
Silo Sideshell Height, each	ft	19		
Dry Usage	lbs/day	1,220		
Dry Usage	tons/day	0.6		
Storage Time	days	61		
Delivery Truck Full Load	tons	24		
Time Between Delivery	days	39		

Table 16Scale Inhibitor Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Scale Inhibitor Characteristics			
Manufacturer/Product:	Avista Vitec 3000		
Concentration:	100 %		
Specific Gravity:	1.2		
Solution Strength:	9.99	lb/gal	
Parameters	Units		Criteria
DPR - RO Pretreatment			
Chemical Usage			
Location: Reverse Osmosis Fo	eed		
Process Flow	MGD		7.1
Chemical Dose	mg/L		4.0
Chemical Usage	lb/day		237
Chemical Feed Rate	gpd		24
Chemical Feed Rate	gph		1.0
No. of Standby Pumps	-		1
No. of Pumps in Service	-		1
Chemical Feed Rate Per Pump	gph		1.0
Chemical Feed Rate Per Pump	gpm		0.02
Bulk Storage Totes			
Number of Totes	No.		4
Tote Capacity, each	gal		250
Tote Capacity, total	gal		1,000
DPR RO Pretreatment	gal/day		24
Total Usage	gal/day		24
Storage Time	days		42
Delivery Truck Full Load	gal		250
Time Between Delivery	days		11

Table 17 Citric Acid Design Crit	eria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara		-		
Citric Acid Characteristics				
Concentration:	50 %			
Specific Gravity:	1.15			
Solution Strength:	4.79	lb/gal		
Parameters	Units	Criteria		
MF/UF Clean-in-Place (CIP)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	5,000		
Chemical Usage	lb/month	730.2		
Chemical Feed Rate	gpm	152.5		
Chemical Feed Rate	gpd	5.1		
Bulk Storage Totes				
Number of Totes	No.	2		
Tote Capacity, each	gal	250		
Tote Capacity, total	gal	500		
MF/UF CIP	gal/month	152.5		
Total Usage	gal/month	152.5		
Storage Time	days	98		
Delivery Truck Full Load	gal	250		
Time Between Delivery	days	49		

Table 18 Caustic Soda Design Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Caustic Soda Characteristics			
Concentration:	50 %		
Specific Gravity:	1.53		
Solution Strength:	6.37	lb/gal	
Parameters	Units	Criteria	
MF/UF Clean-in-Place (CIP) (neutralize CA)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	730.2	
Chemical Feed Rate	gpm	114.6	
Chemical Feed Rate	gpd	3.8	
Bulk Storage Tote			
Number of Totes	No.	2	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	500	
MF/UF CIP	gal/month	114.6	
Total Usage	gal/month	114.6	
Storage Time	days	131	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	65	

Table 19Sodium Bisulfite DesigSubsurface DesalinationCity of Santa Barbara		able Reuse Feasibility Studies
Sodium Bisulfite Characteristics		
Concentration:	38 %	
Specific Gravity:	1.3	
Solution Strength:	4.11	lb/gal
Parameters	Units	Criteria
MF/UF Maintenance Cleans (MC)		
Location: MF/UF CIP Tank		
Number of MC per Day per Rack	No.	1
Number of MC per Day	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	441
Chemical Usage	lb/day	64.4
Chemical Feed Rate	gpd	15.7
MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	4,500
Chemical Usage	lb/month	657.2
Chemical Feed Rate	gpm	159.8
Chemical Feed Rate	gpd	5.3
Bulk Storage Totes	•	
Number of Totes	No.	4
Tote Capacity, each	gal	250
Tote Capacity, total	gal	1,000
MF/UF Maintenance Clean	gal/day	15.7
MF/UF CIP	gal/day	5.3
Total Usage	gal/day	21
Storage Time	days	48
Delivery Truck Full Load	gal	250
Time Between Delivery	days	12

		Direct Pota	
Description	Units	Сарас	ities
Source and Finished Water			
Flows	AFY	9.60	20
City Secondary Effluent City Secondary Effluent	gpm (mgd)	8,66 5,369	
Process Flows: AWTF	gpm (mgu)	5,309	(7.7)
Microfiltration			
Recovery	%	949	1
Permeate Flow	gpm (mgd)	5,369	(7.7)
Feedwater Flow ¹	gpm (mgd)	5,712	(8.2)
Backwash Flow	gpm (mgd)	343	(0.2)
Pre RO UV System			
Process Flow	gpm (mgd)	5,369	(7.7)
Reverse Osmosis			
Recovery	%	80%	6
Permeate Flow	gpm (mgd)	4,295	(6.2)
Feedwater Flow	gpm (mgd)	5,369	(7.7)
Brine Flow	gpm (mgd)	1,074	(1.5)
UV / AOP			
Process Flow	gpm (mgd)	4,295	(6.2)
Total Finished Water Flows			
Total NPR Flow	gpm (mgd)	0	(0.0)
Total DPR Flow	gpm (mgd)	4,295	(6.2)
Total Usable Flow	gpm (mgd)	4,295	(6.2)
Total NPR Flow	AFY	0	
Total DPR Flow	AFY	6,92	28
Total Usable Flow	AFY	6,92	28
Recovery of WWTP Effluent	%	80%	6

Table 2DPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
City of Santa Barbara Description	Units	Criteria	
MICROFILTRATION FEED PUMPS	Onito	Ontonia	
Number of Pumps			
In-Service	No.	4	
Reliability	No.	1	
Total	No.	5	
Type: Vertical Turbine			
Capacity			
Total	gpm	5,712	
Per Pump	gpm	1,428	
Total Dynamic Head Required (TDH)	0.	<i>,</i>	
Water Surface EI to Pump Discharge	ft	10	
Minimum Discharge Pressure	psi	20	
Maximum Discharge Pressure	psi	45	
Safety Factor	ft	20	
Design Pump TDH	feet	134	
Motor Size			
Required	hp	63	
Selected	hp	100	
Drive	type	VFD	
MICROFILTRATION BACKWASH PUMPS			
Number of Pumps			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Type: Vertical Turbine			
Capacity (per pump)			
Design (1.1*Flux Rate)	gpm	984	
Maximum (1.5*Flux Rate)	gpm	1,582	
Total Dynamic Head Required (TDH)			
Water Surface EI to Pump Discharge	ft	10	
Minimum Discharge Pressure	psi	10	
Maximum Discharge Pressure	psi	30	
Safety Factor	ft	20	
Design Pump TDH	feet	103	
Motor Size			
Required	hp	53	
Selected	hp	60	
Drive	type	VFD	

Table 2DPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara					
Description	Units	Criteria			
INFLUENT WET WELL					
Number of Wet Wells	No.	1			
Wet Well Dimensions (each)					
Depth	ft	15			
Length	ft	62			
Width	ft	18			
Volume	ft ³	16,740			
Volume	gallons	125,215			
Storage Time					
Design Flow	Minutes	22			

Table 3 DPR - Strainer / Pre-Screen Desig	n Criteria	
Subsurface Desalination Intake a	nd Potable Reuse	e Feasibility Studies
City of Santa Barbara		
Description	Units	Criteria
Type: Filter (Strainer-type) w/ Automatic Cleaning Mechanism		
Materials: Stainless Steel		
Filter Rating	micron	250
Maximum Pressure Drop		
Clean Filter ⁽¹⁾	psi	3
Before Backwash ⁽²⁾	psi	7
Number of Filters		
In-Service	No.	2
Reliability	No.	1
Total	No.	3
Capacity (Total)	gpm	5,712
Capacity (per Screen)	gpm	2,856
Filter Media Type:	-	Wedgewire
Filter Material:	-	316 SST
Maximum Backwash Flowrate	gpm	310
Backwash Duration	min	1
Total Backwash Waste	gal	310
Housing Design Pressure	psi	150
Motor Size		
Selected	hp	0.33
Drive	type	CS

Table 4DPR - Microfiltration Train Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara		,,	
Description	Units	Crite	ria
General Criteria			
Type: Pressurized, Polymeric hollow fiber			
Microfiltration or Ultrafiltration			
Operating Strategy: Dead end flow			
Number of Microfiltration Trains			
In-Service	No.	6	
Reliability	No.	1	
Total	No.	7	
Production Criteria			
Train Flux Rate			
Flux at Design Capacity (Net Production)	gfd	30	
Flux at Design Capacity (Instantaneous)	gfd	35	
Train Recovery Rate (Permeate/Feed Flow)			
Minimum	percent	94%	
Train Permeate Flow Rate			
Total	gpm (mgd)	5,369	(7.7)
Design	gpm (mgd)	895	(1.3)
Train Configuration			
Type: Open Platform (Non-proprietary)			
Membrane Manufacturer (No. 1)		Tora	ıy
Module Model Number		2020	N
Membrane Area per Module		775	5
Number of Installed Modules per Train	No.	56	
Number of Blank Modules per Train	No.	8	
Number of Total Module Spaces per Train	No.	64	
Backwash Criteria			
Type: Reverse Flow Followed by Simultaneous Air			
Scour and Drain			
Backwash Interval per Train			
Minimum	minutes	20	
Maximum	minutes	30	
Backwash Supply Flow Rate (Water)			
Flux	gfd	46	
Flow	gpm	gpm 1,582	
Backwash Duration	sec 45		
Backwash Supply Flow Rate (Air)	scfm	448	3
Volume of Wastewater Produced			
Per Backwash	gallons	1,18	7

Subsurface Desalination Intake ar	nd Potable Reuse F	easibility Stud
City of Santa Barbara		
Description	Units	Criteria
Maintenance Olean Oritoria (Turically, andy huma		
Maintenance Clean Criteria (Typically only hypo clean)		
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced	5	,
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria	-	
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	17,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4500
Sodium Hydroxide CIP	mg/L	5,000

1) Calculated as 1.5 times the sodium hypochlorite dose. Stoichiometric demand is 1.34 mg sodium bisulfite per 1 mg of sodium hypochlorite.

Table 5DPR - Microfiltration Backwash Air Scour Blowers Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa	City of Santa Barbara			
Description	Units	Criteria		
Type: Rotary Lobe				
Number of Blowers				
In-Service	No.	1		
Reliability	No.	1		
Total	No.	2		
Discharge Pressure	psi	13		
Air Flow Rate	scfm			
Design	scfm	392		
Maximum	scfm	448		
Motor Size				
Required	hp	32		
Selected	hp	50		
Drive	type	VFD		

Table 6 DPR - Ultraviolet	t Disinfection Design Criteria		
Subsurface Des	alination Intake and Potable Reuse	Feasibility S	Studies
City of Santa Ba	rbara		
Description	Units	Crite	eria
Process Type: Low Pressure High	Output Ultraviolet Light Reactor		
Manufacturer(s): Wedeco			
Model(s): spektron 4000e w/ 600 v	watt lamps		
Number of UV Reactors			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Flows			
Total Flow to Reactors	gpm (mgd)	5,369	(7.7)
Flow to Each Reactor	gpm (mgd)	5,369	(7.7)
UV Transmittance (UVT)	percent	90	
UV Dose ⁽¹⁾	mJ/cm ²	110	
Note:			
1) Dose required to achieve 4-log vir	us and 4-log protozoa inactivation.		

Table 7DPR - RO Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	5,369	
Per Pump	gpm	1,342	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	126	
Required (based on maximum			
discharge pressure)	hp	150	
Selected	hp	175	
Drive	type	VFD	
WET WELL			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time			
Design Flow	Minutes	17	

	sis Trains Design Crite ion Intake and Potable		lity Studies
Description	Units	Crit	eria
Number of Reverse Osmosis Trains			
In-Service	No.		4
Reliability	No.		0
Total	No.		4
Train Flux Rate ⁽¹⁾	gfd	1	1
Recovery (Permeate/Feed Flow)	percent	80)%
Total Permeate Flow	gpm (mgd)	4,295	(7.7)
Total Permeate Flow per Train	gpm (mgd)	1,074	(1.5)
Brine Flow per Train	gpm (mgd)	268	(0.39)
Number of Array Stages Per Train	No.		2
1st Stage			
Pressure Vessels per Train	No.	34	
Elements per Pressure Vessel	No.	7	
2nd Stage			
Pressure Vessels per Train	No.		7
Elements per Pressure Vessel	No.	7	
Number of Elements			
Per Train	No.		57
Total (In-Service)	No.	1,428	
Membrane Manufacturer(s) ⁽²⁾		Dow FilmTec, Hydranuatics, or	
	-	Toray	
		BW30-400/34i,	
Membrane Model No. ⁽²⁾		ESPA2-LD, or TML20D-400	
(2)	-	TIVIL2	JD-400
Membrane Area ⁽²⁾	<i>c</i> .	-	
Per Element	sq. ft.		00
Per Train	sq. ft.	142,800	
Total (In-service)	sq. ft.	571,200	

•	Booster Pump Design	Criteria Reuse Feasibility Studies
City of Santa Barbara		e Reuse reasibility studies
Description	Units	Criteria
Type: Turbine assisted motorized boost	er pump	
Manufacturer: FEDCO		
Model: LP-HEMI, LPH-240-125T		
LP-HEMI Units Per RO Train	No.	1
Total Number of Units	No.	4
Pump Data		
Stages	No.	1
Flow		
At 80 Percent RO Recovery	gpm	615
Minimum Total Dynamic Head (1)	ft	70
Maximum Total Dynamic Head ⁽²⁾	ft	120
Shaft Power		
Minimum Required	hp	14
Maximum Required	hp	24
Motor Data		
Drive	type	VFD
Position: Vertical		
Power Rating	hp	30
Notes:		
1) Clean-membrane (start-up) conditions.		
2) Fouled membrane (end of life), worst wa	ter quality conditions.	

