

APPENDIX H

Full-Scale Design Criteria

BARDP Draft Design Criteria

ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Raw Water Flow, Design	mgd	25.0	89.7
Average system recovery		79.1%	79.1%
Actual Feed Water Flow, incl. recycle	mgd	28.2	101.2
Average finished water production	mgd	19.8	71.0
Feedwater Screen			
Type		Passive intake, wedgewire	Passive intake, wedgewire
Screen size	cm	1.0	1.0
Number	each	1	3
Capacity, each	gpm	22,000	22,000
Cleaning		air burst	air burst
Raw Water Pump Station			
Average flow	gpm	19,600	70,300
Peak factor		1.25	1.25
Maximum flow	gpm	24,500	87,900
Pumps			
number, duty	each	2	7
number, standby	each	1	1
type		vertical turbine	vertical turbine
approximate discharge pressure	psi	50	50
capacity	gpm	12,300	12,600
control	each	VFD	VFD
Feedwater Self Cleaning Screens			
Type		automatic self cleaning	automatic self cleaning
Screen opening size	micron	100	100
Number, duty	each	3	13
Number, standby	each	1	1
Capacity, each	gpm	7,400	7,400
Flushing interval (time)	hours	1	1
Flushing interval (pressure drop)	psi	7	7
Minimum flushing flow, each	gpm	220	220
System recovery, minimum		98%	98%
Average screened water flow	mgd	27.65	99.22
MF/UF Pretreatment			
Flow pattern		inside-outside	inside-outside
Type		pressurized	pressurized
System recovery, minimum		88%	88%
Overall filtrate flow	mgd	24.3	87.3
Skid design			
number, duty	each	11	44
design flow, each skid	mgd	2.2	2.0
design flow, each skid	gpm	1536	1378
modules, each skid	each	102	102
maximum flux	gfd	44	44
inlet pressure	psi	35	35
Approximate backwash interval	minutes	30	30
CEB frequency	days	0.5	0.5
Filtrate SDI		3	3
Maximum TMP	psi	15	15
CIP Tanks			
number	each	2	8
volume	gal	6000	6000
diameter	ft	10	10
material		above ground, FRP	above ground, FRP

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ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Filtrate Storage Tank			
HRT	minutes	60	30
Capacity, each tank	gal	600,000	600,000
Number of tanks	each	2	4
Side water depth	feet	20	20
Diameter	feet	70	70
Type		above ground, welded steel	above ground, welded steel
Neutralization Tanks (shared between MF/UF and RO)			
Capacity, each tank	gal	50,000	50,000
Number of tanks	each	2	2
Side water depth	feet	12	12
Diameter	feet	30	30
Type		above ground, welded steel	above ground, welded steel
Booster Pumps			
Maximum flow	gpm	16,900	60,600
Pumps			
type		vertical turbine	vertical turbine
number, duty	each	2	7
number, standby	each	1	1
approximate discharge pressure	psi	50	50
capacity	gpm	8,500	8,700
control	each	VFD	VFD
Cartridge Filters			
Filter rating	micron	5	5
Filter vessels, per skid	each	1 duty	1 duty
Total number, cartridge filter vessels	each	12	41
Cartridge elements, per vessel	each	118	118
Type		vertical	vertical
Cartridge element			
diameter	inches	2.5	2.5
length	inches	40	40
material		polypropylene	polypropylene
Desalination, General			
Design TDS, max.	mg/L	11,500 to 12,000	11,500 to 12,000
Design water temperature, min.	deg F	45	45
Average Recovery		81%	81%
Array configuration		2:1	2:1
Number of stages		two	two
Number of skids	each	12	41
Number of vessels per skid	each, stage 1	30	30
Number of vessels per skid	each, stage 2	15	15
System recovery, minimum		70%	70%
System recovery, maximum		83%	83%
Antiscalant dose, avg.	mg/L	1.5	1.5
Bisulfite dose, avg.	mg/L	1.0	1.0
Membrane element diameter	inch	8	8
Membrane elements per vessel	each	7	7

BARDP Draft Design Criteria

ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Stage 1 Brackish Membrane System (per skid)			
Feed flow, maximum	gpm	1,467	1,467
Permeate flow, maximum	gpm	980	980
Permeate flow, minimum	gpm	812	812
Design flux, maximum	gfd	15.3	15.3
Design flux, minimum	gfd	12.7	12.7
Design pressure, maximum	psi	585	585
Design pressure, minimum	psi	212	212
Stage 2 Seawater Membrane System (per skid)			
Feed flow, maximum	gpm	655	655
Feed flow, minimum	gpm	487	487
Permeate flow, maximum	gpm	325	325
Permeate flow, minimum	gpm	211	211
Design flux, maximum	gfd	11.2	11.2
Design flux, minimum	gfd	7.2	7.2
Design pressure, maximum	psi	650	650
Design pressure, minimum	psi	282	282
Concentrate flow, maximum	gpm	440	440
Concentrate flow, minimum	gpm	249	249
Interstage Boost Pumps			
Boost pressure	psi	100	100
RO Clean-in-Place Tanks			
Capacity, each tank	gal	9,000	9,000
Number of tanks	each	1	2
Side water depth	feet	16	14
Diameter	feet	10	10
Type		Fiberglass reinforced plastic	Fiberglass reinforced plastic
Permeate Storage Tank			
HRT	minutes		
Capacity, each tank	gal	300,000	300,000
Number of tanks	each	1	2
Side water depth	feet	20	20
Diameter	feet	50	50
Type		above ground, welded steel	above ground, welded steel
Clearwell			
Number	each	1	4
Capacity, Each	million gal.	1.5	1.5
Capacity, Total	million gal.	1.5	5.3
Side water depth	feet	20.0	20.0
Diameter		113	113
type		above ground, welded steel	above ground, welded steel
Finished Water Pump Station			
Pumps			
number, duty	each	2	7
number, standby	each	1	1
type		horizontal split case	horizontal split case
approximate discharge pressure	psi	240	240
capacity, nominal	gpm	7,000	7,000
control		VFD	VFD

BARDP Draft Design Criteria

ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Solids Handling Systems			
Thickening			
spent backwash feed, from MF/UF	gpm	2,300	8,270
solids, feed	mg/L	350	350
hydraulic loading rate	gpm/sf	0.25	0.20
number of thickeners	each	2	8
diameter, nominal	feet	80	80
SWD	feet	14	14
sludge concentration		1.5%	1.5%
solids recovery		97%	97%
dry sludge production	ppd	9,400	33,700
wet sludge production	ppd	626,700	2,246,700
type		reinforced concrete	reinforced concrete
Sludge Pump Station			
Pumps (from thickener to centrifuges)			
number, duty	each	1	4
number, standby	each	1	1
capacity	gpm	140	130
Centrifuge Dewatering			
Polymer dose	lb/ton dry	1.5	1.5
Sludge flow, feed, net	gpd	68,000	245,000
Hydraulic loading	gpm	140	510
Dry solids Loading, per unit	pph	1,200	1,050
Number, duty	each	1	4
Number, standby	each	1	1
Operating cycle	hours/day	8	8
Diameter	inches	20	20
Motor	Hp	100	100
Type		solid bowl, skid mounted	solid bowl, skid mounted
CHEMICAL SYSTEMS			
Sodium Hypochlorite			
Concentration	w/w as Na	12.5%	12.5%
Specific Gravity		1.15	1.15
<i>Raw Water, continuous</i>			
Dose, maximum	mg/L	5	5
Process Flow	mgd	25	89.7
Feed pumps			
Flow	gpd	870	3120
number	each	2	4
type	each	diaphragm	diaphragm
<i>Pretreatment Chemical Enhanced Backwash (per Skid)</i>			
Dose	mg/L	200	200
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	250	250
number	each	2	3
type	each	diaphragm	diaphragm

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ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
<i>Pretreatment CIP (per Skid)</i>			
Dose	mg/L	200	200
Dilution volume	gallons	1275	1275
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	255	255
number	each	same as CEB pumps	same as CEB pumps
type	each	diaphragm	diaphragm
<i>Chlorine Residual, continuous</i>			
Dose, maximum	mg/L	2.5	2.5
Process Flow	mgd	19.8	71.0
Feed pumps			
Flow	gpd	344	1235
number	each	2	4
type	each	diaphragm	diaphragm
<i>Sodium Hypochlorite Storage Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		3	13
Storage Duration	days	14	14
Volume	gal	8,500	7,100
Maximum Water Level	ft	10	10
Containment Volume	gal	28,050	101,530
Dimensions (diameter x h)	ft x ft	12' x 11'	11' x 11'
Aqueous Ammonia			
Concentration		19%	19%
Specific Gravity		0.92	0.92
<i>Raw Water, continuous</i>			
Dose, maximum	mg/L	1.25	1.25
Process Flow	mgd	25	90
Feed pumps			
Flow	gpd	179	641
number	each	2	4
type	each	diaphragm	diaphragm
<i>Finished water, continuous</i>			
Dose, maximum	mg/L	0.6	0.6
Process Flow	mgd	19.8	71.0
Feed pumps			
Flow	gpd	71	254
number	each	2	4
type	each	diaphragm	diaphragm
<i>Aqueous Ammonia Storage Tank</i>			
Type		Polyethylene	Polyethylene
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	5,300	4,300
Maximum Water Level	ft	9	9
Containment Volume	gal	5,830	18,920
Dimensions (diameter x h)	ft x ft	10' x 10'	9' x 10'