Table 10	DPR - UV Disinfection	n / AOP Design Criteria		
	Subsurface Desalinat	tion Intake and Potable Re	use Feasibility	y Studies
	City of Santa Barbara	l	-	
D	escription	Units	Crite	eria
Process Type: L	ow Pressure High Outpu	ut Ultraviolet Light Reactor w	// NaOCI AOP	
Manufacturer(s)	: Wedeco			
Model(s): k143	w/ 600 watt lamps			
Number of UV F	Reactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow to F	Reactors	gpm (mgd)	4,295	(6.2)
Flow to Each F	Reactor	gpm (mgd)	4,295	(6.2)
UV Transmittan	ce (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	920	
NaOCI Dose		mg/L	4	
Note: 1) Dose required process.	I to achieve 6-log virus and	6-log protozoa inactivation usi	ng hypochlorite f	or the AOP

Table 11Direct Potable Reuse Train - Storage and Equalization Tanks CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies					
City of Santa Barbara Description Units Criteria					
ENGINEERED STORAGE TANKS	Units	Griteria			
Product Flow	gpm	4,295			
Number of Tanks	No.	2			
Tank Dimensions	110.	2			
Diameter	ft	70			
Height	ft	35			
	ft ³				
Volume (each)		134,696			
Volume (each) Volume (actual)	gallons	1,007,524 1,000,000			
	gallons	2,000,000			
Volume (total) Storage Time (w/ one tank out of service)	gallons	2,000,000			
Design Flow	Minutes	233			
Design Flow	Hours	4			
Storage Time (total)	riours	4			
Design Flow	Minutes	466			
Design Flow	Hours	8			
Description	Units	Criteria			
•	Units	Criteria			
EQUALIZATION TANKS Product Flow	apm	5,369			
Number of Tanks	gpm No.	2			
Tank Dimensions	INU.	2			
Diameter	ft	82			
	ft	35			
Height					
Volume (each)	ft ³	184,836			
Volume (each)	gallons	1,382,570			
Volume (actual)	gallons 1,500,00				
Volume (total)	gallons	3,000,000			
Storage Time (each)					
Design Flow	Minutes	279			
Design Flow	Hours	5			
Storage Time (total)					
Design Flow	Minutes	559			
Design Flow	Hours	9			

Table 12Direct Potable Reuse Train - FinishedSubsurface Desalination Intake and PCity of Santa Barbara	-	
Description	Units	Criteria
FINISHED WATER PUMPS TO GOLF COURSE PS		
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	4,295
Per Pump	gpm	1,432
Total Dynamic Head Required (TDH)		
Head required to reach reservoir	feet	573
Average Pump TDH	feet	593
Maximum Pump TDH	feet	623
Motor Size		
Average operating	hp	268
Required (based on maximum discharge pressure)	hp	282
Selected	hp	300
Drive	type	VFD
GOLF COURSE PS TO LAURO CANYON RESERVOIR		
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	4,295
Per Pump	gpm	1,432
Total Dynamic Head Required (TDH)		
Head required to reach reservoir	feet	346
Average Pump TDH	feet	366
Maximum Pump TDH	feet	396
Motor Size		
Average operating	hp	165
Required (based on maximum discharge pressure)	hp	179
Selected	hp	200
Drive	type	VFD

	Sodium Hypochlorite Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara			
Sodium Hypochlorite Characteristics				
Concentration:	10.5 %			
Specific Gravity:	1.008			
Solution Strength:	0.88	lb/gal		
Parameters	Units	Criteria		
Ultraviolet Light / Advanced Oxidation Proc	cess			
Chemical Usage				
Location: RO Permeate Before UV React				
Process Flow	MGD	6.2		
Chemical Dose	mg/L	4.0		
Chemical Usage	lb/day	206		
Chemical Feed Rate	gpd	234		
Chemical Feed Rate	gph	9.8		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	9.8		
MF/UF Maintenance Cleans (MC)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	300		
Chemical Usage	lb/day	43.8		
Chemical Feed Rate	gpd	49.7		
MF/UF Clean-in-Place (CIP)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	3,000		
Chemical Usage	lb/month	438.1		
Chemical Feed Rate	gpm	497.2		
Chemical Feed Rate	gpd	16.6		

Table 13Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Parameters	Units	Criteria	
Bulk Storage Tanks			
Number of Tanks	No.	2	
Tank Capacity, each	gal	4,000	
Tank Capacity, total	gal	8,000	
UV/AOP Usage	gal/day	234	
MF/UF Maintenance Clean	gal/day	49.7	
MF/UF CIP	gal/day	16.6	
Total Usage	gal/day	301	
Storage Time	days	27	
Delivery Truck Full Load	gal	3,000	
Time Between Delivery	days	10	

Table 14 Sulfuric Acid Design	n Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara				
Sulfuric Acid Characteristics				
Concentration:	93 %			
Specific Gravity:	1.83			
Solution Strength:	14.17	lb/gal		
Parameters	Units	Criteria		
DPR RO Pretreatment				
Chemical Usage				
Location: Reverse Osmosis Feed				
Process Flow	MGD	7.7		
Chemical Dose	mg/L	115		
Chemical Usage	lb/day	7,419		
Chemical Feed Rate	gpd	524		
Chemical Feed Rate	gph	21.8		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	21.8		
Bulk Storage Tanks				
Number of Tanks	No.	2		
Tank Capacity, each	gal	8,000		
Tank Capacity, total	gal	16,000		
Total Usage	gal/day	524		
Storage Time	days	31		
Delivery Truck Full Load	gal	3,000		
Time Between Delivery	days	6		

Table 15Lime Slurry Design CriteriaSubsurface Desalination In		uso Foasibility Studios
City of Santa Barbara		use reasibility studies
Lime Characteristics		
Lime Purity	%	97%
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30
Concentration:	%	35 %
Specific Gravity:		1.271
Solution Strength:	lb/gal	3.70
Parameters	Units	Criteria
DPR Post Treatment		
Chemical Usage		
Location: Before Treated Water Wet Well		
Process Flow	MGD	6.2
Chemical Dose	mg/L	25
Chemical Dose (as stored weight)	mg/L	26
Chemical Usage	lb/day	1,330
Chemical Feed Rate	gpd	359
Chemical Feed Rate	gph	15.0
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	15.0
Lime Storage Silos		
Number of Silos	No.	1
Silo Capacity, each	cu ft	2,500
Silo Capacity, each	lbs	75,000
Silo Capacity, total	Tons	37.5
Silo Diameter, each	ft	13
Silo Sideshell Height, each	ft	19
Dry Usage	lbs/day	1,330
Dry Usage	tons/day	0.7
Storage Time	days	56
Delivery Truck Full Load	tons	24
Time Between Delivery	days	36

Table 16Scale Inhibitor Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Scale Inhibitor Characteristics			
Manufacturer/Product:	Avista Vitec 3000		
Concentration:	100 %		
Specific Gravity:	1.2		
Solution Strength:	9.99	lb/gal	
Parameters	Units		Criteria
DPR - RO Pretreatment			
Chemical Usage			
Location: Reverse Osmosis Feed	k		
Process Flow	MGD		7.7
Chemical Dose	mg/L		4.0
Chemical Usage	lb/day		258
Chemical Feed Rate	gpd		26
Chemical Feed Rate	gph		1.1
No. of Standby Pumps	-		1
No. of Pumps in Service	-		1
Chemical Feed Rate Per Pump	gph		1.1
Chemical Feed Rate Per Pump	gpm		0.02
Bulk Storage Totes			
Number of Totes	No.		4
Tote Capacity, each	gal		250
Tote Capacity, total	gal		1,000
DPR RO Pretreatment	gal/day		26
Total Usage	gal/day		26
Storage Time	days		39
Delivery Truck Full Load	gal		250
Time Between Delivery	days		10

Table 17	Table 17 Citric Acid Design Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
	City of Santa Barbara			
Citric Acid	Characteristics			
Concentra	tion:	50 %		
Specific G	ravity:	1.15		
Solution S	trength:	4.79	lb/gal	
Parameters	i de la construcción de la constru	Units	Criteria	
MF/UF Clea	<u>n-in-Place (CIP)</u>			
Chemical Us	sage			
Location: N	1F/UF CIP Tank			
Number of	CIP per month per Rack	No.	1	
Number of	CIP per month	No.	7	
Cleaning vo	olume	gallons	2,500	
Chemical D	Dose	mg/L	5,000	
Chemical L	Jsage	lb/month	730.2	
Chemical F	Feed Rate	gpm	152.5	
Chemical F	Feed Rate	gpd	5.1	
Bulk Storage	<u>e Totes</u>			
Number of	Totes	No.	2	
Tote Capa	acity, each	gal	250	
Tote Capa	acity, total	gal	500	
MF/UF CIP		gal/month	152.5	
Total Usage		gal/month	152.5	
Storage Tir	ne	days	98	
Delivery Tr	uck Full Load	gal	250	
Time Betwe	een Delivery	days	49	

Table 18 Caustic Soda Design C	riteria		
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Caustic Soda Characteristics			
Concentration:	50 %		
Specific Gravity:	1.53		
Solution Strength:	6.37	lb/gal	
Parameters	Units	Criteria	
MF/UF Clean-in-Place (CIP) (neutralize CA)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	730.2	
Chemical Feed Rate	gpm	114.6	
Chemical Feed Rate	gpd	3.8	
Bulk Storage Tote			
Number of Totes	No.	2	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	500	
MF/UF CIP	gal/month	114.6	
Total Usage	gal/month	114.6	
Storage Time	days	131	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	65	

Table 19Sodium Bisulfite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Sodium Bisulfite Characteristics			
Concentration:	38 %		
Specific Gravity:	1.3		
Solution Strength:	4.11	lb/gal	
Parameters	Units	Criteria	
MF/UF Maintenance Cleans (MC)			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	441	
Chemical Usage	lb/day	64.4	
Chemical Feed Rate	gpd	15.7	
MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	4,500	
Chemical Usage	lb/month	657.2	
Chemical Feed Rate	gpm	159.8	
Chemical Feed Rate	gpd	5.3	
Bulk Storage Totes	01		
Number of Totes	No.	4	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	1,000	
MF/UF Maintenance Clean	gal/day	15.7	
MF/UF CIP	gal/day	5.3	
Total Usage	gal/day	21	
Storage Time	days	48	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	12	

Table 1Process Flow Rates - DPR Facility Alt 2aSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
,		Direct Potable Re Capacities	
Description	Units		
Source and Finished Water Flows			
City Secondary Effluent	AFY	8,6	60
City Secondary Effluent	gpm (mgd)	5,369	(7.7)
Process Flows: AWTF/NPR			
Microfiltration			
Recovery	%	949	%
Permeate Flow	gpm (mgd)	5,414	(7.8)
Feedwater Flow ¹	gpm (mgd)	5,760	(8.3)
Backwash Flow	gpm (mgd)	346	(0.5)
Pre RO UV System			
Process Flow	gpm (mgd)	5,414	(7.8)
Process Flows: NPR			
Flow to NPR System	gpm (mgd)	868	(1.2)
Reverse Osmosis			
Recovery	%	80%	
Permeate Flow	gpm (mgd)	3,637	(5.2)
Feedwater Flow	gpm (mgd)	4,547	(6.6)
Brine Flow	gpm (mgd)	909	(1.3)
UV / AOP			. ,
Process Flow	gpm (mgd)	3,637	(5.2)
Process Flows: WTP			
Microfiltration			
Recovery	%	999	%
Permeate Flow	gpm (mgd)	3,601	(5.2)
Feedwater Flow ¹	gpm (mgd)	3,637	(5.2)
Backwash Flow	gpm (mgd)	36	(0.1)
Post Treatment UV System			
Process Flow ²	gpm (mgd)	3,601	(5.2)
Total Finished Water Flows			
Total NPR Flow	gpm (mgd)	868	(1.2)
Total DPR Flow	gpm (mgd)	3,601	(5.2)
Total Usable Flow	gpm (mgd)	4,469	(6.4)
Total NPR Flow	AFY	1,40	· · · ·
Total DPR Flow	AFY	5,8	
Total Usable Flow	AFY	7,2	
Recovery of WWTP Effluent	%	839	
Notos:	,,,	50	

Notes: 1) MF backwash is recycled to head of WWTP. Instantaneous flow is higher than permeate flow. 2) New WTP will use UV system capacity included in desalination plant design.

Table 2DPR - Microfiltration Feed PunSubsurface Desalination IntakCity of Santa Barbara		
Description	Units	Criteria
MICROFILTRATION FEED PUMPS		
Number of Pumps		
In-Service	No.	4
Reliability	No.	1
Total	No.	5
Type: Vertical Turbine		
Capacity		
Total	gpm	5,760
Per Pump	gpm	1,440
Total Dynamic Head Required (TDH)	0.	,
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	63
Selected	hp	100
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS		
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	993
Maximum (1.5*Flux Rate)	gpm	1,582
Total Dynamic Head Required (TDH)		
Water Surface EI to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

Table 2DPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Description	Units	Criteria
INFLUENT WET WELL		
Number of Wet Wells	No.	1
Wet Well Dimensions (each)		
Depth	ft	15
Length	ft	62
Width	ft	18
Volume	ft ³	16,740
Volume	gallons	125,215
Storage Time		
Design Flow	Minutes	22

Table 3 DPR - Strainer / Pre-Screen D	esign Criteria	
Subsurface Desalination Intal	ke and Potable Reuse Fea	sibility Studies
City of Santa Barbara		
Description	Units	Criteria
Type: Filter (Strainer-type) w/ Automatic Cleaning	Mechanism	
Materials: Stainless Steel		
Filter Rating	micron	250
Maximum Pressure Drop		
Clean Filter ⁽¹⁾	psi	3
Before Backwash (2)	psi	7
Number of Filters		
In-Service	No.	2
Reliability	No.	1
Total	No.	3
Capacity (Total)	gpm	5,760
Capacity (per Screen)	gpm	2,880
Filter Media Type:	-	Wedgewire
Filter Material:	-	316 SST
Maximum Backwash Flowrate	gpm	310
Backwash Duration	min	1
Total Backwash Waste	gal	310
Housing Design Pressure	psi	150
Motor Size		
Selected	hp	0.33
Drive	type	CS

Table 4DPR - Microfiltration Train Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Description	Units	Crite	ria
General Criteria			
Type: Pressurized, Polymeric hollow fiber			
Microfiltration or Ultrafiltration			
Operating Strategy: Dead end flow			
Number of Microfiltration Trains			
In-Service	No.	6	
Reliability	No.	1	
Total	No.	7	
Production Criteria			
Train Flux Rate			
Flux at Design Capacity (Net Production)	gfd	30	
Flux at Design Capacity (Instantaneous)	gfd	35	
Train Recovery Rate (Permeate/Feed Flow)			
Minimum	percent	94%	6
Train Permeate Flow Rate			
Total	gpm (mgd)	5,414	(7.8)
Design	gpm (mgd)	902	(1.3)
Train Configuration			
Type: Open Platform (Non-proprietary)			
Membrane Manufacturer (No. 1)		Tora	ау
Module Model Number		2020	N
Membrane Area per Module		775	5
Number of Installed Modules per Train	No.	56	
Number of Blank Modules per Train	No.	8	
Number of Total Module Spaces per Train	No.	64	
Backwash Criteria			
Type: Reverse Flow Followed by Simultaneous Air			
Scour and Drain			
Backwash Interval per Train	· .	00	
Minimum	minutes	20	
Maximum	minutes	30	
Backwash Supply Flow Rate (Water)	<i>.</i> .	40	
Flux	gfd	46	
Flow	gpm 1,582		
Backwash Duration	sec 45		
Backwash Supply Flow Rate (Air)	scfm	448	3
Volume of Wastewater Produced			_
Per Backwash	gallons	1,18	87

Table 4 DPR - Microfiltration Train D	•	
Subsurface Desalination Inta	ake and Potable Reus	e Feasibility S
City of Santa Barbara		
Description	Units	Criteria
Maintenance Clean Criteria (Typically only hy	<u>po clean)</u>	
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	17,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4,500
Sodium Hydroxide CIP	mg/L	5,000

1) Calculated as 1.5 times the sodium hypochlorite dose. Stoichiometric demand is 1.34 mg sodium bisulfite per 1 mg of sodium hypochlorite.

Table 5 DPR - Microfiltration Backwash Air Scour Blowers Design Criteria				
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa	Units	Criteria		
Type: Rotary Lobe	Onto	Onterna		
Number of Blowers				
In-Service	No.	1		
Reliability	No.	1		
Total	No.	2		
Discharge Pressure	psi	13		
Air Flow Rate	scfm			
Design	scfm	392		
Maximum	scfm	448		
Motor Size				
Required	hp	32		
Selected	hp	50		
Drive	type	VFD		

Table 6DPR - Ultraviolet Disinfection Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara					
Description	Description Units Criteria				
Process Type: Low Pressure High	Output Ultraviolet Light Reactor				
Manufacturer(s): Wedeco					
Model(s): spektron 4000e w/ 600 v	watt lamps				
Number of UV Reactors					
In-Service	No.	1			
Reliability	Reliability No. 1				
Total	Fotal No. 2				
Flows					
Total Flow to Reactors	gpm (mgd) 5,414 (7.8)				
Flow to Each Reactor	v to Each Reactor gpm (mgd) 5,414 (7.8)				
UV Transmittance (UVT)	UV Transmittance (UVT) percent 90				
UV Dose ⁽¹⁾ mJ/cm ² 110					

Table 7 DPR - RO Feed Pump Station Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Serie Berbare			
City of Santa Barbara Description	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	4,547	
Per Pump	gpm	1,137	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	107	
Required (based on maximum discharge			
pressure)	hp	127	
Selected	hp	150	
Drive	type	VFD	
WETWELL			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time			
Design Flow	Minutes	20	

Table 8 DPR - Reverse Osmosis Trains Design Criteria				
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara				
Description	Units	Cri	teria	
Number of Reverse Osmosis Trains				
In-Service	No.		4	
Reliability	No.		0	
Total	No.		4	
Train Flux Rate ⁽¹⁾	gfd		11	
Recovery (Permeate/Feed Flow)	percent	8	0%	
Total Permeate Flow	gpm (mgd)	3,637	(6.5)	
Total Permeate Flow per Train	gpm (mgd)	909	(1.3)	
Brine Flow per Train	gpm (mgd)	227	(0.33)	
Number of Array Stages Per Train	No.		2	
1st Stage				
Pressure Vessels per Train	No.	28		
Elements per Pressure Vessel	No.	7		
2nd Stage				
Pressure Vessels per Train	No.		14	
Elements per Pressure Vessel	No.		7	
Number of Elements				
Per Train	No.		94	
Total (In-Service)	No.	,	176	
Membrane Manufacturer(s) (2)		Dow FilmTec, Hydranuatics, or		
	-	•	oray	
		BW30-400/34i,		
Membrane Model No. (2)		ESPA2-LD, or		
	-	TML20D-400		
Membrane Area ⁽²⁾				
Per Element	sq. ft.	4	00	
Per Train	sq. ft.	117	7,600	
Total (In-service)	sq. ft.	470,400		

Table 9DPR - RO Interstage Booster Pump Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
Type: Turbine assisted motorized boost	er pump		
Manufacturer: FEDCO			
Model: LP-HEMI, LPH-240-125T			
LP-HEMI Units Per RO Train	No.	1	
Total Number of Units	No.	4	
Pump Data			
Stages	No.	1	
Flow			
At 80 Percent RO Recovery	gpm	538	
Minimum Total Dynamic Head (1)	ft	70	
Maximum Total Dynamic Head (2)	ft	120	
Shaft Power			
Minimum Required	hp	12	
Maximum Required	hp	21	
Motor Data			
Drive	type	VFD	
Position: Vertical			
Power Rating	hp	25	
Notes:			
1) Clean-membrane (start-up) conditions.			
2) Fouled membrane (end of life), worst wa	ter quality conditions.		

Table 10 DPR - UV Disinfection / AOP Design Criteria				
	Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
	City of Santa Bar	bara		
Desc	ription	Units	Crite	ria
Process Type	: Low Pressure High	Output Ultraviolet Light Re	actor w/ NaOCI AO	Р
Manufacturer(s): Wedeco			
Model(s): k143	3 w/ 600 watt lamps			
Number of U∨	'Reactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow to	Reactors	gpm (mgd)	3,637	(5.2)
Flow to Each	Reactor	gpm (mgd)	3,637	(5.2)
UV Transmitta	ance (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	920	C
NaOCI Dose		mg/L	4	
Note: 1) Dose requir process.	ed to achieve 6-log vir	us and 6-log protozoa inactiva	tion using hypochlori	te for the AOP

Table 11 Direct Potable Reuse Train - Storage and Equalization Tanks Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Description	Units	Criteria	
ENGINEERED STORAGE			
TANKS		2.001	
Product Flow	gpm	3,601	
Number of Tanks	No.	2	
Tank Dimensions	<i>t</i> 1	70	
Diameter	ft	70	
Height	ft	35	
Volume (each)	ft ³	134,696	
Volume (each)	gallons	1,007,524	
Volume (actual)	gallons	1,000,000	
Volume (total)	gallons	2,000,000	
Storage Time (w/ one tank out of service)			
Design Flow	Minutes	278	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	555	
Design Flow	Hours	9	
Description	Units	Criteria	
EQUALIZATION TANKS			
Product Flow	gpm	5,369	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	82	
Height	ft	35	
Volume (each)	ft ³	184,836	
Volume (each)	gallons	1,382,570	
Volume (actual)	gallons	1,500,000	
Volume (total)	gallons	3,000,000	
Storage Time (each)			
Design Flow	Minutes	279	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	559	
Design Flow	Hours	9	

Table 12Sodium Hypochlorite DesiSubsurface Desalination Ir	-	ble Reuse Feasibility Studies		
City of Santa Barbara				
Sodium Hypochlorite Characteristics				
Concentration:	10.5 %			
Specific Gravity:	1.008			
Solution Strength:	0.88	lb/gal		
Parameters	Units	Criteria		
Ultraviolet Light / Advanced Oxidation Proces	SS			
Chemical Usage				
Location: RO Permeate Before UV Reactors	5			
Process Flow	MGD	5.2		
Chemical Dose	mg/L	4.0		
Chemical Usage	lb/day	175		
Chemical Feed Rate	gpd	198		
Chemical Feed Rate	gph	8.3		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	8.3		
AWTF MF/UF Maintenance Cleans (MC)	01			
Chemical Usage				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	300		
Chemical Usage	lb/day	43.8		
Chemical Feed Rate	gpd	49.7		
AWTF MF/UF Clean-in-Place (CIP)	01			
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	3,000		
Chemical Usage	lb/month	438.1		
Chemical Feed Rate	gpm	497.2		
Chemical Feed Rate	gpd	16.6		
WTP MF/UF Maintenance Cleans (MC)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	5		

Table 12Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudieCity of Santa Barbara				
Parameters	Units	Criteria		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	300		
Chemical Usage	lb/day	31.3		
Chemical Feed Rate	gpd	35.5		
WTP MF/UF Clean-in-Place (CIP)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month	No.	5		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	3,000		
Chemical Usage	lb/month	312.9		
Chemical Feed Rate	gpm	355.1		
Chemical Feed Rate	gpd	11.8		
Bulk Storage Tanks				
Number of Tanks	No.	2		
Tank Capacity, each	gal	5,500		
Tank Capacity, total	gal	11,000		
UV/AOP Usage	gal/day	198		
MF/UF Maintenance Cleans	gal/day	85.2		
MF/UF CIPs	gal/day	28.4		
Total Usage	gal/day	312		
Storage Time	days	35		
Delivery Truck Full Load	gal	3,000		
Time Between Delivery	days	10		

Table 13 Sulfuric Acid Design	Criteria	
Subsurface Desalina	tion Intake and	Potable Reuse Feasibility Studies
City of Santa Barbara	a	
Sulfuric Acid Characteristics		
Concentration:	93 %	
Specific Gravity:	1.83	
Solution Strength:	14.17	lb/gal
Parameters	Units	Criteria
DPR RO Pretreatment		
Chemical Usage		
Location: Reverse Osmosis Feed	d	
Process Flow	MGD	6.5
Chemical Dose	mg/L	115
Chemical Usage	lb/day	6,283
Chemical Feed Rate	gpd	443
Chemical Feed Rate	gph	18.5
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	18.5
Bulk Storage Tanks		
Number of Tanks	No.	2
Tank Capacity, each	gal	8,000
Tank Capacity, total	gal	16,000
Total Usage	gal/day	443
Storage Time	days	36
Delivery Truck Full Load	gal	3,000
Time Between Delivery	days	7

	Lime Slurry Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
	ntake and Potable i	Reuse Feasibility Studies		
City of Santa Barbara				
Lime Purity	%	97%		
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30		
Concentration:	%	35 %		
Specific Gravity:	70	1.271		
Solution Strength:	lb/gal	3.70		
Parameters	Units	Criteria		
	Units	Criteria		
DPR Post Treatment				
Chemical Usage				
Location: Before Treated Water Wet Well	MGD	5.2		
Process Flow	-			
Chemical Dose	mg/L	25		
Chemical Dose (as stored weight)	mg/L	26		
Chemical Usage	lb/day	1,115		
Chemical Feed Rate	gpd	301		
Chemical Feed Rate	gph	12.5		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	12.5		
Lime Storage Silos				
Number of Silos	No.	1		
Silo Capacity, each	cu ft	2,500		
Silo Capacity, each	lbs	75,000		
Silo Capacity, total	Tons	37.5		
Silo Diameter, each	ft	13		
Silo Sideshell Height, each	ft	19		
Dry Usage	lbs/day	1,115		
Dry Usage	tons/day	0.6		
Storage Time	days	67		
Delivery Truck Full Load	tons	24		
Time Between Delivery	days	43		

Table 15Scale Inhibitor DesignSubsurface DesalinationCity of Santa Barbara	tion Intake and Pota	ble Reuse Feasibility Studies
Scale Inhibitor Characteristics		
Manufacturer/Product:	Avista Vitec 3000	
Concentration:	100 %	
Specific Gravity:	1.2	
Solution Strength:	9.99	lb/gal
Parameters	Units	Criteria
DPR - RO Pretreatment		
Chemical Usage		
Location: Reverse Osmosis Feed		
Process Flow	MGD	6.5
Chemical Dose	mg/L	4.0
Chemical Usage	lb/day	219
Chemical Feed Rate	gpd	22
Chemical Feed Rate	gph	0.9
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	0.9
Chemical Feed Rate Per Pump	gpm	0.02
Bulk Storage Totes		
Number of Totes	No.	4
Tote Capacity, each	gal	250
Tote Capacity, total	gal	1,000
DPR RO Pretreatment	gal/day	22
Total Usage	gal/day	22
Storage Time	days	46
Delivery Truck Full Load	gal	250
Time Between Delivery	days	11

Table 16Citric Acid Design CriterSubsurface DesalinationCity of Santa Barbara		e Reuse Feasibility Studies
Citric Acid Characteristics		
Concentration:	50 %	
Specific Gravity:	1.15	
Solution Strength:	4.79	lb/gal
Parameters	Units	Criteria
AWTF MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	730.2
Chemical Feed Rate	gpm	152.5
Chemical Feed Rate	gpd	5.1
WTP MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month	No.	5
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	521.6
Chemical Feed Rate	gpm	108.9
Chemical Feed Rate	gpd	3.6
Bulk Storage Totes		
Number of Totes	No.	2
Tote Capacity, each	gal	250
Tote Capacity, total	gal	500
MF/UF CIP	gal/month	261.5
Total Usage	gal/month	261.5
Storage Time	days	57
Delivery Truck Full Load	gal	250
Time Between Delivery	days	29

Table 17Caustic Soda Design CSubsurface DesalinationCity of Santa Barbara		ole Reuse Feasibility Studies
Caustic Soda Characteristics		
Concentration:	50 %	
Specific Gravity:	1.53	
Solution Strength:	6.37	lb/gal
Parameters	Units	Criteria
AWTF MF/UF Clean-in-Place (CIP) (neut	ralize CA)	
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	730.2
Chemical Feed Rate	gpm	114.6
Chemical Feed Rate	gpd	3.8
WTP MF/UF Clean-in-Place (CIP) (neutra	<u>lize CA)</u>	
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	5
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	521.6
Chemical Feed Rate	gpm	81.9
Chemical Feed Rate	gpd	2.7
Bulk Storage Tote		
Number of Totes	No.	2
Tote Capacity, each	gal	250
Tote Capacity, total	gal	500
MF/UF CIPs	gal/month	196.5
Total Usage	gal/month	196.5
Storage Time	days	76
Delivery Truck Full Load	gal	250
Time Between Delivery	days	38

Table 18 Sodium Bisulfite Design 0		
	Intake and Pot	able Reuse Feasibility Studies
City of Santa Barbara		
Sodium Bisulfite Characteristics		
Concentration:	38 %	
Specific Gravity:	1.3	
Solution Strength:	4.11	lb/gal
Parameters	Units	Criteria
AWTF MF/UF Maintenance Cleans (MC)		
Chemical Usage (NaOCI Neutralization)		
Location: MF/UF CIP Tank		
Number of MC per Day per Rack	No.	1
Number of MC per Day	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	441
Chemical Usage	lb/day	64.4
Chemical Feed Rate	gpd	15.7
AWTF MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	4,500
Chemical Usage	lb/month	657.2
Chemical Feed Rate	gpm	159.8
Chemical Feed Rate	gpd	5.3
WTP MF/UF Maintenance Cleans (MC)	0.	
Chemical Usage (NaOCI Neutralization)		
Location: MF/UF CIP Tank		
Number of MC per Day per Rack	No.	1
Number of MC per Day	No.	5
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	441
Chemical Usage	lb/day	46.0
Chemical Feed Rate	gpd	11.2
WTP MF/UF Clean-in-Place (CIP)	01	
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	5
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	4,500