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ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Citric Acid			
Concentration	w/w as H ₃ C ₆ H ₅ O ₇	50%	50%
Specific Gravity		1.24	1.24
<i>Pretreatment Chemical Enhanced Backwash (per Skid)</i>			
Dose	mg/L	1800	1800
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	523	523
number	each	2	3
type	each	diaphragm	diaphragm
<i>Pretreatment CIP (per Skid)</i>			
Dose	mg/L	24800	24800
Dilution volume	gallons	1275	1275
Feed pumps			
Pumping duration	minutes	5	5
Flow, total	gpd	14688	14688
number		2	3
type		diaphragm	diaphragm
<i>RO CIP (per skid - first stage only)</i>			
Dose	mg/L	24800	24800
Dilution volume	gallons	5500	5500
Feed pumps			
Pumping duration	minutes	20	10
Flow, total	gpd	15840	31680
number		same as MF CIP pumps	same as MF CIP pumps
type		diaphragm	diaphragm
<i>Citric Acid Storage Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	2,100	2,100
Maximum Water Level	ft	7	7
Containment Volume	gal	2,310	9,240
Dimensions (diameter x h)	ft x ft	7' x 8'	7' x 8'
Caustic Soda (Sodium Hydroxide)			
Concentration	w/w as Na	30%	30%
Specific Gravity		1.26	1.26
<i>Pretreatment CIP (per skid)</i>			
Dose	mg/L	6300	6300
Dilution volume	gallons	1000	1000
Feed pumps			
Pumping duration	minutes	9	10
Flow, total	gpd	2667	2400
number		2	3
type		diaphragm	diaphragm

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ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
<i>RO CIP (per skid - first stage only)</i>			
Dose	mg/L	1260	1260
Dilution volume	gallons	5,500	5,500
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	2640	2640
number		same as MF CIP pumps	same as MF CIP pumps
type		diaphragm	diaphragm
<i>Caustic Soda Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	300	300
Maximum Water Level	ft	4	4
Containment Volume	gal	330	1,320
Dimensions (diameter x h)	ft x ft	3' x 5'	3' x 5'
Ferric Chloride			
<i>Coagulation for Pretreatment Membranes</i>			
Concentration	w/w as Fe	42%	42%
Specific Gravity		1.4	1.4
Dose, avg	mg/L	5	5
Process Flow	mgd	25	90
Feed pumps			
Flow	gpd	213	763
number	each	2	4
type	each	diaphragm	diaphragm
<i>Ferric Chloride Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	4,300	3,400
Maximum Water Level	ft	9	9
Containment Volume	gal	4,730	14,960
Dimensions (diameter x h)	ft x ft	9' x 10'	8' x 10'
Antiscalant			
<i>Antiscalant for RO System</i>			
Chemical Make-up		100%	100%
Specific Gravity		1.2	1.2
Dose, avg	mg/L	1.5	1.5
Process Flow	mgd	22	79
Feed pumps			
Flow	gpd	28	99
number		2	4
type		diaphragm	diaphragm

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ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
<i>Antiscalant Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	600	600
Maximum Water Level	ft	6	6
Containment Volume	gal	660	2,640
Dimensions (diameter x h)	ft x ft	4' x 7'	4' x 7'
Sodium Bisulfite			
<i>Remove free Cl before RO System</i>			
Concentration		38%	38%
Specific Gravity		1.31	1.31
Dose, avg	mg/L	1.0	1.0
Process Flow	mgd	22	79
Feed pumps			
Flow	gpd	44	159
number		2	4
type		diaphragm	diaphragm
<i>Sodium Bisulfite Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	900	900
Maximum Water Level	ft	6	6
Containment Volume	gal	990	3,960
Dimensions (diameter x h)	ft x ft	5' x 7'	5' x 7'
Fluorosilicic Acid			
<i>Fluoride Addition to Finished Water</i>			
Concentration		24%	24%
Specific Gravity		1.234	1.234
Dose, avg	mg/L	0.6	0.6
Process Flow	mgd	20	71
Feed pumps			
Flow	gpd	51	182
number		2	4
type		diaphragm	diaphragm
<i>Fluorosilicic Acid Tank</i>			
Type		Polyethylene	Polyethylene
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	1,300	900
Maximum Water Level	ft	6	6
Containment Volume	gal	1,430	3,960
Dimensions (diameter x h)	ft x ft	6' x 7'	5' x 7'

BARDP Draft Design Criteria

ALTERNATIVE NO. 1		Initial Capacity	Ultimate Capacity
Polymer			
<i>Coagulant for Thickeners</i>			
Concentration		100%	100%
Specific Gravity		1.05	1.05
Dose, maximum	mg/L	1.5	1.5
Process Flow	mgd	3.00	11
Feed pumps			
Flow	gpd	4	15
number	each	2	4
type	each	diaphragm	diaphragm
<i>Polymer Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	200	100
Maximum Water Level	ft	3	3
Containment Volume	gal	220	440
Dimensions (diameter x h)	ft x ft	3' x 4'	2' x 4'
Lime			
<i>Stabilization</i>			
Dose, maximum	mg/L	40	40
Storage Duration	days	14	14
Storage Capacity	tons	54	244
Type		quick lime	quick lime
Carbon Dioxide			
<i>pH adjustment</i>			
Dose, maximum	mg/L	25	25
Storage Duration	days	14	14
Storage Capacity	tons	29	104

Alternative No. 1 - Two Stage RO Performance Projections

Project Information: 2 stage BW30440i (1st) and SW30XLE400i (2nd)
FEBRUARY

System Details

Feed Flow to Stage 1	1467 gpm	Pass 1 Permeate Flow	1202.84 gpm	Osmotic Pressure:	
Raw Water Flow to System	1467 gpm	Pass 1 Recovery	81.99 %	Feed	15.55 psig
Feed Pressure	286.67 psig	Feed Temperature	49 F	Concentrate	82 psig
Fouling Factor	0.85	Feed TDS	1600.34 mg/l	Average	48.78 psig
Chem. Dose	None	Number of Elements	315	Average NDP	252.61 psig
Total Active Area	134400 ft ²	Average Pass 1 Flux	12.89 gfd	Power	259.64 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	3.6 kWh/kgal

	Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
	1	BW30-440i	30	7	1467	281.67	0	568.85	253.73	898.15	14	0	0	7.54
	2	SW30XLE-400i	15	7	568.85	348.73	0	264.16	325.57	304.7	10.45	0	100	10.8

Pass Streams (mg/l as Ion)								
Name	Feed	Adjusted Feed	Concentrate		Permeate		Total	
			Stage 1	Stage 2	Stage 1	Stage 2		
NH4	0	0	0	0	0	0	0	0
K	19	19	48.82	104.93	0.11	0.18	0.13	
Na	448	448	1151.86	2476.49	2.21	3.48	2.53	
Mg	64	64	164.81	354.78	0.15	0.12	0.14	
Ca	32	32	82.41	177.4	0.07	0.06	0.07	
Sr	0	0	0	0	0	0	0	
Ba	0.03	0.03	0.08	0.17	0	0	0	
CO3	0.22	0.22	1.52	6.08	0	0	0	
HCO3	70	70	177.92	376.66	0.55	0.78	0.6	
NO3	0.5	0.5	1.25	2.66	0.02	0.03	0.03	
Cl	803.04	803.04	2065.16	4440.89	3.66	5.53	4.13	
F	0.4	0.4	1.03	2.21	0	0	0	
SO4	144	144	370.97	798.75	0.25	0.1	0.21	
SiO2	18	18	46.33	99.5	0.06	0.23	0.1	
Boron	0.2	0.2	0.39	0.78	0.08	0.05	0.07	
CO2	2.59	2.59	3.14	4.73	2.6	3.47	2.82	
TDS	1600.33	1600.34	4114.38	8844.98	7.54	10.8	8.37	
pH	7.6	7.6	7.85	7.92	5.65	5.68	5.66	

Project Information: 2 stage BW30440i (1st) and SW30XLE400i (2nd)
MARCH

System Details

Feed Flow to Stage 1	1467 gpm	Pass 1 Permeate Flow	1202.83 gpm	Osmotic Pressure:	
Raw Water Flow to System	1467 gpm	Pass 1 Recovery	81.99 %	Feed	4.67 psig
Feed Pressure	238.53 psig	Feed Temperature	52 F	Concentrate	24.82 psig
Fouling Factor	0.85	Feed TDS	499.2 mg/l	Average	14.74 psig
Chem. Dose	None	Number of Elements	315	Average NDP	231.44 psig
Total Active Area	134400 ft ²	Average Pass 1 Flux	12.89 gfd	Power	222.36 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	3.08 kWh/kgal

	Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
	1	BW30-440i	30	7	1467	233.53	0	589.37	205.8	877.63	13.68	0	0	2.48
	2	SW30XLE-400i	15	7	589.37	300.8	0	264.17	277.27	325.2	11.15	0	100	4