Table 18 Sodium Bisulfite D	esign Criteria			
Subsurface Desali	nation Intake and Potable F	Reuse Feasibility Studies		
City of Santa Barbara				
Parameters	Units	Criteria		
Chemical Usage	lb/month	469.4		
Chemical Feed Rate	gpm	114.1		
Chemical Feed Rate	gpd	3.8		
Bulk Storage Totes				
Number of Totes	No.	4		
Tote Capacity, each	gal	250		
Tote Capacity, total	gal	1,000		
MF/UF Maintenance Clean	gal/day	26.8		
MF/UF CIP	gal/day	9.1		
Total Usage	gal/day	36		
Storage Time	days	28		
Delivery Truck Full Load	gal	250		
Time Between Delivery	days	7		

Table 19 DPR - WTP Microfiltration Fee Subourface Decelination Intel	•	•
Subsurface Desalination Intak City of Santa Barbara	e and Potable Reus	e reasibility Studies
Description	Units	Criteria
MICROFILTRATION FEED PUMPS		ententa
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	3,637
Per Pump	gpm	1,212
Total Dynamic Head Required (TDH)	51	,
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	53
Selected	hp	75
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS		
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	990
Maximum (1.3*Flux Rate)	gpm	1,567
Total Dynamic Head Required (TDH)		
Water Surface EI to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

Table 19DPR - WTP Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
INFLUENT WET WELL			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	15	
Length	ft	50	
Width	ft	15	
Volume	ft ³	11,250	
Volume	gallons	84,150	
Storage Time			
Design Flow	Minutes	23	

Table 20	DPR - WTP Strainer / Pre-Screen Design Crit	teria	
	Subsurface Desalination Intake and Potable		bility Studies
	City of Santa Barbara		
	Description	Units	Criteria
Type: Filter (S	Strainer-type) w/ Automatic Cleaning Mechanism		
Materials: Sta	inless Steel		
Filter Rating		micron	250
Maximum Pre	essure Drop		
Clean Filter	(1)	psi	3
Before Back	wash ⁽²⁾	psi	7
Number of Fil	ters		
In-Service		No.	2
Reliability		No.	1
Total		No.	3
Capacity (Tot	al)	gpm	3,637
Capacity (per	Screen)	gpm	1,819
Filter Media T	ype:	-	Wedgewire
Filter Material	:	-	316 SST
Maximum Ba	ckwash Flowrate	gpm	310
Backwash Du	ration	min	1
Total Backwa	sh Waste	gal	310
Housing Desi	gn Pressure	psi	150
Motor Size			
Selected		hp	0.33
Drive		type	CS

Table 21 DPR - WTP Microfiltration Train D	esign Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara		0.14		
Description	Units	Crite	eria	
General Criteria Type: Pressurized, Polymeric hollow fiber				
Microfiltration or Ultrafiltration				
Operating Strategy: Dead end flow				
Number of Microfiltration Trains				
In-Service	No.	4		
Reliability	No.	1		
Total	No.	5		
Production Criteria	-			
Train Flux Rate				
Flux at Design Capacity (Net Production)	gfd	30	C	
Flux at Design Capacity (Instantaneous)	gfd	4	C	
Train Recovery Rate (Permeate/Feed Flow)	0			
Minimum	percent	94	%	
Train Permeate Flow Rate				
Total	gpm (mgd)	3,601	(5.2)	
Design	gpm (mgd)	900	(1.3)	
Train Configuration				
Type: Open Platform (Non-proprietary)				
Membrane Manufacturer (No. 1)		Tor	ay	
Module Model Number		202	0N	
Membrane Area per Module		77	<i>'</i> 5	
Number of Installed Modules per Train	No.	5	6	
Number of Blank Modules per Train	No.	8	5	
Number of Total Module Spaces per Train	No.	64	4	
Backwash Criteria				
Type: Reverse Flow Followed by Simultaneous Air				
Scour and Drain				
Backwash Interval per Train		0	2	
Minimum	minutes	20		
Maximum	minutes	30	J	
Backwash Supply Flow Rate (Water)		F	r	
Flux	gfd	52		
Flow Realized Duration	gpm	1,5 4		
Backwash Duration	Sec	43 44		
Backwash Supply Flow Rate (Air)	scfm	44	0	
Volume of Wastewater Produced	acliene	1 1	75	
Per Backwash	gallons	1,1	10	

Table 21 DPR - WTP Microfiltration Train	Design Criteria	
Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Maintenance Clean Criteria (Typically only hype	<u>o clean)</u>	
Maintenance Clean Frequency	days	3
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	4,167
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	12,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4500
Sodium Hydroxide CIP	mg/L	5,000
Note:		

Note:
1) Calculated as 1.5 times the sodium hypochlorite dose. Stoichiometric demand is 1.34 mg sodium bisulfite per 1 mg of sodium hypochlorite.

Table 22	DPR - WTP Microfiltration Backwash Air Scour Blowers Design Criteria			
	Subsurface Desalination I	ntake and Potable Reuse F	easibility Studies	
	City of Santa Barbara			
	Description	Units	Criteria	
Type: Rotar	y Lobe			
Number of E	Blowers			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Discharge P	ressure	psi	13	
Air Flow Rat	e	scfm		
Design		scfm	392	
Maximum		scfm	448	
Motor Size				
Required		hp	32	
Selected		hp	50	
Drive		type	VFD	

Table 23Direct Potable Reuse Train - Finished WaSubsurface Desalination Intake and PotalCity of Santa Barbara	•	
Description	Units	Criteria
FINISHED WATER PUMPS TO SOUTH COAST CONDUIT		
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	3,601
Per Pump	gpm	1,200
Total Dynamic Head Required (TDH)		
Head required to reach reservoir	feet	534
Average Pump TDH	feet	554
Maximum Pump TDH	feet	584
Motor Size		
Average operating	hp	210
Required (based on maximum discharge pressure)	hp	221
Selected	hp	250
Drive	type	VFD

Table 1Process Flow Rates - DPR Facility Alt 2bSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
		Direct Pota	
Description	Units	Capac	ities
Source and Finished Water Flows			
City Secondary Effluent	AFY	8,60	
City Secondary Effluent	gpm (mgd)	5,369	(7.7)
Process Flows: AWTF			
Microfiltration			
Recovery	%	949	%
Permeate Flow	gpm (mgd)	5,423	(7.8)
Feedwater Flow ¹	gpm (mgd)	5,769	(8.3)
Backwash Flow	gpm (mgd)	346	(0.5)
Pre RO UV System			
Process Flow	gpm (mgd)	5,423	(7.8)
Reverse Osmosis			
Recovery	%	809	%
Permeate Flow	gpm (mgd)	4,338	(6.2)
Feedwater Flow	gpm (mgd)	5,423	(7.8)
Brine Flow	gpm (mgd)	1,085	(1.6)
UV / AOP			
Process Flow	gpm (mgd)	4,338	(6.2)
Process Flows: WTP			
Microfiltration			
Recovery	%	999	%
Permeate Flow	gpm (mgd)	4,295	(6.2)
Feedwater Flow ¹	gpm (mgd)	4,338	(6.2)
Backwash Flow	gpm (mgd)	43	(0.1)
Post Treatment UV System			
Process Flow ²	gpm (mgd)	4,295	(6.2)
Total Finished Water Flows			
Total NPR Flow	gpm (mgd)	0	(0.0)
Total DPR Flow	gpm (mgd)	4,295	(6.2)
Total Usable Flow	gpm (mgd)	4,295	(6.2)
Total NPR Flow	AFY	4,200	
Total DPR Flow	AFY	6,92	
Total Usable Flow	AFY	6,92	
	%	•	
Recovery of WWTP Effluent	70	809	/0

Notes:

1) MF backwash is recycled to head of WWTP. Instantaneous flow is higher than permeate flow.

2) New WTP will use UV system capacity included in desalination plant design.

Table 2 DPR - Microfiltration Feed P		
Subsurface Desalination Int City of Santa Barbara	ake and Potable Rei	use Feasibility Studies
Description	Units	Criteria
MICROFILTRATION FEED PUMPS		
Number of Pumps		
In-Service	No.	4
Reliability	No.	1
Total	No.	5
Type: Vertical Turbine		
Capacity		
Total	gpm	5,769
Per Pump	gpm	1,442
Total Dynamic Head Required (TDH)	0.	
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	63
Selected	hp	100
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS		
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	994
Maximum (1.5*Flux Rate)	gpm	1,582
Total Dynamic Head Required (TDH)		
Water Surface EI to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

Table 2DPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara				
Description	Units	Criteria		
INFLUENT WET WELL				
Number of Wet Wells	No.	1		
Wet Well Dimensions (each)				
Depth	ft	15		
Length	ft	62		
Width	ft	18		
Volume	ft ³	16,740		
Volume	gallons	125,215		
Storage Time				
Design Flow	Minutes	22		

Table 3 DPR - Strainer / Pre-Screen	Design Criteria	
Subsurface Desalination In	take and Potable Reuse F	easibility Studies
City of Santa Barbara		
Description	Units	Criteria
Type: Filter (Strainer-type) w/ Automatic Clear	ning Mechanism	
Materials: Stainless Steel		
Filter Rating	micron	250
Maximum Pressure Drop		
Clean Filter ⁽¹⁾	psi	3
Before Backwash ⁽²⁾	psi	7
Number of Filters		
In-Service	No.	2
Reliability	No.	1
Total	No.	3
Capacity (Total)	gpm	5,769
Capacity (per Screen)	gpm	2,885
Filter Media Type:	-	Wedgewire
Filter Material:	-	316 SST
Maximum Backwash Flowrate	gpm	310
Backwash Duration	min	1
Total Backwash Waste	gal	310
Housing Design Pressure	psi	150
Motor Size		
Selected	hp	0.33
Drive	type	CS

Table 4DPR - Microfiltration Train DesignSubsurface Desalination Intake an City of Santa Barbara		e Feasibilit	y Studies
Description	Units	Crit	eria
General Criteria			
Type: Pressurized, Polymeric hollow fiber Microfiltration or			
Ultrafiltration			
Operating Strategy: Dead end flow			
Number of Microfiltration Trains			
In-Service	No.	6	
Reliability	No.	1	
Total	No.	7	7
Production Criteria			
Train Flux Rate			
Flux at Design Capacity (Net Production)	gfd	3	0
Flux at Design Capacity (Instantaneous)	gfd	3	5
Train Recovery Rate (Permeate/Feed Flow)			
Minimum	percent	94	%
Train Permeate Flow Rate			
Total	gpm (mgd)	5,423	(7.8)
Design	gpm (mgd)	904	(1.3)
Train Configuration			
Type: Open Platform (Non-proprietary)			
Membrane Manufacturer (No. 1)		Тог	ray
Module Model Number		202	20N
Membrane Area per Module		77	7 5
Number of Installed Modules per Train	No.	50	6
Number of Blank Modules per Train	No.	8	3
Number of Total Module Spaces per Train	No.	6	4
Backwash Criteria			
Type: Reverse Flow Followed by Simultaneous Air Scour and Drain			
Backwash Interval per Train			
Minimum	minutes	2	0
Maximum	minutes	3	0
Backwash Supply Flow Rate (Water)			
Flux	gfd	4	6
Flow	gpm	1,5	82
Backwash Duration	sec	4	5
Backwash Supply Flow Rate (Air)	scfm	448	
Volume of Wastewater Produced			
Per Backwash	gallons	1,1	87

Table 4 DPR - Microfiltration Train Detection	esign Criteria	
Subsurface Desalination Inta	ke and Potable Reuse	Feasibility Studie
City of Santa Barbara		
Description	Units	Criteria
Maintenance Clean Criteria (Typically only hypo c	<u>:lean)</u>	
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	17,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4,500
Sodium Hydroxide CIP	mg/L	5,000
 Note: 1) Calculated as 1.5 times the sodium hypochlorite dose. bisulfite per 1 mg of sodium hypochlorite. 	Stoichiometric demand is	1.34 mg sodium

	DPR - Microfiltration Backwash Air Scour Blowers Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara					
Description	Units	Criteria			
Type: Rotary Lobe					
Number of Blowers					
In-Service	No.	1			
Reliability	No.	1			
Total	No.	2			
Discharge Pressure	psi	13			
Air Flow Rate	Air Flow Rate scfm				
Design	scfm	392			
Maximum	scfm	448			
Motor Size	Motor Size				
Required	hp	32			
Selected	hp	50			
Drive	type	VFD			

Table 6	DPR - Ultraviolet Disinf	ection Design Criteria		
	Subsurface Desalinatio	n Intake and Potable Reuse Fe	easibility Stu	dies
	City of Santa Barbara			
	Description	Units	Crite	eria
Process Ty	/pe: Low Pressure High Outp	out Ultraviolet Light Reactor		
Manufactu	rer(s): Wedeco			
Model(s): s lamps	spektron 4000e w/ 600 watt			
Number of	UV Reactors			
In-Service	9	No.	1	
Reliability	,	No.	1	
Total		No.	2	
Flows				
Total Flow	v to Reactors	gpm (mgd)	5,423	(7.8)
Flow to E	ach Reactor	gpm (mgd)	5,423	(7.8)
UV Transm	nittance (UVT)	percent	90)
UV Dose ⁽¹⁾)	mJ/cm ²	11	0
Note:				
1) Dose rec	uired to achieve 4-log virus and	4-log protozoa inactivation.		

Table 7DPR - RO Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	5,423	
Per Pump	gpm	1,356	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	127	
Required (based on maximum discharge			
pressure)	hp	152	
Selected	hp	175	
Drive	type	VFD	
WETWELL			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time			
Design Flow	Minutes	17	

Table 8DPR - Reverse OsmoSubsurface DesalinatiCity of Santa Barbara	-		ility Studies
Description	Units	Cri	teria
Number of Reverse Osmosis Trains			
In-Service	No.		4
Reliability	No.		0
Total	No.		4
Train Flux Rate ⁽¹⁾	gfd		11
Recovery (Permeate/Feed Flow)	percent	80	0%
Total Permeate Flow	gpm (mgd)	4,338	(7.8)
Total Permeate Flow per Train	gpm (mgd)	1,085	(1.6)
Brine Flow per Train	gpm (mgd)	271	(0.39)
Number of Array Stages Per Train	No.		2
1st Stage			
Pressure Vessels per Train	No.	3	34
Elements per Pressure Vessel	No.	7	
2nd Stage			
Pressure Vessels per Train	No.		17
Elements per Pressure Vessel	No.		7
Number of Elements			
Per Train	No.	3	57
Total (In-Service)	No.	,	428
Membrana Manufacturar(a) ⁽²⁾			ilmTec,
Membrane Manufacturer(s) ⁽²⁾	_	•	uatics, or oray
			400/34i,
Membrane Model No. (2)		ESPA2-LD, or	
	-	TML2	0D-400
Membrane Area ⁽²⁾			
Per Element	sq. ft.	400	
Per Train	sq. ft.	142	2,800
Total (In-service)	sq. ft.	571,200	

Table 9DPR - RO Interstage Booster Pump Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
Type: Turbine assisted motorized boost	ter pump		
Manufacturer: FEDCO			
Model: LP-HEMI, LPH-240-125T			
LP-HEMI Units Per RO Train	No.	1	
Total Number of Units	No.	4	
Pump Data			
Stages	No.	1	
Flow			
At 80 Percent RO Recovery	gpm	629	
Minimum Total Dynamic Head (1)	ft	70	
Maximum Total Dynamic Head ⁽²⁾	ft	120	
Shaft Power			
Minimum Required	hp	14	
Maximum Required	hp	25	
Motor Data			
Drive	type	VFD	
Position: Vertical			
Power Rating	hp	30	
Notes:			
1) Clean-membrane (start-up) conditions.			
2) Fouled membrane (end of life), worst wa	ater quality conditions.		

Table 10		ction / AOP Design Criteria		•
	Subsurface Desa City of Santa Bar	lination Intake and Potable bara	e Reuse Feasibility	Studies
De	scription	Units	Crite	eria
Process Typ	be: Low Pressure Hig	h Output Ultraviolet Light Re	actor w/ NaOCI AO	Р
	er(s): Wedeco I43 w/ 600 watt			
Number of l	JV Reactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow	to Reactors	gpm (mgd)	4,338	(6.2)
Flow to Ea	ch Reactor	gpm (mgd)	4,338	(6.2)
UV Transmi	ttance (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	92	0
NaOCI Dose	9	mg/L	4	
Note: 1) Dose req process.	uired to achieve 6-log v	irus and 6-log protozoa inactiva	tion using hypochlori	te for the AOP

	euse Train - Storage and Ed	-
City of Santa Bar		e Reuse Feasibility Studies
Description	Units	Criteria
ENGINEERED STORAGE TAN	KS	
Product Flow	gpm	4,295
Number of Tanks	No.	2
Tank Dimensions		
Diameter	ft	70
Height	ft	35
Volume (each)	ft ³	134,696
Volume (each)	gallons	1,007,524
Volume (actual)	gallons	1,000,000
Volume (total)	gallons	2,000,000
Storage Time (w/ one tank out o service)	f	
Design Flow	Minutes	233
Design Flow	Hours	4
Storage Time (total)		
Design Flow	Minutes	466
Design Flow	Hours	8
Description	Units	Criteria
EQUALIZATION TANKS		
Product Flow	gpm	5,369
Number of Tanks	No.	2
Tank Dimensions		
Diameter	ft	82
Height	ft	35
Volume (each)	ft ³	184,836
Volume (each)	gallons	1,382,570
Volume (actual)	gallons	1,500,000
Volume (total)	gallons	3,000,000
Storage Time (each)		
Design Flow	Minutes	279
Design Flow	Hours	5
Storage Time (total)		
Design Flow	Minutes	559
Design Flow	Hours	9

Table 12 Sodium Hypochlorite Des	•			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara Sodium Hypochlorite Characteristics				
Concentration:	10.5 %			
Specific Gravity:	1.008			
Solution Strength:	0.88	lb/gal		
Parameters	Units	Criteria		
Ultraviolet Light / Advanced Oxidation Proce				
Chemical Usage				
Location: RO Permeate Before UV Reacto	rs			
Process Flow	MGD	6.2		
Chemical Dose	mg/L	4.0		
Chemical Usage	lb/day	209		
Chemical Feed Rate	gpd	237		
Chemical Feed Rate	gph	9.9		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	9.9		
AWTF MF/UF Maintenance Cleans (MC)	51			
Chemical Usage				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	300		
Chemical Usage	lb/day	43.8		
Chemical Feed Rate	gpd	49.7		
AWTF MF/UF Clean-in-Place (CIP)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	3,000		
Chemical Usage	lb/month	438.1		
Chemical Feed Rate	gpm	497.2		
Chemical Feed Rate	gpd	16.6		
WTP MF/UF Maintenance Cleans (MC)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	5		

Table 12Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Parameters	Units	Criteria	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	300	
Chemical Usage	lb/day	31.3	
Chemical Feed Rate	gpd	35.5	
WTP MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	5	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	3,000	
Chemical Usage	lb/month	312.9	
Chemical Feed Rate	gpm	355.1	
Chemical Feed Rate	gpd	11.8	
Bulk Storage Tanks			
Number of Tanks	No.	2	
Tank Capacity, each	gal	5,500	
Tank Capacity, total	gal	11,000	
UV/AOP Usage	gal/day	237	
MF/UF Maintenance Cleans	gal/day	85.2	
MF/UF CIPs	gal/day	28.4	
Total Usage	gal/day	350	
Storage Time	days	31	
Delivery Truck Full Load	gal	3,000	
Time Between Delivery	days	9	

Table 13 Sulfuric Acid Desig	n Criteria			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies				
City of Santa Barbara				
Sulfuric Acid Characteristics				
Concentration:	93 %			
Specific Gravity:	1.83			
Solution Strength:	14.17	lb/gal		
Parameters	Units	Criteria		
DPR RO Pretreatment				
Chemical Usage				
Location: Reverse Osmosis Feed	k			
Process Flow	MGD	7.8		
Chemical Dose	mg/L	115		
Chemical Usage	lb/day	7,494		
Chemical Feed Rate	gpd	529		
Chemical Feed Rate	gph	22.0		
No. of Standby Pumps	-	1		
No. of Pumps in Service	-	1		
Chemical Feed Rate Per Pump	gph	22.0		
Bulk Storage Tanks				
Number of Tanks	No.	2		
Tank Capacity, each	gal	8,000		
Tank Capacity, total	gal	16,000		
Total Usage	gal/day	529		
Storage Time	days	30		
Delivery Truck Full Load	gal	3,000		
Time Between Delivery	days	6		

Table 14Lime Slurry Design CriteriaSubsurface Desalination IntalCity of Santa Barbara	e and Potable Reuse	e Feasibility Studies
Lime Characteristics		
Lime Purity	%	97%
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30
Concentration:	%	35 %
Specific Gravity:		1.271
Solution Strength:	lb/gal	3.70
Parameters	Units	Criteria
DPR Post Treatment		
Chemical Usage		
Location: Before Treated Water Wet Well		
Process Flow	MGD	6.2
Chemical Dose	mg/L	25
Chemical Dose (as stored weight)	mg/L	26
Chemical Usage	lb/day	1,330
Chemical Feed Rate	gpd	359
Chemical Feed Rate	gph	15.0
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	15.0
Lime Storage Silos		
Number of Silos	No.	1
Silo Capacity, each	cu ft	2,500
Silo Capacity, each	lbs	75,000
Silo Capacity, total	Tons	37.5
Silo Diameter, each	ft	13
Silo Sideshell Height, each	ft	19
Dry Usage	lbs/day	1,330
Dry Usage	tons/day	0.7
Storage Time	days	56
Delivery Truck Full Load	tons	24
Time Between Delivery	days	36

Table 15Scale Inhibitor Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Scale Inhibitor Characteristics		
Manufacturer/Product:	Avista Vitec 3000	
Concentration:	100 %	
Specific Gravity:	1.2	
Solution Strength:	9.99	lb/gal
Parameters	Units	Criteria
DPR - RO Pretreatment		
Chemical Usage		
Location: Reverse Osmosis Feed		
Process Flow	MGD	7.8
Chemical Dose	mg/L	4.0
Chemical Usage	lb/day	261
Chemical Feed Rate	gpd	26
Chemical Feed Rate	gph	1.1
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	1.1
Chemical Feed Rate Per Pump	gpm	0.02
Bulk Storage Totes		
Number of Totes	No.	4
Tote Capacity, each	gal	250
Tote Capacity, total	gal	1,000
DPR RO Pretreatment	gal/day	26
Total Usage	gal/day	26
Storage Time	days	38
Delivery Truck Full Load	gal	250
Time Between Delivery	days	10

Ū.	Citric Acid Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Citric Acid Characteristics			
Concentration:	50 %		
Specific Gravity:	1.15		
Solution Strength:	4.79	lb/gal	
Parameters	Units	Criteria	
AWTF MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	730.2	
Chemical Feed Rate	gpm	152.5	
Chemical Feed Rate	gpd	5.1	
WTP MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	5	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	521.6	
Chemical Feed Rate	gpm	108.9	
Chemical Feed Rate	gpd	3.6	
Bulk Storage Totes			
Number of Totes	No.	2	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	500	
MF/UF CIP	gal/month	261.5	
Total Usage	gal/month	261.5	
Storage Time	days	57	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	29	

Table 17Caustic Soda Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Caustic Soda Characteristics			
Concentration:	50 %		
Specific Gravity:	1.53		
Solution Strength:	6.37	lb/gal	
Parameters	Units	Criteria	
AWTF MF/UF Clean-in-Place (CIP) (neutr	alize CA)		
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	730.2	
Chemical Feed Rate	gpm	114.6	
Chemical Feed Rate	gpd	3.8	
WTP MF/UF Clean-in-Place (CIP) (neutra	<u>lize CA)</u>		
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	5	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	521.6	
Chemical Feed Rate	gpm	81.9	
Chemical Feed Rate	gpd	2.7	
Bulk Storage Tote			
Number of Totes	No.	2	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	500	
MF/UF CIPs	gal/month	196.5	
Total Usage	gal/month	196.5	
Storage Time	days	76	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	38	

Table 18 Sodium Bisulfite Design Critical			
	Subsurface Desalination Intake and Potable Reuse Feasibility Studies		
City of Santa Barbara			
Sodium Bisulfite Characteristics	22 0/		
Concentration:	38 %		
Specific Gravity:	1.3		
Solution Strength:	4.11	lb/gal	
Parameters	Units	Criteria	
AWTF MF/UF Maintenance Cleans (MC)			
Chemical Usage (NaOCI Neutralization)			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	441	
Chemical Usage	lb/day	64.4	
Chemical Feed Rate	gpd	15.7	
AWTF MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	4,500	
Chemical Usage	lb/month	657.2	
Chemical Feed Rate	gpm	159.8	
Chemical Feed Rate	gpd	5.3	
WTP MF/UF Maintenance Cleans (MC)	•		
Chemical Usage (NaOCI Neutralization)			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	5	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	441	
Chemical Usage	lb/day	46.0	
Chemical Feed Rate	gpd	11.2	
WTP MF/UF Clean-in-Place (CIP)	315 -		
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	5	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	4,500	

Table 18Sodium Bisulfite ISubsurface DesaliCity of Santa Barb	ination Intake and Potable Re	use Feasibility Studies
Parameters	Units	Criteria
Chemical Usage	lb/month	469.4
Chemical Feed Rate	gpm	114.1
Chemical Feed Rate	gpd	3.8
Bulk Storage Totes		
Number of Totes	No.	4
Tote Capacity, each	gal	250
Tote Capacity, total	gal	1,000
MF/UF Maintenance Clean	gal/day	26.8
MF/UF CIP	gal/day	9.1
Total Usage	gal/day	36
Storage Time	days	28
Delivery Truck Full Load	gal	250
Time Between Delivery	days	7

Table 19 DPR - WTP Microfiltration Feed Put	Imp Station Design C	riteria
Subsurface Desalination Intake and Potable Reuse Feasibility Studies		
City of Santa Barbara		
Description	Units	Criteria
MICROFILTRATION FEED PUMPS		
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	4,338
Per Pump	gpm	1,446
Total Dynamic Head Required (TDH)		
Water Surface EI to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	64
Selected	hp	75
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS		
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	1,181
Maximum (1.3*Flux Rate)	gpm	1,567
Total Dynamic Head Required (TDH)		
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

Table 19DPR - WTP Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Description	Units	Criteria
INFLUENT WET WELL		
Number of Wet Wells	No.	1
Wet Well Dimensions (each)		
Depth	ft	15
Length	ft	50
Width	ft	15
Volume	ft ³	11,250
Volume	gallons	84,150
Storage Time		
Design Flow	Minutes	19

Table 20 DPR - WTP Strainer / Pre-Sc	reen Design Criteria	
Subsurface Desalination Inte	ake and Potable Reuse Feas	sibility Studies
City of Santa Barbara		
Description	Units	Criteria
Type: Filter (Strainer-type) w/ Automatic Cleani	ing Mechanism	
Materials: Stainless Steel		
Filter Rating	micron	250
Maximum Pressure Drop		
Clean Filter ⁽¹⁾	psi	3
Before Backwash (2)	psi	7
Number of Filters		
In-Service	No.	2
Reliability	No.	1
Total	No.	3
Capacity (Total)	gpm	4,338
Capacity (per Screen)	gpm	2,169
Filter Media Type:	-	Wedgewire
Filter Material:	-	316 SST
Maximum Backwash Flowrate	gpm	310
Backwash Duration	min	1
Total Backwash Waste	gal	310
Housing Design Pressure	psi	150
Motor Size		
Selected	hp	0.33
Drive	type	CS

Table 21 DPR - WTP Microfiltration Train	-			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara				
Description	Units	Crite	eria	
General Criteria				
Type: Pressurized, Polymeric hollow fiber				
Microfiltration or Ultrafiltration				
Operating Strategy: Dead end flow				
Number of Microfiltration Trains				
In-Service	No.	4		
Reliability	No.	1		
Total	No.	5		
Production Criteria				
Train Flux Rate				
Flux at Design Capacity (Net Production)	gfd	36	6	
Flux at Design Capacity (Instantaneous)	gfd	4()	
Train Recovery Rate (Permeate/Feed Flow)	U U			
Minimum	percent	949	%	
Train Permeate Flow Rate				
Total	gpm (mgd)	4,295	(6.2)	
Design	gpm (mgd)	1,074	(1.5)	
Train Configuration	51 (5*)			
Type: Open Platform (Non-proprietary)				
Membrane Manufacturer (No. 1)		Tor	av	
Module Model Number		202		
Membrane Area per Module		77		
Number of Installed Modules per Train	No.	56		
Number of Blank Modules per Train	No.	8		
Number of Total Module Spaces per Train	No.	64		
Backwash Criteria	NO.	0		
Type: Reverse Flow Followed by Simultaneous Air				
Scour and Drain				
Backwash Interval per Train				
Minimum	minutes	20)	
Maximum	minutes	30)	
Backwash Supply Flow Rate (Water)				
Flux	gfd	52	2	
Flow	gpm	1,50		
Backwash Duration	sec	45		
Backwash Supply Flow Rate (Air)	scfm	44		
Volume of Wastewater Produced	30111		-	
Per Backwash	Gallons	1,1	75	

Table 21 DPR - WTP Microfiltration Train Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara Description

Description	Units	Criteria
Maintenance Clean Criteria (Typically only hyp	o clean)	
Maintenance Clean Frequency	days	3
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	4,167
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	12,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4,500
Sodium Hydroxide CIP	mg/L	5,000
Note:		

Note:

1) Calculated as 1.5 times the sodium hypochlorite dose. Stoichiometric demand is 1.34 mg sodium bisulfite per 1 mg of sodium hypochlorite.