Pass Streams (mg/l as Ion)								
Name	Feed	Adjusted Feed	Concentrate		Permeate		Total	
			Stage 1	Stage 2	Stage 1	Stage 2		
NH4	0	0	0	0	0	0	0	0
K	6	6	14.88	33.11	0.04	0.07	0.05	
Na	131	131	325.3	724.44	0.52	1.06	0.67	
Mg	18	18	44.75	99.8	0.03	0.03	0.03	
Ca	9	9	22.38	49.9	0.02	0.02	0.02	
Sr	0	0	0	0	0	0	0	
Ba	0.03	0.03	0.07	0.17	0	0	0	
CO3	0.16	0.16	0.99	4.27	0	0	0	
HCO3	70	70	172.5	379.81	0.49	0.79	0.57	
NO3	0.5	0.5	1.21	2.68	0.02	0.03	0.02	
Cl	202.96	202.96	504.09	1122.88	0.73	1.43	0.92	
F	0.4	0.4	0.99	2.21	0	0	0	
SO4	42	42	104.46	233	0.06	0.03	0.05	
SiO2	18	18	44.68	99.4	0.08	0.24	0.12	
Boron	0.2	0.2	0.37	0.76	0.09	0.05	0.08	
CO2	2.91	2.91	3.27	4.46	2.85	3.47	3.02	
TDS	499.2	499.2	1238.45	2756.05	2.48	4	2.89	
pH	7.6	7.6	7.9	8.05	5.57	5.68	5.6	

Alternative No. 1 - Two Stage RO Performance Projections

Project Information: 2 stage BW30440i (1st) and SW30XLE400i (2nd)										
JUNE										
System Details										
Feed Flow to Stage 1	1467 gpm	Pass 1 Permeate Flow	1217.7 gpm	Osmotic Pressure:						
Raw Water Flow to System	1467 gpm	Pass 1 Recovery	83.01 %	Feed	23.82 psig					
Feed Pressure	229.47 psig	Feed Temperature	65 F	Concentrate	132.71 psig					
Fouling Factor	0.85	Feed TDS	2377.31 mg/l	Average	78.26 psig					
Chem. Dose	None	Number of Elements	315	Average NDP	176.16 psig					
Total Active Area	134400 ft ²	Average Pass 1 Flux	13.05 gfd	Power	212.15 kW					
Water Classification: Surface Supply SDI < 3				Specific Energy	2.9 kWh/kgal					
				Perm		Boost				
				Flow	Avg Flux	Press	Press	Perm	TDS	
				(gpm)	(gfd)	(psig)	(psig)	(mg/l)		
1	Stage	Element	#PV #Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)		
2		SW30XLE-400i	15 7	534.71	296.1	0	249.3	277.94	932.29	14.53
									285.4	9.79
									0	100
									0	0
									0	20.62
									0	33.64
Pass Streams (mg/l as Ion)										
Concentrate										
Permeate										
Name	Feed	Adjusted Feed		Stage 1	Stage 2	Stage 1	Stage 2	Total		
NH4	0	0		0	0	0	0	0		0
K	29	29		79.02	168.81	0.31	0.58	0.38		0.38
Na	672	672.02		1832.52	3917.42	6.43	11.32	7.57		7.57
Mg	96	96		262.61	562.81	0.44	0.38	0.43		0.43
Ca	48	48		131.31	281.43	0.22	0.19	0.21		0.21
Sr	0	0		0	0	0	0	0		0
Ba	0.03	0.03		0.08	0.18	0	0	0		0
CO3	0.33	0.33		2.41	9.01	0	0	0		0
HCO3	70	70		187.64	393.11	0.87	1.46	1		1
NO3	0.5	0.5		1.29	2.7	0.05	0.06	0.05		0.05
Cl	1225.88	1225.88		3344.33	7151.92	10.85	18.34	12.61		12.61
F	0.4	0.4		1.09	2.33	0	0.01	0.01		0.01
SO4	216	216		591.34	1267.92	0.73	0.34	0.64		0.64
SiO2	18	18		49.22	105	0.1	0.49	0.19		0.19
Boron	0.2	0.2		0.36	0.67	0.11	0.08	0.1		0.1
CO2	2.04	2.04		2.85	4.97	2.14	3.37	2.43		2.43
TDS	2377.29	2377.31		6484.91	13866.48	20.62	33.64	23.67		23.67
pH	7.6	7.6		7.8	7.79	5.85	5.87	5.86		5.86

Project Information: 2 stage BW30440i (1st) and SW30XLE400i (2nd)										
JULY										
System Details										
Feed Flow to Stage 1	1467 gpm	Pass 1 Permeate Flow	1217.57 gpm	Osmotic Pressure:						
Raw Water Flow to System	1467 gpm	Pass 1 Recovery	83 %	Feed	31.04 psig					
Feed Pressure	235.27 psig	Feed Temperature	69 F	Concentrate	173.05 psig					
Fouling Factor	0.85	Feed TDS	3132.13 mg/l	Average	102.04 psig					
Chem. Dose	None	Number of Elements	315	Average NDP	162.9 psig					
Total Active Area	134400 ft ²	Average Pass 1 Flux	13.05 gfd	Power	215.55 kW					
Water Classification: Surface Supply SDI < 3				Specific Energy	2.95 kWh/kgal					
				Perm		Boost				
				Flow	Avg Flux	Press	Press	Perm	TDS	
				(gpm)	(gfd)	(psig)	(psig)	(mg/l)		
1	Stage	Element	#PV #Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)		
2		SW30XLE-400i	15 7	512.06	303.31	0	249.43	286.65	954.94	14.88
									262.63	9
									0	100
									0	0
									0	31.59
									0	56.19
Pass Streams (mg/l as Ion)										
Concentrate										
Permeate										
Name	Feed	Adjusted Feed		Stage 1	Stage 2	Stage 1	Stage 2	Total		
NH4	0	0		0	0	0	0	0		0
K	37.9	37.9		107.68	220.03	0.48	0.98	0.59		0.59
Na	884.27	884.27		2514.59	5141.94	10.07	19.32	12.06		12.06
Mg	126.32	126.32		360.68	739.86	0.66	0.57	0.64		0.64
Ca	63.16	63.16		180.36	369.97	0.32	0.28	0.31		0.31
Sr	0	0		0	0	0	0	0		0
Ba	0.03	0.03		0.08	0.16	0	0	0		0
CO3	0.45	0.45		3.45	11.83	0	0	0		0
HCO3	78.5	78.5		218.58	437.03	1.11	2.07	1.32		1.32
NO3	0.56	0.56		1.49	2.98	0.06	0.08	0.06		0.06
Cl	1569.95	1569.96		4466.52	9136.72	16.76	31.09	19.85		19.85
F	0.45	0.45		1.27	2.6	0.01	0.01	0.01		0.01
SO4	353.24	353.24		1009.36	2071.4	1.41	0.71	1.26		1.26
SiO2	16.24	16.24		46.35	94.55	0.1	0.57	0.2		0.2
Boron	0.18	0.18		0.32	0.57	0.11	0.09	0.1		0.1
CO2	2.1	2.1		3.23	5.88	2.28	3.93	2.63		2.63
TDS	3132.12	3132.13		8912.26	18232.34	31.59	56.19	36.89		36.89
pH	7.6	7.6		7.76	7.71	5.91	5.93	5.92		5.92

Feed water quality is based on dry year conditons within Suisun Bay from 2006 through 2009. Calculations are based on ROSA projection model, The Dow Chemical Company, version 6.1.5.

Alternative No. 1 - Two Stage RO Performance Projections

Project Information: 2 stage BW30440i (1st) and SW30XLE400i (2nd)

DECEMBER

System Details

Feed Flow to Stage 1	1467 gpm	Pass 1 Permeate Flow	1173.5 gpm	Osmotic Pressure:	
Raw Water Flow to System	1467 gpm	Pass 1 Recovery	79.99 %	Feed	46.85 psig
Feed Pressure	373.98 psig	Feed Temperature	48 F	Concentrate	226.19 psig
Fouling Factor	0.85	Feed TDS	4771.59 mg/l	Average	136.52 psig
Chem. Dose	None	Number of Elements	315	Average NDP	264.26 psig
Total Active Area	134400 ft ²	Average Pass 1 Flux	12.57 gfd	Power	328.04 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	4.66 kWh/kgal

	Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1		BW30-440i	30	7	1467	368.98	0	545.55	341.73	921.45	14.36	0	0	25.86
2		SW30XLE-400i	15	7	545.55	436.73	0	293.5	413.45	252.05	8.64	0	100	37.59

Pass Streams (mg/l as Ion)								
Name	Feed	Adjusted Feed	Concentrate		Permeate		Total	
			Stage 1	Stage 2	Stage 1	Stage 2		
NH4	0	0	0	0	0	0	0	0
K	49	49	131.27	243.57	0.29	0.5	0.33	
Na	1470	1470	3939.43	7311.46	7.95	12.76	8.99	
Mg	172	172	461.77	858.03	0.44	0.33	0.42	
Ca	39	39	104.71	194.56	0.1	0.07	0.09	
Sr	0	0	0	0	0	0	0	
Ba	0.06	0.06	0.16	0.3	0	0	0	
CO3	0.45	0.45	3.37	10.31	0	0	0	
HCO3	90	90	236.59	430.76	0.7	1.07	0.78	
NO3	0.5	0.5	1.3	2.38	0.03	0.03	0.03	
Cl	2555.47	2555.47	6849.54	12714.05	13.12	20.45	14.69	
F	0.8	0.8	2.14	3.97	0.01	0.01	0.01	
SO4	368	368	988.38	1836.9	0.7	0.29	0.61	
SiO2	20	20	53.69	99.55	0.06	0.28	0.1	
Boron	1.1	1.1	2.23	3.88	0.43	0.31	0.41	
CO2	2.79	2.79	3.98	6.32	2.96	4.59	3.31	
TDS	4771.58	4771.59	12785.09	23728.02	25.86	37.59	28.38	
pH	7.6	7.6	7.76	7.73	5.7	5.68	5.69	

BARDP Draft Design Criteria

ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
Raw Water Flow, Design	mgd	25	92.3
Average system recovery		76.9%	76.9%
Actual Feed Water Flow, incl. recycle	mgd	28.2	104.2
Average finished water production	mgd	19.2	71.0
Feedwater Screen			
Type		Passive intake, wedgewire	Passive intake, wedgewire
Screen size	cm	1.0	1.0
Number	each	1	3
Capacity, each	gpm	22,000	22,000
Cleaning		air burst	air burst
Raw Water Pump Station			
Average flow	gpm	19,600	72,400
Peak factor		1.25	1.25
Maximum flow	gpm	24,500	90,500
Pumps			
number, duty	each	2	7
number, standby	each	1	1
type		vertical turbine	vertical turbine
approximate discharge pressure	psi	50	50
capacity	gpm	12,300	12,900
control	each	VFD	VFD
Feedwater Self Cleaning Screens			
Type		self cleaning	self cleaning
Screen opening size	micron	100	100
Number, duty	each	3	14
Number, standby	each	1	1
Capacity, each	gpm	7,400	7,400
Flushing interval (time)	hours	1	1
Flushing interval (pressure drop)	psi	7	7
Minimum flushing flow, each	gpm	220	220
System recovery, minimum		98%	98%
Average screened water flow	mgd	27.65	102.10
MF/UF Pretreatment			
Flow pattern		inside-outside	inside-outside
Type		pressurized	pressurized
System recovery, minimum		88%	88%
Overall filtrate flow	mgd	24.3	89.8
Skid design			
number, duty	each	11	44
design flow, each skid	mgd	2.2	2.0
design flow, each skid	gpm	1536	1418
modules, each skid	each	100	100
maximum flux	gfd	44	44
inlet pressure	psi	35	35
Approximate backwash interval	minutes	30	30
CEB frequency	days	0.5	0.5
Filtrate SDI		3	3
Maximum TMP	psi	15	15
CIP Tanks			
number	each	2	2
volume	gal	6000	6000
diameter	ft	10	10
material		above ground, FRP	above ground, FRP

BARDP Draft Design Criteria

ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
Filtrate Storage Tank			
HRT	minutes	60	30
Capacity, each tank	gal	600,000	600,000
Number of tanks	each	2	4
Side water depth	feet	20	20
Diameter	feet	70	70
Type		above ground, welded steel	above ground, welded steel
Neutralization Tanks (shared between MF/UF and RO)			
Capacity, each tank	gal	50,000	50,000
Number of tanks	each	2	2
Side water depth	feet	14	14
Diameter	feet	25	25
Type		above ground, welded steel	above ground, welded steel
Booster Pump Station			
Maximum flow	gpm	16,900	62,400
Pumps			
type		vertical turbine	vertical turbine
number, duty	each	2	7
number, standby	each	1	1
approximate discharge pressure	psi	50	50
capacity	gpm	8,500	8,900
control	each	VFD	VFD
Cartridge Filters			
Filter rating	micron	5	5
Filter vessels, per skid	each	1 duty	1 duty
Total number, cartridge filter vessels for NF	each	7	25
Total number, cartridge filter vessels for SW	each	7	31
Cartridge elements for NF, per vessel	each	200	200
Cartridge elements for SW, per vessel	each	160	160
Type		vertical	vertical
Cartridge element			
diameter	inches	2.5	2.5
length	inches	40	40
material		polypropylene	polypropylene
Desalination, General			
Design TDS, max.	mg/L	11,500 to 12,000	11,500 to 12,000
Design water temperature, min.	deg F	45	45
Average Recovery		79%	79%
System recovery, minimum		58%	58%
System recovery, maximum		85%	85%
Array configuration		2 parallel systems	2 parallel systems
Number of stages		one per system	one per system
Number of vessels per skid (NF)		49	49
Number of vessels per skid (SW)		42	42
Antiscalant dose, avg.	mg/L	1.5	1.5
Bisulfite dose, avg.	mg/L	1.0	1.0
Membrane element diameter	inch	8	8
Membrane elements per vessel	each	7	7

BARDP Draft Design Criteria

ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
System 1 Nanofiltration (per skid)			
Number of skids installed		7	25
Number of skids running, high TDS		2	7
Number of skids running, low TDS		7	25
Feed flow	gpm	2,500	2,500
Permeate flow, maximum	gpm	1,550	1,550
Permeate flow, minimum	gpm	1,150	1,150
Design flux, maximum	gfd	16.3	16.3
Design flux, minimum	gfd	12.1	12.1
Design pressure, maximum	psi	318	318
Design pressure, minimum	psi	97	97
System 2 Seawater Membrane (per skid)			
Number of skids installed	per skid	7	31
Number of skids running, high TDS		7	31
Number of skids running, low TDS		3	12
Feed flow	gpm	2,000	2,000
Permeate flow, maximum	gpm	1,300	1,300
Permeate flow, minimum	gpm	1,000	1,000
Design flux, maximum	gfd	15.9	15.9
Design flux, minimum	gfd	12.3	12.3
Design pressure, maximum	psi	828	828
Design pressure, minimum	psi	376	376
RO Clean-in-Place Tanks			
Capacity, each tank	gal	9,000	9,000
Number of tanks	each	1	2
Side water depth	feet	16	14
Diameter	feet	10	10
Type		Fiberglass reinforced plastic	Fiberglass reinforced plastic
Permeate Storage Tank			
HRT	minutes		
Capacity, each tank	gal	300,000	300,000
Number of tanks	each	1	2
Side water depth	feet	20	20
Diameter	feet	50	50
Type		above ground, welded steel	above ground, welded steel
Clearwell			
Number	each	1	4
Capacity, Each	million gal.	1.5	1.5
Capacity, Total	million gal.	1.5	6.0
Side water depth	feet	20.0	20.0
Diameter		113	113
Type		above ground, welded steel	above ground, welded steel
Finished Water Pump Station			
Pumps			
number, duty	each	2	7
number, standby	each	1	1
type		horizontal split case	horizontal split case
approximate discharge pressure	psi	240	240
capacity	gpm	6,500	7,000
control		VFD	VFD

BARDP Draft Design Criteria

ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
Solids Handling Systems			
Thickening			
spent backwash feed, from MF/UF	gpm	2,300	8,510
solids, feed	mg/L	350	350
hydraulic loading rate	gpm/sf	0.25	0.2
number of thickeners	each	2	8
diameter	feet	80	80
SWD	feet	14	14
sludge concentration		1.5%	1.5%
solids recovery		97%	97%
dry sludge production	ppd	9,000	35,000
wet sludge production	ppd	600,000	2,333,300
type		reinforced concrete	reinforced concrete
Sludge Pump Station			
Pumps (from thickener to centrifuges)			
number, duty	each	1	4
number, standby	each	1	1
capacity	gpm	140	130
Centrifuge Dewatering			
Polymer dose	lb/ton dry solids	1.5	1.5
Sludge flow, feed, net	gpd	65,000	254,000
Hydraulic loading	gpm	140	530
Dry solids Loading, per unit	pph	1,100	1,100
number, duty	each	1	4
number, standby	each	1	1
operating cycle	hours	8	8
diameter	inches	20	20
motor	Hp	100	100
type		solid bowl, skid mounted	solid bowl, skid mounted
CHEMICAL SYSTEMS			
Sodium Hypochlorite			
Chemical Make-up	w/w as NaOCl	12.5%	12.5%
Specific Gravity		1.15	1.15
<i>Raw Water, continuous</i>			
Dose, maximum	mg/L	5	5
Process Flow	mgd	25	92.3
Feed pumps			
Flow	gpd	870	3210
number	each	2	4
type	each	diaphragm	diaphragm
<i>Pretreatment Chemical Enhanced Backwash (per Skid)</i>			
Dose	mg/L	200	200
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	250	250
number	each	2	3
type	each	diaphragm	diaphragm

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ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
<i>Pretreatment CIP (per Skid)</i>			
Dose	mg/L	200	200
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	250	250
number	each	same as CEB pumps	same as CEB pumps
type	each	diaphragm	diaphragm
<i>Chlorine Residual, continuous</i>			
Dose, maximum	mg/L	2.5	2.5
Process Flow	mgd	19.2	71.0
Feed pumps			
Flow	gpd	334	1234
number	each	2	4
type	each	diaphragm	diaphragm
<i>Sodium Hypochlorite Storage Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		3	14
Storage Duration	days	14	14
Volume	gal	7,100	5,900
Maximum Water Level	ft	10	10
Containment Volume	gal	23,430	90,860
Dimensions (diameter x h)	ft x ft	11' x 11'	10' x 11'
Aqueous Ammonia			
Chemical Make-up		19%	19%
Specific Gravity		0.92	0.92
<i>Raw Water, continuous</i>			
Dose, maximum	mg/L	1.25	1.25
Process Flow	mgd	25	92
Feed pumps			
Flow	gpd	179	660
number	each	2	4
type	each	diaphragm	diaphragm
<i>Finished water, continuous</i>			
Dose, maximum	mg/L	0.6	0.6
Process Flow	mgd	19.2	71.0
Feed pumps			
Flow	gpd	69	254
number	each	2	4
type	each	diaphragm	diaphragm
<i>Aqueous Ammonia Storage Tank</i>			
Type		Polyethylene	Polyethylene
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	5,300	4,200
Maximum Water Level	ft	11	11
Containment Volume	gal	5,830	18,480
Dimensions (diameter x h)	ft x ft	9' x 12'	8' x 12'