Table 22		on Backwash Air Scour Blo n Intake and Potable Reuse	-
	City of Santa Barbara	I Intake and I Otable Neuse	e i easibility Studies
	Description	Units	Criteria
Type: Rotary	Lobe		
Number of Blo	owers		
In-Service		No.	1
Reliability		No.	1
Total		No.	2
Discharge Pre	essure	psi	13
Air Flow Rate		scfm	
Design		scfm	392
Maximum		scfm	448
Motor Size			
Required		hp	32
Selected		hp	50
Drive		type	VFD

Table 23Direct Potable Reuse Train - FSubsurface Desalination IntakCity of Santa Barbara	•	
Description	Units	Criteria
FINISHED WATER PUMPS TO SOUTH COAST	CONDUIT	
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	4,295
Per Pump	gpm	1,432
Total Dynamic Head Required (TDH)		
Head required to reach reservoir	feet	534
Average Pump TDH	feet	554
Maximum Pump TDH	feet	584
Motor Size		
Average operating	hp	250
Required (based on maximum discharge press	ure) hp	264
Selected	hp	275
Drive	type	VFD

Table 1 Process Flow Rates -	IPR Facility Alt 3a		
	tion Intake and Potable	Reuse Feasibilit	y Studies
City of Santa Barbara	1	Direct Data	
Description	Units	Direct Pota	
Description	Units	Capac	ities
Source and Finished Water Flows			
City Secondary Effluent	AFY	8,60	
City Secondary Effluent	gpm (mgd)	5,369	(7.7)
Process Flows: AWTF			
Microfiltration			
Recovery	%	949	-
Permeate Flow	gpm (mgd)	5,369	(7.7)
Feedwater Flow ¹	gpm (mgd)	5,712	(8.2)
Backwash Flow	gpm (mgd)	343	(0.5)
Process Flows: NPR			
Flow to NPR System	gpm (mgd)	868	(1.2)
Reverse Osmosis			
Recovery	%	809	%
Permeate Flow	gpm (mgd)	3,601	(5.2)
Feedwater Flow	gpm (mgd)	4,501	(6.5)
Brine Flow	gpm (mgd)	900	(1.3)
UV / AOP			
Process Flow	gpm (mgd)	3,601	(5.2)
Total Finished Water Flows			
Total NPR Flow	gpm (mgd)	868	(1.2)
Total IPR Flow	gpm (mgd)	3,601	(5.2)
Total Usable Flow	gpm (mgd)	4,469	(6.4)
Total NPR Flow	AFY	1,40	00
Total IPR Flow	AFY	5,80	
Total Usable Flow	AFY	7,20	08
Recovery of WWTP Effluent	%	83%	
Note:			
1) MF backwash is recycled to head of WV	VTP. Instantaneous flow is	higher than permea	te flow.

Table 2 IPR - Microfiltration Feed Pu		
Subsurface Desalination Int	ake and Potable Rei	use Feasibility Studies
City of Santa Barbara Description	Units	Criteria
MICROFILTRATION FEED PUMPS	Onits	Onteria
Number of Pumps		
In-Service	No.	4
Reliability	No.	1
Total	No.	5
Type: Vertical Turbine		Ũ
Capacity		
Total	gpm	5,712
Per Pump	gpm	1,428
Total Dynamic Head Required (TDH)	98	1,120
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	20
Maximum Discharge Pressure	psi	45
Safety Factor	ft	20
Design Pump TDH	feet	134
Motor Size		
Required	hp	63
Selected	hp	100
Drive	type	VFD
MICROFILTRATION BACKWASH PUMPS	51	
Number of Pumps		
In-Service	No.	1
Reliability	No.	1
Total	No.	2
Type: Vertical Turbine		
Capacity (per pump)		
Design (1.1*Flux Rate)	gpm	984
Maximum (1.5*Flux Rate)	gpm	1,582
Total Dynamic Head Required (TDH)	•	
Water Surface El to Pump Discharge	ft	10
Minimum Discharge Pressure	psi	10
Maximum Discharge Pressure	, psi	30
Safety Factor	ft	20
Design Pump TDH	feet	103
Motor Size		
Required	hp	53
Selected	hp	60
Drive	type	VFD

	Feed Pump Station Design (tion Intake and Potable Reu a	
Description	Units	Criteria
INFLUENT WET WELL		
Number of Wet Wells	No.	1
Wet Well Dimensions (each)		
Depth	ft	15
Length	ft	62
Width	ft	18
Volume	ft ³	16,740
Volume	gallons	125,215
Storage Time		
Design Flow	Minutes	22

Table 3 IPR - Strainer / Pre-Screen I	Design Criteria	
Subsurface Desalination In	take and Potable Reuse F	easibility Studies
City of Santa Barbara		
Description	Units	Criteria
Type: Filter (Strainer-type) w/ Automatic Clear	ning Mechanism	
Materials: Stainless Steel		
Filter Rating	micron	250
Maximum Pressure Drop		
Clean Filter ⁽¹⁾	psi	3
Before Backwash ⁽²⁾	psi	7
Number of Filters		
In-Service	No.	2
Reliability	No.	1
Total	No.	3
Capacity (Total)	gpm	5,712
Capacity (per Screen)	gpm	2,856
Filter Media Type:	-	Wedgewire
Filter Material:	-	316 SST
Maximum Backwash Flowrate	gpm	310
Backwash Duration	min	1
Total Backwash Waste	gal	310
Housing Design Pressure	psi	150
Motor Size		
Selected	hp	0.33
Drive	type	CS

Table 4 IPR - Microfiltration Train Design Subsurface Desclination Intols Intols		e Feesibili	
Subsurface Desalination Intake a City of Santa Barbara	ind Potable Reus	e reasibili	ty Studies
Description	Units	Crit	eria
General Criteria			
Type: Pressurized, Polymeric hollow fiber Microfiltration of	or		
Ultrafiltration			
Operating Strategy: Dead end flow			
Number of Microfiltration Trains			
In-Service	No.		6
Reliability	No.		1
Total	No.	7	7
Production Criteria			
Train Flux Rate			
Flux at Design Capacity (Net Production)	gfd	3	0
Flux at Design Capacity (Instantaneous)	gfd	3	5
Train Recovery Rate (Permeate/Feed Flow)			
Minimum	percent	94	%
Train Permeate Flow Rate			
Total	gpm (mgd)	5,369	(7.7)
Design	gpm (mgd)	895	(1.3)
Train Configuration			
Type: Open Platform (Non-proprietary)			
Membrane Manufacturer (No. 1)		То	ray
Module Model Number		202	20N
Membrane Area per Module		77	75
Number of Installed Modules per Train	No.	5	6
Number of Blank Modules per Train	No.	8	3
Number of Total Module Spaces per Train	No.	6	4
Backwash Criteria			
Type: Reverse Flow Followed by Simultaneous Air Scour and Drain			
Backwash Interval per Train			
Minimum	minutes	2	0
Maximum	minutes	3	0
Backwash Supply Flow Rate (Water)			
Flux	gfd	4	6
Flow	gpm		582
Backwash Duration	Sec	4	
Backwash Supply Flow Rate (Air)	scfm	44	
Volume of Wastewater Produced			
Per Backwash	gallons	1.1	87

Table 4 IPR - Microfiltration Train De	sign Criteria	
Subsurface Desalination Inta	•	Feasibility Studi
City of Santa Barbara		
Description	Units	Criteria
Maintenance Clean Criteria (Typically only hypo o	<u>clean)</u>	
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	17,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4,500
Sodium Hydroxide CIP	mg/L	5,000
 Note: 1) Calculated as 1.5 times the sodium hypochlorite dose. bisulfite per 1 mg of sodium hypochlorite. 	Stoichiometric demand is	1.34 mg sodium

Table 5IPR - Microfiltration Backwash Air Scour Blowers Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
Type: Rotary Lobe			
Number of Blowers			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Discharge Pressure	psi	13	
Air Flow Rate	scfm		
Design	scfm	392	
Maximum	scfm	448	
Motor Size			
Required	hp	32	
Selected	hp	50	
Drive	type	VFD	

Table 6IPR - RO Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara	11.24	0.14	
Description	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	4,501	
Per Pump	gpm	1,125	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	106	
Required (based on maximum discharge	h a	400	
pressure)	hp	126	
Selected	hp	150	
	type	VFD	
	Nie	4	
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)	6	10	
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time			
Design Flow	Minutes	20	

Table 7IPR - Reverse OsmosSubsurface Desalinati	-		ilitv Studies
City of Santa Barbara			-
Description	Units	Cri	teria
Number of Reverse Osmosis Trains			
In-Service	No.		4
Reliability	No.		0
Total	No.		4
Train Flux Rate ⁽¹⁾	gfd		11
Recovery (Permeate/Feed Flow)	percent	8	0%
Total Permeate Flow	gpm (mgd)	3,601	(6.5)
Total Permeate Flow per Train	gpm (mgd)	900	(1.3)
Brine Flow per Train	gpm (mgd)	225	(0.32)
Number of Array Stages Per Train	No.		2
1st Stage			
Pressure Vessels per Train	No.	28	
Elements per Pressure Vessel	No.	7	
2nd Stage			
Pressure Vessels per Train	No.	1714	
Elements per Pressure Vessel	No.	7	
Number of Elements			
Per Train	No.	2	94
Total (In-Service)	No.	1,	176
			ilmTec,
Membrane Manufacturer(s) ⁽²⁾		•	uatics, or
	-		oray ∙400/34i,
Membrane Model No. (2)			2-LD, or
	-		0D-400
Membrane Area ⁽²⁾			
Per Element	sq. ft.	4	.00
Per Train	sq. ft.	117	7,600
Total (In-service)	sq. ft.	470,400	

	ion Intake and Potable	Criteria e Reuse Feasibility Studies
City of Santa Barbara Description	Units	Criteria
Type: Turbine assisted motorized boost	er pump	
Manufacturer: FEDCO		
Model: LP-HEMI, LPH-240-125T		
LP-HEMI Units Per RO Train	No.	1
Total Number of Units	No.	4
Pump Data		
Stages	No.	1
Flow		
At 80 Percent RO Recovery	gpm	526
Minimum Total Dynamic Head (1)	ft	70
Maximum Total Dynamic Head (2)	ft	120
Shaft Power		
Minimum Required	hp	12
Maximum Required	hp	21
Motor Data		
Drive	type	VFD
Position: Vertical		
Power Rating	hp	25
Notes:		
1) Clean-membrane (start-up) conditions.		
2) Fouled membrane (end of life), worst wa	ater quality conditions.	

Table 9	IPR - UV Disinfectio	n / AOP Design Criteria		
	Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
	City of Santa Barba	ra		
	Description	Units	Crite	eria
Process Typ	e: Low Pressure High C	Output Ultraviolet Light Read	ctor w/ NaOCI AC	P
Manufacture	er(s): Wedeco			
Model(s): k1	43 w/ 600 watt lamps			
Number of L	JV Reactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow	to Reactors	gpm (mgd)	3,601	(5.2)
Flow to Ea	ch Reactor	gpm (mgd)	3,601	(5.2)
UV Transmit	ttance (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	92	0
NaOCI Dose)	mg/L	4	
Note: 1) Dose requ process.	uired to achieve 6-log virus	s and 6-log protozoa inactivati	on using hypochlor	ite for the AOP

Table 10Indirect Potable Reuse Train - Storage and Equalization Tanks Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara			
Description	Units	Criteria	
ENGINEERED STORAGE TANKS			
Product Flow	gpm	3,601	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	70	
Height	ft	35	
Volume (each)	ft ³	134,696	
Volume (each)	gallons	1,007,524	
Volume (actual)	gallons	1,000,000	
Volume (total)	gallons	2,000,000	
Storage Time (w/ one tank out of service)			
Design Flow	Minutes	278	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	555	
Design Flow	Hours	9	
Description	Units	Criteria	
EQUALIZATION TANKS			
Product Flow	gpm	5,369	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	82	
Height	ft	35	
Volume (each)	ft ³	184,836	
Volume (each)	gallons	1,382,570	
Volume (actual)	gallons	1,500,000	
Volume (total)	gallons	3,000,000	
Storage Time (each)			
Design Flow	Minutes	279	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	559	
Design Flow	Hours	9	

	Sodium Hypochlorite Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Sodium Hypochlorite Characteristics			
Concentration:	10.5 %		
Specific Gravity:	1.008		
Solution Strength:	0.88	lb/gal	
Parameters	Units	Criteria	
Ultraviolet Light / Advanced Oxidation Proce	<u>SS</u>		
Chemical Usage			
Location: RO Permeate Before UV Reactor	S		
Process Flow	MGD	5.2	
Chemical Dose	mg/L	4.0	
Chemical Usage	lb/day	173	
Chemical Feed Rate	gpd	196	
Chemical Feed Rate	gph	8.2	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	8.2	
MF/UF Maintenance Cleans (MC)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	300	
Chemical Usage	lb/day	43.8	
Chemical Feed Rate	gpd	49.7	
MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	3,000	
Chemical Usage	lb/month	438.1	
Chemical Feed Rate	gpm	497.2	
Chemical Feed Rate	gpd	16.6	

Table 11Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Parameters	Units	Criteria
Bulk Storage Tanks		
Number of Tanks	No.	2
Tank Capacity, each	gal	5,500
Tank Capacity, total	gal	11,000
UV/AOP Usage	gal/day	196
MF/UF Maintenance Cleans	gal/day	49.7
MF/UF CIPs	gal/day	16.6
Total Usage	gal/day	263
Storage Time	days	42
Delivery Truck Full Load	gal	3,000
Time Between Delivery	days	11