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ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
Citric Acid			
Chemical Make-up	w/w as H ₃ C ₆ H ₅ O ₇	50%	50%
Specific Gravity		1.24	1.24
<i>Pretreatment Chemical Enhanced Backwash (per Skid)</i>			
Dose	mg/L	1800	1800
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	523	523
number	each	2	3
type	each	diaphragm	diaphragm
<i>Pretreatment CIP (per Skid)</i>			
Dose	mg/L	24800	24800
Dilution volume	gallons	1250	1250
Feed pumps			
Pumping duration	minutes	5	5
Flow, total	gpd	14400	14400
number		2	3
type		diaphragm	diaphragm
<i>RO CIP (per skid - nano filtration)</i>			
Dose	mg/L	24800	24800
Dilution volume	gallons	8900	8900
Feed pumps			
Pumping duration	minutes	20	10
Flow, total	gpd	25632	51264
number		same as MF CIP pumps	same as MF CIP pumps
type		diaphragm	diaphragm
<i>Citric Acid Storage Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	2,300	2,300
Maximum Water Level	ft	8	8
Containment Volume	gal	2,530	10,120
Dimensions (diameter x h)	ft x ft	7' x 9'	7' x 9'
Caustic Soda (Sodium Hydroxide)			
Chemical Make-up	w/w as NaOH	30%	30%
Specific Gravity		1.26	1.26
<i>Pretreatment CIP (per skid)</i>			
Dose	mg/L	6300	6300
Dilution volume	gallons	1000	1000
Feed pumps			
Pumping duration	minutes	9	10
Flow, total	gpd	2667	2400
number		2	3
type		diaphragm	diaphragm

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ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
<i>RO CIP (per skid - first stage only)</i>			
Dose	mg/L	1260	1260
Dilution volume	gallons	8,900	8,900
Feed pumps			
Pumping duration	minutes	10	10
Flow, total	gpd	4272	4272
number		same as MF CIP pumps	same as MF CIP pumps
type		diaphragm	diaphragm
<i>Caustic Soda Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	300	300
Maximum Water Level	ft	4	4
Containment Volume	gal	330	1,320
Dimensions (diameter x h)	ft x ft	3' x 5'	3' x 5'
Ferric Chloride			
<i>Coagulation for Pretreatment Membranes</i>			
Chemical Make-up	w/w as FeCl ₃	42.0%	42.0%
Specific Gravity		1.4	1.4
Dose, avg	mg/L	5	5
Process Flow	mgd	25	92
Feed pumps			
Flow	gpd	213	785
number	each	2	4
type	each	diaphragm	diaphragm
<i>Ferric Chloride Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	4,300	4,300
Maximum Water Level	ft	9	9
Containment Volume	gal	4,730	18,920
Dimensions (diameter x h)	ft x ft	9' x 10'	9' x 10'
Antiscalant			
<i>Antiscalant for RO System</i>			
Chemical Make-up		100.0%	100.0%
Specific Gravity		1.2	1.2
Dose, avg	mg/L	1.5	1.5
Process Flow	mgd	22	81
Feed pumps			
Flow	gpd	28	102
number		2	4
type		diaphragm	diaphragm

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ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
<i>Antiscalant Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	600	600
Maximum Water Level	ft	6	6
Containment Volume	gal	660	2,640
Dimensions (diameter x h)	ft x ft	4' x 7'	4' x 7'
Sodium Bisulfite			
<i>Remove free Cl before RO System</i>			
Chemical Make-up		38.0%	38.0%
Specific Gravity		1.31	1.31
Dose, avg	mg/L	1.0	1.0
Process Flow	mgd	22	81
Feed pumps			
Flow	gpd	44	163
number		2	4
type		diaphragm	diaphragm
<i>Sodium Bisulfite Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	900	900
Maximum Water Level	ft	6	6
Containment Volume	gal	990	3,960
Dimensions (diameter x h)	ft x ft	5' x 7'	5' x 7'
Fluorosilicic Acid			
<i>Fluoride Addition to Finished Water</i>			
Chemical Make-up		24.0%	24.0%
Specific Gravity		1.234	1.234
Dose, avg	mg/L	0.6	0.6
Process Flow	mgd	19	71
Feed pumps			
Flow	gpd	49	182
number		2	4
type		diaphragm	diaphragm
<i>Fluorosilicic Acid Tank</i>			
Type		Polyethylene	Polyethylene
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	900	900
Maximum Water Level	ft	6	6
Containment Volume	gal	990	3,960
Dimensions (diameter x h)	ft x ft	5' x 7'	5' x 7'

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ALTERNATIVE NO. 2		Initial Capacity	Ultimate Capacity
Polymer			
<i>Coagulant for Thickeners</i>			
Chemical Make-up		100%	100%
Specific Gravity		1.05	1.05
Dose, maximum	mg/L	1.5	1.5
Process Flow	mgd	3.00	11
Feed pumps			
Flow number	gpd	4	16
type	each	2	4
	each	diaphragm	diaphragm
<i>Polymer Tank</i>			
Type		Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Number of Tanks		1	4
Storage Duration	days	14	14
Volume	gal	200	100
Maximum Water Level	ft	3	3
Containment Volume	gal	220	440
Dimensions (diameter x h)	ft x ft	3' x 4'	2' x 4'
Lime			
<i>Stabilization</i>			
Dose, maximum	mg/L	40	40
Storage Duration	days	14	14
Storage Capacity	tons	53	195
Type		quick lime	quick lime
Carbon Dioxide			
<i>pH adjustment</i>			
Dose, maximum	mg/L	25	25
Storage Duration	days	14	14
Storage Capacity	tons	28	104

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: SW30XLE-400i											
MAXIMUM TDS, TEMP = 7 DEG C											
System Details											
Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1000.17 gpm	Osmotic Pressure:							
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	50.01 %	Feed	130.03 psig						
Feed Pressure	832.64 psig	Feed Temperature	7 C	Concentrate	258.38 psig						
Fouling Factor	0.65	Feed TDS	13561.95 mg/l	Average	194.21 psig						
Chem. Dose	None	Number of Elements	294	Average NDP	616.46 psig						
Total Active Area	117600 ft ²	Average Pass 1 Flux	12.25 gfd	Power	905.64 kW						
Water Classification:	Surface Supply SDI < 3			Specific Energy	15.09 kWh/kgal						

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	827.64	0	999.83	792.98	1000.17	12.25	0	0	32.34

Pass Streams (mg/l as Ion)						
Name	Feed	Adjusted Feed	Concentrate		Permeate	
			Stage 1	Stage 1	Stage 1	Total
NH4	0	0	0	0	0	0
K	140	140	279.61	0.43	0.43	0.43
Na	4210	4210	8410	11.42	11.42	11.42
Mg	493	493	985.87	0.3	0.3	0.3
Ca	113	113	225.97	0.07	0.07	0.07
Sr	0	0	0	0	0	0
Ba	0.07	0.07	0.14	0	0	0
CO3	1.02	1.02	4.14	0	0	0
HCO3	104.99	104.99	205.38	0.53	0.53	0.53
NO3	0.56	0.56	1.11	0.01	0.01	0.01
Cl	7411.35	7411.35	14806.61	18.59	18.59	18.59
F	0.93	0.93	1.86	0	0	0
SO4	1057.73	1057.73	2115.55	0.27	0.27	0.27
SiO2	23	23	45.91	0.1	0.1	0.1
Boron	1.1	1.1	2.09	0.11	0.11	0.11
CO2	2.61	2.61	3.82	2.83	2.83	2.83
TDS	13561.95	13561.95	27094.12	32.34	32.34	32.34
pH	7.6	7.6	7.63	5.61	5.61	5.61

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.69%	1.65	
Na	99.73%	45.94	
Mg	99.94%	1.46	
Ca	99.94%	0.33	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.50%	0.79	
NO3	98.21%	0.04	
Cl	99.75%	75.64	100
F	100.00%	0.01	
SO4	99.97%	1.50	
SiO2	99.57%	0.19	
Boron	90.00%	0.08	0.5 - 1
CO2	-8.43%	2.75	
TDS	99.76%	127.99	500
pH	26.18%	5.69	

Project Information: SW30XLE-400i											
JANUARY											
System Details											
Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1199.98 gpm	Osmotic Pressure:							
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	60 %	Feed	64.71 psig						
Feed Pressure	606.16 psig	Feed Temperature	47 F	Concentrate	158.27 psig						
Fouling Factor	0.85	Feed TDS	6870.79 mg/l	Average	111.49 psig						
Chem. Dose	None	Number of Elements	294	Average NDP	474.54 psig						
Total Active Area	117600 ft ²	Average Pass 1 Flux	14.69 gfd	Power	659.31 kW						
Water Classification:	Surface Supply SDI < 3			Specific Energy	9.16 kWh/kgal						

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	601.16	0	800.02	570.55	1199.98	14.69	0	0	16.21

Pass Streams (mg/l as Ion)						
Name	Feed	Adjusted Feed	Concentrate		Permeate	
			Stage 1	Stage 1	Stage 1	Total
NH4	0	0	0	0	0	0
K	82.32	82.32	205.39	0.27	0.27	0.27
Na	1945.33	1945.33	4854.99	5.48	5.48	5.48
Mg	282.53	282.53	706.02	0.19	0.19	0.19
Ca	141.29	141.29	353.08	0.09	0.09	0.09
Sr	0	0	0	0	0	0
Ba	0.07	0.07	0.17	0	0	0
CO3	0.96	0.96	6.18	0	0	0
HCO3	152.38	152.38	372.44	0.73	0.73	0.73
NO3	0.94	0.94	2.32	0.02	0.02	0.02
Cl	3584.86	3585.47	8950.03	8.96	8.96	8.96
F	0.86	0.86	2.15	0	0	0
SO4	637.97	637.97	1594.63	0.17	0.17	0.17
SiO2	39.51	39.51	98.5	0.18	0.18	0.18
Boron	0.2	0.2	0.47	0.02	0.02	0.02
CO2	4.37	4.37	6.43	4.71	4.71	4.71
TDS	6870.79	6870.79	17148.6	16.21	16.21	16.21
pH	7.6	7.6	7.71	5.52	5.52	5.52

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.67%	1.26	
Na	99.72%	27.00	
Mg	99.93%	1.12	
Ca	99.94%	0.55	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.52%	1.10	
NO3	97.87%	0.10	
Cl	99.75%	45.50	100
F	100.00%	0.01	
SO4	99.97%	1.19	
SiO2	99.54%	0.33	
Boron	90.00%	0.01	0.5 - 1
CO2	-7.78%	3.18	
TDS	99.76%	78.21	500
pH	27.37%	5.79	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

MAXIMUM TDS, TEMP = 7 DEG C

System Details

Hybrid option

Flow Rates: **25** mgd Raw water
 MF/UF filtrate ratio **85%**
 6.38 mgd Raw Water Directed to NF Train
 3.19 mgd Concentrate recycled from NF train to SW Train
 14.88 mgd Raw Water Directed to SW Train
 18.06 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	70.0%	18.06	50%	9.03	7
NF train	30.0%	6.38	50%	3.19	2
				12.22	
			total recovery	58%	

Project Information: NF90-400 and SW30XLE-400i

JANUARY

System Details

Hybrid option

Flow Rates: **25** mgd Raw water
 MF/UF filtrate ratio **85%**
 21.25 mgd Raw Water Directed to NF Train
 9.56 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 9.56 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	9.56	60%	5.74	4
NF train	100.0%	21.25	55%	11.69	6
				17.43	
			total recovery	82%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: SW30XLE-400i												
FEBRUARY												
System Details												
Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1199.99 gpm	Osmotic Pressure:								
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	60 %	Feed	35.34 psig							
Feed Pressure	510.45 psig	Feed Temperature	49 F	Concentrate	85.97 psig							
Fouling Factor	0.85	Feed TDS	3727.62 mg/l	Average	60.66 psig							
Chem. Dose	None	Number of Elements	294	Average NDP	429.77 psig							
Total Active Area	117600 ft ²	Average Pass 1 Flux	14.69 gfd	Power	555.21 kW							
Water Classification: Surface Supply SDI < 3				Specific Energy	7.71 kWh/kgal							

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	505.45	0	800.01	475.21	1199.99	14.69	0	0	9.59

Name	Feed	Pass Streams (mg/l as Ion)		Concentrate			Permeate		
		Adjusted Feed	Concentrate Stage 1	Stage 1	Total	Stage 1	Total		
NH4	0	0	0	0	0	0	0	0	0
K	43.91	43.91	109.54	0.16	0.16				
Na	1039.14	1039.14	2593.14	3.11	3.11				
Mg	151.21	151.21	377.86	0.11	0.11				
Ca	75.62	75.62	188.97	0.05	0.05				
Sr	0	0	0	0	0				
Ba	0.07	0.07	0.17	0	0				
CO3	0.74	0.74	4.86	0	0				
HCO3	163.33	163.33	401.33	0.78	0.78				
NO3	0.98	0.98	2.42	0.02	0.02				
Cl	1866.06	1866.72	4659.32	4.93	4.93				
F	0.92	0.92	2.29	0	0				
SO4	341.57	341.57	853.76	0.1	0.1				
SiO2	42.26	42.26	105.34	0.2	0.2				
Boron	0.2	0.2	0.47	0.02	0.02				
CO2	5.23	5.23	6.89	5.46	5.46				
TDS	3726.96	3727.62	9301.68	9.59	9.59				
pH	7.6	7.6	7.78	5.49	5.49				

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.64%	0.72	
Na	99.70%	14.78	
Mg	99.93%	0.62	
Ca	99.93%	0.30	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.52%	1.18	
NO3	97.96%	0.11	
Cl	99.74%	24.58	100
F	100.00%	0.01	
SO4	99.97%	0.66	
SiO2	99.53%	0.36	
Boron	90.00%	0.01	0.5 - 1
CO2	-4.40%	3.49	
TDS	99.74%	43.36	500
pH	27.76%	5.78	

Project Information: SW30XLE-400i												
MARCH												
System Details												
Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1199.98 gpm	Osmotic Pressure:								
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	60 %	Feed	11.72 psig							
Feed Pressure	423.1 psig	Feed Temperature	52 F	Concentrate	28.55 psig							
Fouling Factor	0.85	Feed TDS	1279.28 mg/l	Average	20.14 psig							
Chem. Dose	None	Number of Elements	294	Average NDP	383.2 psig							
Total Active Area	117600 ft ²	Average Pass 1 Flux	14.69 gfd	Power	460.2 kW							
Water Classification: Surface Supply SDI < 3				Specific Energy	6.39 kWh/kgal							

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	418.1	0	800.02	388.48	1199.98	14.69	0	0	4.04

Name	Feed	Pass Streams (mg/l as Ion)		Concentrate			Permeate		
		Adjusted Feed	Concentrate Stage 1	Stage 1	Total	Stage 1	Total		
NH4	0	0	0	0	0	0	0	0	0
K	15.15	15.15	37.77	0.07	0.07				
Na	334.32	334.32	834.13	1.1	1.1				
Mg	46.95	46.95	117.32	0.04	0.04				
Ca	23.48	23.48	58.67	0.02	0.02				
Sr	0	0	0	0	0				
Ba	0.08	0.08	0.2	0	0				
CO3	0.53	0.53	3.45	0	0				
HCO3	180.29	180.29	445.35	0.89	0.89				
NO3	1.05	1.05	2.59	0.02	0.02				
Cl	517.95	518.61	1294.3	1.48	1.48				
F	1.01	1.01	2.52	0	0				
SO4	110.05	110.05	275.07	0.03	0.03				
SiO2	46.6	46.6	116.13	0.25	0.25				
Boron	0.2	0.2	0.46	0.02	0.02				
CO2	6.71	6.71	7.92	6.81	6.81				
TDS	1278.61	1279.28	3190.16	4.04	4.04				
pH	7.6	7.6	7.86	5.44	5.44				

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.54%	0.30	
Na	99.67%	4.96	
Mg	99.91%	0.20	
Ca	99.91%	0.09	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.51%	1.42	
NO3	98.10%	0.12	
Cl	99.71%	7.64	100
F	100.00%	0.01	
SO4	99.97%	0.22	
SiO2	99.46%	0.41	
Boron	90.00%	0.01	0.5 - 1
CO2	-1.49%	3.97	
TDS	99.68%	15.43	500
pH	28.42%	5.79	

Feed water quality is based on dry year conditions within Suisun Bay from 2006 through 2009. Calculations are based on ROSA projection model, The Dow Chemical Company, version 7.0.0.