Table 12	Sulfuric Acid Design (Criteria	
	Subsurface Desalination Intake and Potable Reuse Feasibility Studies		
	City of Santa Barbara		-
Sulfuric Acid	Characteristics		
Concentra	tion:	93 %	
Specific Gr	ravity:	1.83	
Solution S	trength:	14.17	lb/gal
Parameters		Units	Criteria
IPR RO Pretre	atment		
Chemical Usag	ge		
Location: R	Reverse Osmosis Feed		
Process Flo	OW	MGD	6.5
Chemical D	Dose	mg/L	115
Chemical L	Jsage	lb/day	6,220
Chemical F	Feed Rate	gpd	439
Chemical F	Feed Rate	gph	18.3
No. of Star	ndby Pumps	-	1
No. of Pum	ips in Service	-	1
Chemical Fee	ed Rate Per Pump	gph	18.3
Bulk Storage T	<u>anks</u>		
Number of	Tanks	No.	2
Tank Cap	acity, each	gal	8,000
Tank Cap	acity, total	gal	16,000
Total Usa	ge	gal/day	439
Storage Tir	ne	days	36
Delivery Tr	uck Full Load	gal	3,000
Time Betwo	een Delivery	days	7

Table 13Lime Slurry Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Lime Characteristics			
Lime Purity	%	97%	
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30	
Concentration:	%	35 %	
Specific Gravity:		1.271	
Solution Strength:	lb/gal	3.70	
Parameters	Units	Criteria	
IPR Post Treatment			
Chemical Usage			
Location: Before Treated Water Wet Well			
Process Flow	MGD	5.2	
Chemical Dose	mg/L	25	
Chemical Dose (as stored weight)	mg/L	26	
Chemical Usage	lb/day	1,115	
Chemical Feed Rate	gpd	301	
Chemical Feed Rate	gph	12.5	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	12.5	
Lime Storage Silos			
Number of Silos	No.	1	
Silo Capacity, each	cu ft	2,500	
Silo Capacity, each	lbs	75,000	
Silo Capacity, total	Tons	37.5	
Silo Diameter, each	ft	13	
Silo Sideshell Height, each	ft	19	
Dry Usage	lbs/day	1,115	
Dry Usage	tons/day	0.6	
Storage Time	days	67	
Delivery Truck Full Load	tons	24	
Time Between Delivery	days	43	

Subsurface Desalina	le 14 Scale Inhibitor Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Scale Inhibitor Characteristics			
Manufacturer/Product:	Avista Vitec 3000		
Concentration:	100 %		
Specific Gravity:	1.2		
Solution Strength:	9.99	lb/gal	
Parameters	Units	Criteria	
IPR - RO Pretreatment			
Chemical Usage			
Location: Reverse Osmosis Feed			
Process Flow	MGD	6.5	
Chemical Dose	mg/L	4.0	
Chemical Usage	lb/day	216	
Chemical Feed Rate	gpd	22	
Chemical Feed Rate	gph	0.9	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	0.9	
Chemical Feed Rate Per Pump	gpm	0.02	
Bulk Storage Totes			
Number of Totes	No.	4	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	1,000	
DPR RO Pretreatment	gal/day	22	
Total Usage	gal/day	22	
Storage Time	days	46	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	12	

Table 15 Citric Acid Design Crite	eria	
Subsurface Desalinatio	on Intake and Potal	ble Reuse Feasibility Studies
City of Santa Barbara		-
Citric Acid Characteristics		
Concentration:	50 %	
Specific Gravity:	1.15	
Solution Strength:	4.79	lb/gal
Parameters	Units	Criteria
MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	730.2
Chemical Feed Rate	gpm	152.5
Chemical Feed Rate	gpd	5.1
Bulk Storage Totes		
Number of Totes	No.	2
Tote Capacity, each	gal	250
Tote Capacity, total	gal	500
MF/UF CIP	gal/month	152.5
Total Usage	gal/month	152.5
Storage Time	days	98
Delivery Truck Full Load	gal	250
Time Between Delivery	days	49

Table 16 Caustic Soda Design	Criteria		
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Caustic Soda Characteristics			
Concentration:	50 %		
Specific Gravity:	1.53		
Solution Strength:	6.37	lb/gal	
Parameters	Units	Criteria	
MF/UF Clean-in-Place (CIP) (neutralize C	<u>(A)</u>		
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	5,000	
Chemical Usage	lb/month	730.2	
Chemical Feed Rate	gpm	114.6	
Chemical Feed Rate	gpd	3.8	
Bulk Storage Tote			
Number of Totes	No.	2	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	500	
MF/UF CIPs	gal/month	114.6	
Total Usage	gal/month	114.6	
Storage Time	days	131	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	65	

•	Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
Sodium Bisulfite Characteristics				
Concentration:	38 %			
Specific Gravity:	1.3			
Solution Strength:	4.11	lb/gal		
Parameters	Units	Criteria		
MF/UF Maintenance Cleans (MC)				
Chemical Usage (NaOCI Neutralization)				
Location: MF/UF CIP Tank				
Number of MC per Day per Rack	No.	1		
Number of MC per Day	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	441		
Chemical Usage	lb/day	64.4		
Chemical Feed Rate	gpd	15.7		
MF/UF Clean-in-Place (CIP)				
Chemical Usage				
Location: MF/UF CIP Tank				
Number of CIP per month per Rack	No.	1		
Number of CIP per month per Rack	No.	7		
Cleaning volume	gallons	2,500		
Chemical Dose	mg/L	4,500		
Chemical Usage	lb/month	657.2		
Chemical Feed Rate	gpm	159.8		
Chemical Feed Rate	gpd	5.3		
Bulk Storage Totes				
Number of Totes	No.	4		
Tote Capacity, each	gal	250		
Tote Capacity, total	gal	1,000		
MF/UF Maintenance Clean	gal/day	15.7		
MF/UF CIP	gal/day	5.3		
Total Usage	gal/day	21		
Storage Time	days	48		
Delivery Truck Full Load	gal	250		
Time Between Delivery	days	12		

Table 18Indirect Potable Reuse Train - Finished Subsurface Desalination Intake and Po City of Santa Barbara	•	
Description	Units	Criteria
FINISHED WATER PUMPS TO IPR INJECTION WELLS		
Number of Pumps		
In-Service	No.	3
Reliability	No.	1
Total	No.	4
Type: Vertical Turbine		
Capacity		
Total	gpm	3,601
Per Pump	gpm	1,200
Total Dynamic Head Required (TDH)		
Head required to reach reservoir	feet	373
Average Pump TDH	feet	393
Maximum Pump TDH	feet	423
Motor Size		
Average operating	hp	149
Required (based on maximum discharge pressure)	hp	160
Selected	hp	175
Drive	type	VFD

Table 1Process Flow Rates - IPR Facility Alt 3bSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
		Direct Pota	ble Reuse
Description	Units	Capac	ities
Source and Finished Water Flows			
City Secondary Effluent	AFY	8,60	60
City Secondary Effluent	gpm (mgd)	5,369	(7.7)
Process Flows: AWTF			
Microfiltration			
Recovery	%	949	%
Permeate Flow	gpm (mgd)	5,369	(7.7)
Feedwater Flow ¹	gpm (mgd)	5,712	(8.2)
Backwash Flow	gpm (mgd)	343	(0.5)
Reverse Osmosis			
Recovery	%	809	%
Permeate Flow	gpm (mgd)	4,295	(6.2)
Feedwater Flow	gpm (mgd)	5,369	(7.7)
Brine Flow	gpm (mgd)	1,074	(1.5)
UV / AOP			
Process Flow	gpm (mgd)	4,295	(6.2)
Total Finished Water Flows			
Total NPR Flow	gpm (mgd)	0	(0.0)
Total IPR Flow	gpm (mgd)	4,295	(6.2)
Total Usable Flow	gpm (mgd)	4,295	(6.2)
Total NPR Flow	AFY	0	
Total IPR Flow	AFY	6,92	28
Total Usable Flow	AFY	6,92	28
Recovery of WWTP Effluent	%	80%	
Note:			
1) MF backwash is recycled to head of WV	WTP. Instantaneous flow is	higher than permea	te flow.

Table 2 IPR - Microfiltration Feed Pu			
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara Description	Units	Criteria	
MICROFILTRATION FEED PUMPS	Onits	Onteria	
Number of Pumps			
In-Service	No.	4	
Reliability	No.	1	
Total	No.	5	
Type: Vertical Turbine		Ũ	
Capacity			
Total	gpm	5,712	
Per Pump	gpm	1,428	
Total Dynamic Head Required (TDH)	98	1,120	
Water Surface El to Pump Discharge	ft	10	
Minimum Discharge Pressure	psi	20	
Maximum Discharge Pressure	psi	45	
Safety Factor	ft	20	
Design Pump TDH	feet	134	
Motor Size			
Required	hp	63	
Selected	hp	100	
Drive	type	VFD	
MICROFILTRATION BACKWASH PUMPS	51		
Number of Pumps			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Type: Vertical Turbine			
Capacity (per pump)			
Design (1.1*Flux Rate)	gpm	984	
Maximum (1.5*Flux Rate)	gpm	1,582	
Total Dynamic Head Required (TDH)	•		
Water Surface El to Pump Discharge	ft	10	
Minimum Discharge Pressure	psi	10	
Maximum Discharge Pressure	, psi	30	
Safety Factor	ft	20	
Design Pump TDH	feet	103	
Motor Size			
Required	hp	53	
Selected	hp	60	
Drive	type	VFD	

Table 2IPR - Microfiltration Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Description	Units	Criteria
INFLUENT WET WELL		
Number of Wet Wells	No.	1
Wet Well Dimensions (each)		
Depth	ft	15
Length	ft	62
Width	ft	18
Volume	ft ³	16,740
Volume	gallons	125,215
Storage Time		
Design Flow	Minutes	22

Table 3 IPR - Strainer / Pre-Screen I	Design Criteria		
Subsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara			
Description	Units	Criteria	
Type: Filter (Strainer-type) w/ Automatic Clear	ning Mechanism		
Materials: Stainless Steel			
Filter Rating	micron	250	
Maximum Pressure Drop			
Clean Filter ⁽¹⁾	psi	3	
Before Backwash ⁽²⁾	psi	7	
Number of Filters			
In-Service	No.	2	
Reliability	No.	1	
Total	No.	3	
Capacity (Total)	gpm	5,712	
Capacity (per Screen)	gpm	2,856	
Filter Media Type:	-	Wedgewire	
Filter Material:	-	316 SST	
Maximum Backwash Flowrate	gpm	310	
Backwash Duration	min	1	
Total Backwash Waste	gal	310	
Housing Design Pressure	psi	150	
Motor Size			
Selected	hp	0.33	
Drive	type	CS	

Table 4 IPR - Microfiltration Train Design Subsurface Desclination Intols Intols		e Feesibili	
Subsurface Desalination Intake a City of Santa Barbara	ind Potable Reus	e reasibili	ty Studies
Description	Units	Crit	eria
General Criteria			
Type: Pressurized, Polymeric hollow fiber Microfiltration of	or		
Ultrafiltration			
Operating Strategy: Dead end flow			
Number of Microfiltration Trains			
In-Service	No.		6
Reliability	No.		1
Total	No.	7	7
Production Criteria			
Train Flux Rate			
Flux at Design Capacity (Net Production)	gfd	3	0
Flux at Design Capacity (Instantaneous)	gfd	3	5
Train Recovery Rate (Permeate/Feed Flow)			
Minimum	percent	94	%
Train Permeate Flow Rate			
Total	gpm (mgd)	5,369	(7.7)
Design	gpm (mgd)	895	(1.3)
Train Configuration			
Type: Open Platform (Non-proprietary)			
Membrane Manufacturer (No. 1)		То	ray
Module Model Number		202	20N
Membrane Area per Module		77	75
Number of Installed Modules per Train	No.	5	6
Number of Blank Modules per Train	No.	8	3
Number of Total Module Spaces per Train	No.	6	4
Backwash Criteria			
Type: Reverse Flow Followed by Simultaneous Air Scour and Drain			
Backwash Interval per Train			
Minimum	minutes	2	0
Maximum	minutes	3	0
Backwash Supply Flow Rate (Water)			
Flux	gfd	4	6
Flow	gpm		582
Backwash Duration	Sec	4	
Backwash Supply Flow Rate (Air)	scfm	44	
Volume of Wastewater Produced			
Per Backwash	gallons	1.1	87

Table 4 IPR - Microfiltration Train De	sign Criteria	
Subsurface Desalination Inta	•	Feasibility Studi
City of Santa Barbara		
Description	Units	Criteria
Maintenance Clean Criteria (Typically only hypo o	<u>clean)</u>	
Maintenance Clean Frequency	days	1
Sodium Hypochlorite Dose	mg/L	300
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Day	gallons	17,500
Clean-in-Place (CIP) Criteria		
CIP Frequency	days	30
Sodium Hypochlorite Dose	mg/L	3,000
Citric Acid Dose	mg/L	5,000
Maintenance Clean Batch Tank Volume	gallons	2,500
Volume of Wastewater Produced		
Per Train	gallons	2,500
Per Month	gallons	17,500
Chemical Neutralization Criteria		
Sodium Bisulfite Dose MC ¹	mg/L	450
Sodium Bisulfite Dose CIP ¹	mg/L	4,500
Sodium Hydroxide CIP	mg/L	5,000
 Note: 1) Calculated as 1.5 times the sodium hypochlorite dose. bisulfite per 1 mg of sodium hypochlorite. 	Stoichiometric demand is	1.34 mg sodium

Table 5IPR - Microfiltration Backwash Air Scour Blowers Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
Type: Rotary Lobe			
Number of Blowers			
In-Service	No.	1	
Reliability	No.	1	
Total	No.	2	
Discharge Pressure	psi	13	
Air Flow Rate	scfm		
Design	scfm	392	
Maximum	scfm	448	
Motor Size			
Required	hp	32	
Selected	hp	50	
Drive	type	VFD	