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

FEBRUARY

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 8.93 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 8.93 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	8.93	60%	5.36	4
NF train	100.0%	21.25	58%	12.33	6
				17.68	
			total recovery	83%	

Project Information: NF90-400 and SW30XLE-400i

MARCH

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 8.08 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 8.08 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	8.08	60%	4.85	3
NF train	100.0%	21.25	62%	13.18	6
				18.02	
			total recovery	85%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

APRIL

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 9.14 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 9.14 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	9.14	61%	5.57	4
NF train	100.0%	21.25	57%	12.11	6
				17.69	
			total recovery	83%	

Project Information: NF90-400 and SW30XLE-400i

MAY

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 9.56 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 9.56 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	9.56	61%	5.83	4
NF train	100.0%	21.25	55%	11.69	6
				17.52	
			total recovery	82%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

JUNE

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 10.41 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 10.41 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	10.41	63%	6.56	4
NF train	100.0%	21.25	51%	10.84	6
				17.40	
			total recovery	82%	

Project Information: NF90-400 and SW30XLE-400i

JULY

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 17.00 mgd Raw Water Directed to NF Train
 8.67 mgd Concentrate recycled from NF train to SW Train
 4.25 mgd Raw Water Directed to SW Train
 12.92 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	20.0%	12.92	64%	8.27	5
NF train	80.0%	17.00	49%	8.33	5
				16.60	
			total recovery	78%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: SW30XLE-400i
AUGUST
System Details

Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1300.06 gpm	Osmotic Pressure:	
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	65 %	Feed	62.51 psig
Feed Pressure	427.12 psig	Feed Temperature	69 F	Concentrate	174.47 psig
Fouling Factor	0.85	Feed TDS	6153.54 mg/l	Average	118.49 psig
Chem. Dose	None	Number of Elements	294	Average NDP	292.24 psig
Total Active Area	117600 ft ²	Average Pass 1 Flux	15.92 gfd	Power	464.57 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	5.96 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	422.12	0	699.94	398.63	1300.06	15.92	0	0	31.92

Name	Feed	Adjusted Feed	Concentrate		Permeate	
			Stage 1	Stage 1	Stage 1	Total
NH4	0	0	0	0	0	0
K	62.95	62.95	179.1	0.42	0.42	0.42
Na	1891.68	1891.68	5385.08	10.88	10.88	10.88
Mg	224.44	224.44	640.76	0.3	0.3	0.3
Ca	51.41	51.41	146.78	0.07	0.07	0.07
Sr	0	0	0	0	0	0
Ba	0.08	0.08	0.23	0	0	0
CO3	0.92	0.92	6.85	0	0	0
HCO3	111.97	111.97	309.83	0.93	0.93	0.93
NO3	0.64	0.64	1.78	0.03	0.03	0.03
Cl	3295.43	3295.62	9384.47	17.47	17.47	17.47
F	0.98	0.98	2.79	0.01	0.01	0.01
SO4	481.6	481.6	1375.63	0.27	0.27	0.27
SiO2	24.95	24.95	70.86	0.23	0.23	0.23
Boron	1.1	1.1	2.71	0.23	0.23	0.23
CO2	2.62	2.62	4.83	3.03	3.03	3.03
TDS	6153.35	6153.54	17519.66	31.92	31.92	31.92
pH	7.6	7.6	7.65	5.71	5.71	5.71

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.33%	1.79	
Na	99.42%	49.09	
Mg	99.87%	1.62	
Ca	99.86%	0.37	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.17%	1.69	
NO3	95.31%	0.10	
Cl	99.47%	80.43	100
F	98.98%	0.03	
SO4	99.94%	1.69	
SiO2	99.08%	0.46	
Boron	79.09%	0.16	0.5 - 1
CO2	-15.65%	2.83	
TDS	99.48%	138.19	500
pH	24.87%	5.82	

Project Information: SW30XLE-400i
SEPTEMBER
System Details

Feed Flow to Stage 1	2000 gpm	Pass 1 Permeate Flow	1300.03 gpm	Osmotic Pressure:	
Raw Water Flow to System	2000 gpm	Pass 1 Recovery	65 %	Feed	66.91 psig
Feed Pressure	468.08 psig	Feed Temperature	65 F	Concentrate	187.01 psig
Fouling Factor	0.85	Feed TDS	6642.25 mg/l	Average	126.96 psig
Chem. Dose	None	Number of Elements	294	Average NDP	324.28 psig
Total Active Area	117600 ft ²	Average Pass 1 Flux	15.92 gfd	Power	509.12 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	6.53 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	463.08	0	699.97	438.73	1300.03	15.92	0	0	30.38

Name	Feed	Adjusted Feed	Concentrate		Permeate	
			Stage 1	Stage 1	Stage 1	Total
NH4	0	0	0	0	0	0
K	68.07	68.07	193.76	0.4	0.4	0.4
Na	2044.86	2044.86	5823.43	10.4	10.4	10.4
Mg	242.16	242.16	691.39	0.28	0.28	0.28
Ca	55.21	55.21	157.63	0.06	0.06	0.06
Sr	0	0	0	0	0	0
Ba	0.08	0.08	0.23	0	0	0
CO3	0.92	0.92	6.88	0	0	0
HCO3	112.08	112.08	310.17	0.85	0.85	0.85
NO3	0.57	0.57	1.59	0.02	0.02	0.02
Cl	3567.61	3567.78	10163.11	16.72	16.72	16.72
F	0.99	0.99	2.82	0.01	0.01	0.01
SO4	518.25	518.25	1480.32	0.25	0.25	0.25
SiO2	24.98	24.98	70.99	0.21	0.21	0.21
Boron	1.1	1.1	2.76	0.21	0.21	0.21
CO2	2.67	2.67	4.91	3.08	3.08	3.08
TDS	6642.08	6642.25	18918.11	30.38	30.38	30.38
pH	7.6	7.6	7.65	5.68	5.68	5.68

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.41%	1.69	
Na	99.49%	46.67	
Mg	99.88%	1.53	
Ca	99.89%	0.34	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.24%	1.51	
NO3	96.49%	0.08	
Cl	99.53%	76.50	100
F	98.99%	0.03	
SO4	99.95%	1.58	
SiO2	99.16%	0.41	
Boron	80.91%	0.15	0.5 - 1
CO2	-15.36%	2.88	
TDS	99.54%	131.18	500
pH	25.26%	5.79	

Feed water quality is based on dry year conditions within Suisun Bay from 2006 through 2009. Calculations are based on ROSA projection model, The Dow Chemical Company, version 7.0.0.

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

AUGUST

System Details

Hybrid option

Flow Rates:	25 mgd	Raw water
MF/UF filtrate ratio	85%	
	9.56 mgd	Raw Water Directed to NF Train
	5.16 mgd	Concentrate recycled from NF train to SW Train
	11.69 mgd	Raw Water Directed to SW Train
	16.85 mgd	Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	55.0%	16.85	65%	10.95	6
NF train	45.0%	9.56	46%	4.40	3
				15.35	
			total recovery	72%	

Project Information: NF90-400 and SW30XLE-400i

SEPTEMBER

System Details

Hybrid option

Flow Rates:	25 mgd	Raw water
MF/UF filtrate ratio	85%	
	9.56 mgd	Raw Water Directed to NF Train
	5.16 mgd	Concentrate recycled from NF train to SW Train
	11.69 mgd	Raw Water Directed to SW Train
	16.85 mgd	Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	55.0%	16.85	65%	10.95	6
NF train	45.0%	9.56	46%	4.40	3
				15.35	
			total recovery	72%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400
OCTOBER

System Details

Feed Flow to Stage 1	2500 gpm	Pass 1 Permeate Flow	1174.9 gpm	Osmotic Pressure:	
Raw Water Flow to System	2500 gpm	Pass 1 Recovery	47 %	Feed	49.1 psig
Feed Pressure	144.9 psig	Feed Temperature	62 F	Concentrate	88.29 psig
Fouling Factor	0.85	Feed TDS	4859.88 mg/l	Average	68.7 psig
Chem. Dose	None	Number of Elements	343	Average NDP	59.11 psig
Total Active Area	137200 ft ²	Average Pass 1 Flux	12.33 gfd	Power	197.01 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	2.79 kWh/kgal

				Recirc								Boost	
	Stage	Element	#PV #Ele	Feed Flow	Feed Press	Flow	Conc Flow	Conc Press	Perm Flow	Avg Flux	Perm Press	Press	Perm TDS
	1	NF90-400	49 7	(gpm)	(psig)	(gpm)	(gpm)	(psig)	(gpm)	(gfd)	(psig)	(psig)	(mg/l)
				2500	139.9	0	1325.1	108.61	1174.9	12.33	0	0	312.28

Pass Streams (mg/l as ion)						Name		Calc'd SW Feed
Name	Feed	Adjusted Feed	Concentrate		Permeate		Name	Calc'd SW Feed
			Stage 1	Stage 1	Total			
NH4	0	0	0	0	0	NH4	0.00	
K	50	50	90.76	4.03	4.03	K	68.05	
Na	1500	1500	2730.75	111.92	111.92	Na	2045.10	
Mg	175	175	326.84	3.75	3.75	Mg	242.25	
Ca	40	40	74.72	0.84	0.84	Ca	55.38	
Sr	0	0	0	0	0	Sr	0.00	
Ba	0.06	0.06	0.11	0	0	Ba	0.08	
CO3	0.58	0.58	2.04	0	0	CO3	1.23	
HCO3	90	90	165.41	2.82	2.82	HCO3	123.40	
NO3	0.5	0.5	0.76	0.21	0.21	NO3	0.62	
Cl	2607.83	2607.93	4757.24	183.87	183.87	Cl	3559.80	
F	0.8	0.8	1.45	0.07	0.07	F	1.09	
SO4	375	375	703.98	3.96	3.96	SO4	520.70	
SiO2	20	20	37.01	0.81	0.81	SiO2	27.53	
Boron	0	0	0	0	0	Boron	1.10	
CO2	2.37	2.37	2.94	2.48	2.48	CO2	2.62	
TDS	4859.77	4859.88	8891.08	312.28	312.28	TDS	6645.22	
pH	7.6	7.6	7.71	6.25	6.25	pH	7.65	

boron is not modeled by ROSA for NF membranes

Project Information: NF90-400
NOVEMBER

System Details

Feed Flow to Stage 1	2500 gpm	Pass 1 Permeate Flow	1225.02 gpm	Osmotic Pressure:	
Raw Water Flow to System	2500 gpm	Pass 1 Recovery	49 %	Feed	53.17 psig
Feed Pressure	167.47 psig	Feed Temperature	55 F	Concentrate	99.91 psig
Fouling Factor	0.85	Feed TDS	5341.98 mg/l	Average	76.54 psig
Chem. Dose	None	Number of Elements	343	Average NDP	72.61 psig
Total Active Area	137200 ft ²	Average Pass 1 Flux	12.86 gfd	Power	227.69 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	3.1 kWh/kgal

				Recirc								Boost	
	Stage	Element	#PV #Ele	Feed Flow	Feed Press	Flow	Conc Flow	Conc Press	Perm Flow	Avg Flux	Perm Press	Press	Perm TDS
	1	NF90-400	49 7	(gpm)	(psig)	(gpm)	(gpm)	(psig)	(gpm)	(gfd)	(psig)	(psig)	(mg/l)
				2500	162.47	0	1274.98	129.81	1225.02	12.86	0	0	267.25

Pass Streams (mg/l as ion)						Name		Calc'd SW Feed
Name	Feed	Adjusted Feed	Concentrate		Permeate		Name	Calc'd SW Feed
			Stage 1	Stage 1	Total			
NH4	0	0	0	0	0	NH4	0.00	
K	55	55	104.53	3.45	3.45	K	81.91	
Na	1650	1650	3143.23	95.86	95.86	Na	2461.39	
Mg	193	193	375.37	3.2	3.2	Mg	292.10	
Ca	44	44	85.59	0.71	0.71	Ca	66.60	
Sr	0	0	0	0	0	Sr	0.00	
Ba	0.06	0.06	0.12	0	0	Ba	0.09	
CO3	0.55	0.55	2.13	0	0	CO3	1.41	
HCO3	90	90	172.26	2.2	2.2	HCO3	134.70	
NO3	0.5	0.5	0.81	0.18	0.18	NO3	0.67	
Cl	2875.84	2876.06	5487.97	157.62	157.62	Cl	4295.22	
F	0.8	0.8	1.51	0.06	0.06	F	1.19	
SO4	412	412	804.63	3.35	3.35	SO4	625.35	
SiO2	20	20	38.61	0.63	0.63	SiO2	30.11	
Boron	0	0	0	0	0	Boron	1.10	
CO2	2.5	2.5	3.12	2.62	2.62	CO2	2.84	
TDS	5341.76	5341.98	10216.77	267.25	267.25	TDS	7990.74	
pH	7.6	7.6	7.72	6.15	6.15	pH	7.66	

boron is not modeled by ROSA for NF membranes

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

OCTOBER

System Details

Hybrid option

Flow Rates: **25** mgd Raw water
 MF/UF filtrate ratio **85%**
 12.75 mgd Raw Water Directed to NF Train
 6.76 mgd Concentrate recycled from NF train to SW Train
 8.50 mgd Raw Water Directed to SW Train
 15.26 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	40.0%	15.26	64%	9.76	6
NF train	60.0%	12.75	47%	5.99	4
				15.76	
			total recovery	74%	

Project Information: NF90-400 and SW30XLE-400i

NOVEMBER

System Details

Hybrid option

Flow Rates: **25** mgd Raw water
 MF/UF filtrate ratio **85%**
 14.88 mgd Raw Water Directed to NF Train
 7.59 mgd Concentrate recycled from NF train to SW Train
 6.38 mgd Raw Water Directed to SW Train
 13.96 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	30.0%	13.96	64%	8.94	5
NF train	70.0%	14.88	49%	7.29	5
				16.22	
			total recovery	76%	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400

DECEMBER

System Details

Feed Flow to Stage 1	2500 gpm	Pass 1 Permeate Flow	1300.05 gpm	Osmotic Pressure:	
Raw Water Flow to System	2500 gpm	Pass 1 Recovery	52 %	Feed	46.85 psig
Feed Pressure	178.09 psig	Feed Temperature	48 F	Concentrate	93.82 psig
Fouling Factor	0.85	Feed TDS	4765.38 mg/l	Average	70.33 psig
Chem. Dose	None	Number of Elements	343	Average NDP	87.77 psig
Total Active Area	137200 ft ²	Average Pass 1 Flux	13.64 gfd	Power	242.14 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	3.1 kWh/kgal

				Recirc						Boost		
Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Perm TDS (mg/l)
1	NF90-400	49	7	2500	173.09	0	1199.95	139.06	1300.05	13.64	0	182.2

Pass Streams (mg/l as Ion)					
Name	Feed	Adjusted Feed	Concentrate		Permeate
			Stage 1	Stage 1	Total
NH4	0	0	0	0	0
K	49	49	99.53	2.36	2.36
Na	1470	1470	2991.87	65.31	65.31
Mg	172	172	356	2.17	2.17
Ca	39	39	80.73	0.48	0.48
Sr	0	0	0	0	0
Ba	0.06	0.06	0.12	0	0
CO3	0.45	0.45	2.06	0	0
HCO3	90	90	183.49	1.7	1.7
NO3	0.5	0.5	0.88	0.15	0.15
Cl	2555.47	2555.56	5208.12	107.24	107.24
F	0.8	0.8	1.62	0.04	0.04
SO4	368	368	764.23	2.28	2.28
SiO2	20	20	41.15	0.48	0.48
Boron	0	0	0	0	0
CO2	2.79	2.79	3.43	2.9	2.9
TDS	4765.29	4765.38	9729.82	182.2	182.2
pH	7.6	7.6	7.75	6.05	6.05

boron is not modeled by ROSA for NF membranes

Name	Calc'd SW Feed
NH4	0.00
K	99.53
Na	2991.87
Mg	356.00
Ca	80.73
Sr	0.00
Ba	0.12
CO3	2.06
HCO3	183.49
NO3	0.88
Cl	5208.12
F	1.62
SO4	764.23
SiO2	41.15
Boron	1.10
CO2	3.43
TDS	9729.82
pH	7.75

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: SW30XLE-400i

DECEMBER

System Details

Feed Flow to Stage 1 2000 gpm Pass 1 Permeate Flow 1279.91 gpm
 Raw Water Flow to System 2000 gpm Pass 1 Recovery 64 %
 Feed Pressure 720.35 psig Feed Temperature 48 F
 Fouling Factor 0.85 Feed TDS 9736.1 mg/l
 Chem. Dose None Number of Elements 294
 Total Active Area 117600 ft² Average Pass 1 Flux 15.67 gfd
 Water Classification: Surface Supply SDI < 3

Osmotic Pressure:
 Feed 93.82 psig
 Concentrate 257.04 psig
 Average 175.43 psig
 Average NDP 525.77 psig
 Power 783.51 kW
 Specific Energy 10.2 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	SW30XLE-400i	42	7	2000	715.35	0	720.09	686.49	1279.91	15.67	0	0	25.5

Name	Pass Streams (mg/l as Ion)		Concentrate		Permeate	
	Feed	Adjusted Feed	Stage 1	Stage 1	Total	
NH4	0	0	0	0	0	0
K	99.53	99.53	275.84	0.34	0.34	
Na	2991.87	2991.87	8294.12	8.79	8.79	
Mg	356	356	988.34	0.24	0.24	
Ca	80.73	80.73	224.13	0.05	0.05	
Sr	0	0	0	0	0	
Ba	0.12	0.12	0.33	0	0	
CO3	1.47	1.47	11.09	0	0	
HCO3	183.49	183.49	494.11	0.86	0.86	
NO3	0.88	0.88	2.41	0.02	0.02	
Cl	5208.12	5208.71	14441.83	14.1	14.1	
F	1.62	1.62	4.49	0.01	0.01	
SO4	764.23	764.23	2122.22	0.22	0.22	
SiO2	41.15	41.15	113.94	0.2	0.2	
Boron	1.1	1.1	2.85	0.12	0.12	
CO2	4.79	4.79	8.5	5.49	5.49	
TDS	9735.51	9736.1	26989.14	25.5	25.5	
pH	7.6	7.6	7.64	5.52	5.52	

Name	SW Rejection	Final Permeate	WQ Goals
NH4	#DIV/0!	0.00	
K	99.66%	1.61	
Na	99.71%	44.32	
Mg	99.93%	1.45	
Ca	99.94%	0.32	
Sr	#DIV/0!	0.00	
Ba	100.00%	0.00	
CO3	100.00%	0.00	
HCO3	99.53%	1.39	
NO3	97.73%	0.10	
Cl	99.73%	72.65	100
F	99.38%	0.03	
SO4	99.97%	1.51	
SiO2	99.51%	0.38	
Boron	89.09%	0.04	0.5 - 1
CO2	-14.61%	3.86	
TDS	99.74%	124.01	500
pH	27.37%	5.77	

Alternative No. 2 - Hybrid RO Performance Projections

Project Information: NF90-400 and SW30XLE-400i

DECEMBER

System Details

Hybrid option

Flow Rates: 25 mgd Raw water
 MF/UF filtrate ratio 85%
 21.25 mgd Raw Water Directed to NF Train
 10.20 mgd Concentrate recycled from NF train to SW Train
 0.00 mgd Raw Water Directed to SW Train
 10.20 mgd Feed water as pumped to SW train: Raw water + recycled NF concentrate

	raw water split	Inlet mgd	Recovery	Outlet mgd	# of skids
SW train	0.0%	10.20	64%	6.53	4
NF train	100.0%	21.25	52%	11.05	6
				17.58	
			total recovery	83%	