Table 6IPR - RO Feed Pump Station Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility Studies			
City of Santa Barbara	11-14-	Oritaria	
	Units	Criteria	
RO HIGH PRESSURE FEED PUMPS			
Number of Pumps			
In-Service	No.	4	
Reliability	No.	0	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	5,369	
Per Pump	gpm	1,342	
Total Dynamic Head Required (TDH)			
Average Discharge Pressure	psi	120	
Average Pump TDH	feet	297	
Maximum Discharge Pressure	psi	145	
Maximum Pump TDH	feet	355	
Motor Size			
Average operating	hp	126	
Required (based on maximum discharge			
pressure)	hp	150	
Selected	hp	175	
Drive	type	VFD	
<u>WET WELL</u>			
Number of Wet Wells	No.	1	
Wet Well Dimensions (each)			
Depth	ft	10	
Length	ft	80	
Width	ft	15	
Volume	ft ³	12,000	
Volume	gallons	89,766	
Storage Time	-		
Design Flow	Minutes	17	

Table 7IPR - Reverse OsmosSubsurface Desalination	-		ility Studies
City of Santa Barbara	Units		teria
Description Number of Reverse Osmosis Trains	Units	CII	teria
In-Service	No.		4
Reliability	No.		4 0
Total	No.		4
Train Flux Rate ⁽¹⁾			•
	gfd		11
Recovery (Permeate/Feed Flow)	percent	-	0%
Total Permeate Flow	gpm (mgd)	4,295	(7.7)
Total Permeate Flow per Train	gpm (mgd)	1,074	(1.5)
Brine Flow per Train	gpm (mgd)	268	(0.39)
Number of Array Stages Per Train	No.		2
1st Stage			
Pressure Vessels per Train	No.	34	
Elements per Pressure Vessel	No.	7	
2nd Stage			
Pressure Vessels per Train	No.	17	
Elements per Pressure Vessel	No.	7	
Number of Elements			
Per Train	No.	3	57
Total (In-Service)	No.	,	428
Mambrana Manufaaturar(a) ⁽²⁾			ilmTec,
Membrane Manufacturer(s) ⁽²⁾	_	•	uatics, or oray
			400/34i,
Membrane Model No. ⁽²⁾		ESPA	2-LD, or
	-	TML2	0D-400
Membrane Area (2)			
Per Element	sq. ft.	400	
Per Train	sq. ft.	142,800	
Total (In-service)	sq. ft.	571,200	

Table 8IPR - RO Interstage Booster Pump Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara			
Description	Units	Criteria	
Type: Turbine assisted motorized boost	ter pump		
Manufacturer: FEDCO			
Model: LP-HEMI, LPH-240-125T			
LP-HEMI Units Per RO Train	No.	1	
Total Number of Units	No.	4	
Pump Data			
Stages	No.	1	
Flow			
At 80 Percent RO Recovery	gpm	615	
Minimum Total Dynamic Head ⁽¹⁾	ft	70	
Maximum Total Dynamic Head ⁽²⁾	ft	120	
Shaft Power			
Minimum Required	hp	14	
Maximum Required	hp	24	
Motor Data			
Drive	type	VFD	
Position: Vertical			
Power Rating	hp	30	
Notes:			
1) Clean-membrane (start-up) conditions.			
2) Fouled membrane (end of life), worst wa	ater quality conditions.		

Table 9 IP	R - UV Disinfection	AOP Design Criteria		
Su	Ibsurface Desalinat	ion Intake and Potable	Reuse Feasibility	y Studies
Ci	ty of Santa Barbara			
Desc	ription	Units	Crite	eria
Process Type: Lo	w Pressure High Out	put Ultraviolet Light Read	ctor w/ NaOCI AC	P
Manufacturer(s):	Wedeco			
Model(s): k143 w	600 watt lamps			
Number of UV Re	eactors			
In-Service		No.	1	
Reliability		No.	1	
Total		No.	2	
Flows				
Total Flow to Re	actors	gpm (mgd)	4,295	(6.2)
Flow to Each Re	eactor	gpm (mgd)	4,295	(6.2)
UV Transmittance	e (UVT)	percent	95	5
UV Dose ⁽¹⁾		mJ/cm ²	92	0
NaOCI Dose		mg/L	4	
Note: 1) Dose required t process.	o achieve 6-log virus a	nd 6-log protozoa inactivatio	on using hypochlori	te for the AOP

Table 10Indirect Potable Reuse Train - Storage and Equalization Tanks Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara			
Description	Units	Criteria	
ENGINEERED STORAGE TANKS			
Product Flow	gpm	4,295	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	70	
Height	ft	35	
Volume (each)	ft ³	134,696	
Volume (each)	gallons	1,007,524	
Volume (actual)	gallons	1,000,000	
Volume (total)	gallons	2,000,000	
Storage Time (w/ one tank out of service)			
Design Flow	Minutes	233	
Design Flow	Hours	4	
Storage Time (total)			
Design Flow	Minutes	466	
Design Flow	Hours	8	
Description	Units	Criteria	
EQUALIZATION TANKS			
Product Flow	gpm	5,369	
Number of Tanks	No.	2	
Tank Dimensions			
Diameter	ft	82	
Height	ft	35	
Volume (each)	ft ³	184,836	
Volume (each)	gallons	1,382,570	
Volume (actual)	gallons	1,500,000	
Volume (total)	gallons	3,000,000	
Storage Time (each)	-		
Design Flow	Minutes	279	
Design Flow	Hours	5	
Storage Time (total)			
Design Flow	Minutes	559	
Design Flow	Hours	9	

	Sodium Hypochlorite Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Sodium Hypochlorite Characteristics			
Concentration:	10.5 %		
Specific Gravity:	1.008		
Solution Strength:	0.88	lb/gal	
Parameters	Units	Criteria	
Ultraviolet Light / Advanced Oxidation Proce	<u>SS</u>		
Chemical Usage			
Location: RO Permeate Before UV Reactor	S		
Process Flow	MGD	6.2	
Chemical Dose	mg/L	4.0	
Chemical Usage	lb/day	206	
Chemical Feed Rate	gpd	234	
Chemical Feed Rate	gph	9.8	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	9.8	
MF/UF Maintenance Cleans (MC)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	300	
Chemical Usage	lb/day	43.8	
Chemical Feed Rate	gpd	49.7	
MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	3,000	
Chemical Usage	lb/month	438.1	
Chemical Feed Rate	gpm	497.2	
Chemical Feed Rate	gpd	16.6	

Table 11Sodium Hypochlorite Design CriteriaSubsurface Desalination Intake and Potable Reuse Feasibility StudiesCity of Santa Barbara		
Parameters	Units	Criteria
Bulk Storage Tanks		
Number of Tanks	No.	2
Tank Capacity, each	gal	4,000
Tank Capacity, total	gal	8,000
UV/AOP Usage	gal/day	234
MF/UF Maintenance Cleans	gal/day	49.7
MF/UF CIPs	gal/day	16.6
Total Usage	gal/day	301
Storage Time	days	27
Delivery Truck Full Load	gal	3,000
Time Between Delivery	days	10

Table 12	Sulfuric Acid Design (Criteria	
	Subsurface Desalination Intake and Potable Reuse Feasibility Studies		
	City of Santa Barbara		-
Sulfuric Acid	Characteristics		
Concentra	tion:	93 %	
Specific Gr	avity:	1.83	
Solution S	trength:	14.17	lb/gal
Parameters		Units	Criteria
IPR RO Pretre	atment		
Chemical Usag	ge		
Location: R	everse Osmosis Feed		
Process Flo	WC	MGD	7.7
Chemical D	lose	mg/L	115
Chemical L	Isage	lb/day	7,419
Chemical F	eed Rate	gpd	524
Chemical F	eed Rate	gph	21.8
No. of Stan	dby Pumps	-	1
No. of Pum	ps in Service	-	1
Chemical Fee	ed Rate Per Pump	gph	21.8
Bulk Storage T	anks		
Number of	Tanks	No.	2
Tank Cap	acity, each	gal	8,000
Tank Cap	acity, total	gal	16,000
Total Usag	ge	gal/day	524
Storage Tir	ne	days	31
Delivery Tr	uck Full Load	gal	3,000
Time Betwe	een Delivery	days	6

Table 13Lime Slurry Design CriteriaSubsurface Desalination IntaCity of Santa Barbara	Subsurface Desalination Intake and Potable Reuse Feasibility Studies		
Lime Characteristics			
Lime Purity	%	97%	
Dry Lime Bulk Density (Storage Value)	lb/cu ft	30	
Concentration:	%	35 %	
Specific Gravity:		1.271	
Solution Strength:	lb/gal	3.70	
Parameters	Units	Criteria	
IPR Post Treatment			
Chemical Usage			
Location: Before Treated Water Wet Well			
Process Flow	MGD	6.2	
Chemical Dose	mg/L	25	
Chemical Dose (as stored weight)	mg/L	26	
Chemical Usage	lb/day	1,330	
Chemical Feed Rate	gpd	359	
Chemical Feed Rate	gph	15.0	
No. of Standby Pumps	-	1	
No. of Pumps in Service	-	1	
Chemical Feed Rate Per Pump	gph	15.0	
Lime Storage Silos			
Number of Silos	No.	1	
Silo Capacity, each	cu ft	2,500	
Silo Capacity, each	lbs	75,000	
Silo Capacity, total	Tons	37.5	
Silo Diameter, each	ft	13	
Silo Sideshell Height, each	ft	19	
Dry Usage	lbs/day	1,330	
Dry Usage	tons/day	0.7	
Storage Time	days	56	
Delivery Truck Full Load	tons	24	
Time Between Delivery	days	36	

Table 14Scale Inhibitor DesignSubsurface DesalinationCity of Santa Barbara	tion Intake and Pota	able Reuse Feasibility Studies
Scale Inhibitor Characteristics		
Manufacturer/Product:	Avista Vitec 3000	
Concentration:	100 %	
Specific Gravity:	1.2	
Solution Strength:	9.99	lb/gal
Parameters	Units	Criteria
IPR - RO Pretreatment		
Chemical Usage		
Location: Reverse Osmosis Feed		
Process Flow	MGD	7.7
Chemical Dose	mg/L	4.0
Chemical Usage	lb/day	258
Chemical Feed Rate	gpd	26
Chemical Feed Rate	gph	1.1
No. of Standby Pumps	-	1
No. of Pumps in Service	-	1
Chemical Feed Rate Per Pump	gph	1.1
Chemical Feed Rate Per Pump	gpm	0.02
Bulk Storage Totes		
Number of Totes	No.	4
Tote Capacity, each	gal	250
Tote Capacity, total	gal	1,000
DPR RO Pretreatment	gal/day	26
Total Usage	gal/day	26
Storage Time	days	39
Delivery Truck Full Load	gal	250
Time Between Delivery	days	10

Table 15 Citric Acid Design Crite	eria	
Subsurface Desalinatio	on Intake and Potal	ble Reuse Feasibility Studies
City of Santa Barbara		-
Citric Acid Characteristics		
Concentration:	50 %	
Specific Gravity:	1.15	
Solution Strength:	4.79	lb/gal
Parameters	Units	Criteria
MF/UF Clean-in-Place (CIP)		
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	730.2
Chemical Feed Rate	gpm	152.5
Chemical Feed Rate	gpd	5.1
Bulk Storage Totes		
Number of Totes	No.	2
Tote Capacity, each	gal	250
Tote Capacity, total	gal	500
MF/UF CIP	gal/month	152.5
Total Usage	gal/month	152.5
Storage Time	days	98
Delivery Truck Full Load	gal	250
Time Between Delivery	days	49

Table 16 Caustic Soda Design	Criteria	
Subsurface Desalinat	ion Intake and Pot	able Reuse Feasibility Studies
City of Santa Barbara	l	
Caustic Soda Characteristics		
Concentration:	50 %	
Specific Gravity:	1.53	
Solution Strength:	6.37	lb/gal
Parameters	Units	Criteria
MF/UF Clean-in-Place (CIP) (neutralize C	<u>(A)</u>	
Chemical Usage		
Location: MF/UF CIP Tank		
Number of CIP per month per Rack	No.	1
Number of CIP per month per Rack	No.	7
Cleaning volume	gallons	2,500
Chemical Dose	mg/L	5,000
Chemical Usage	lb/month	730.2
Chemical Feed Rate	gpm	114.6
Chemical Feed Rate	gpd	3.8
Bulk Storage Tote		
Number of Totes	No.	2
Tote Capacity, each	gal	250
Tote Capacity, total	gal	500
MF/UF CIPs	gal/month	114.6
Total Usage	gal/month	114.6
Storage Time	days	131
Delivery Truck Full Load	gal	250
Time Between Delivery	days	65

	Sodium Bisulfite Design Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara		
Sodium Bisulfite Characteristics			
Concentration:	38 %		
Specific Gravity:	1.3		
Solution Strength:	4.11	lb/gal	
Parameters	Units	Criteria	
MF/UF Maintenance Cleans (MC)			
Chemical Usage (NaOCI Neutralization)			
Location: MF/UF CIP Tank			
Number of MC per Day per Rack	No.	1	
Number of MC per Day	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	441	
Chemical Usage	lb/day	64.4	
Chemical Feed Rate	gpd	15.7	
MF/UF Clean-in-Place (CIP)			
Chemical Usage			
Location: MF/UF CIP Tank			
Number of CIP per month per Rack	No.	1	
Number of CIP per month per Rack	No.	7	
Cleaning volume	gallons	2,500	
Chemical Dose	mg/L	4,500	
Chemical Usage	lb/month	657.2	
Chemical Feed Rate	gpm	159.8	
Chemical Feed Rate	gpd	5.3	
Bulk Storage Totes			
Number of Totes	No.	4	
Tote Capacity, each	gal	250	
Tote Capacity, total	gal	1,000	
MF/UF Maintenance Clean	gal/day	15.7	
MF/UF CIP	gal/day	5.3	
Total Usage	gal/day	21	
Storage Time	days	48	
Delivery Truck Full Load	gal	250	
Time Between Delivery	days	12	

Table 18Indirect Potable Reuse Train - Finished Water Pump Station Criteria Subsurface Desalination Intake and Potable Reuse Feasibility Studies City of Santa Barbara			
Description	Units	Criteria	
FINISHED WATER PUMPS TO IPR INJECTION WELL	<u>_S</u>		
Number of Pumps			
In-Service	No.	3	
Reliability	No.	1	
Total	No.	4	
Type: Vertical Turbine			
Capacity			
Total	gpm	4,295	
Per Pump	gpm	1,432	
Total Dynamic Head Required (TDH)			
Head required to reach reservoir	feet	373	
Average Pump TDH	feet	393	
Maximum Pump TDH	feet	423	
Motor Size			
Average operating	hp		
Required (based on maximum discharge pressure)	hp	178	
Selected	hp	191	
Drive	type	VFD	

City of Santa Barbara

APPENDIX E – FACILITY MODELING RESULTS

AWTF for DPR/IPR Treatment



