

## Permeate Throttling (Variable), Concentrate Recirculation

Project name	Cray Barn		Page : 1/3
Calculated by	Stefan Massingham	Permeate flow/train	0.40 m3/h
HP Pump flow	3.07 m3/h	Raw water flow/train	0.57 m3/h
Feed pressure	5.5 bar	Permeate recovery	13.03 %
Feed temperature	25.0 °C(77.0°F)	Total system recovery	70.00 %
Concentrate recirculation	2.50 m3/h	Element age	0.0 years
Feed water pH	8.40	Flux decline %, per year	5.0
Chem dose, mg/l, -	H2SO4	Fouling factor	1.00
Specific energy	1.47 kWh/m3	SP increase, per year	7.0 %
Pass NDP	2.3 bar		
Average flux rate	17.9 lmh		

Pass - Stage	Flow m3/h	Perm. Feed m3/h	Flow / Vessel Conc m3/h	Flux lmh	DP bar	Flux lmh	Beta	Feed type			Brackish Well Non-Fouling			
								Stagewise Pressure			Perm. bar	Element Type	Element Quantity	PV# x
								Max bar	Boost bar	Conc bar				
1-1	0.4	1	0.9	18	0.1	18	1.13	1	0	5.4	120.1	ESPA4-LD-4040	3	3 x 1M

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1
Hardness, as CaCO3	0.00	0.00	0.000	0.0
Ca	0.00	0.00	0.000	0.0
Mg	0.00	0.00	0.000	0.0
Na	380.00	1018.82	46.386	1164.5
K	0.00	0.00	0.000	0.0
NH4	0.70	1.08	0.079	1.2
Ba	0.000	0.000	0.000	0.0
Sr	0.000	0.000	0.000	0.0
H	0.00	0.00	0.000	0.0
CO3	0.00	0.02	0.000	0.0
HCO3	0.10	0.26	0.012	0.3
SO4	2.00	5.78	0.026	6.6
Cl	585.45	1571.37	71.619	1796.1
F	0.00	0.00	0.000	0.0
NO3	0.00	0.00	0.000	0.0
PO4	0.00	0.00	0.000	0.0
OH	0.04	0.10	0.005	0.1
SiO2	6.70	18.69	0.444	21.4
B	1.58	1.58	1.581	1.6
CO2	0.00	0.00	0.00	0.00
NH3	0.10	0.36	0.36	0.36
<b>TDS</b>	<b>976.53</b>	<b>2617.59</b>	<b>120.15</b>	<b>2991.78</b>
<b>pH</b>	<b>8.40</b>	<b>8.78</b>	<b>7.50</b>	<b>8.83</b>

Saturations	Raw Water	Feed Water	Concentrate	Limits
CaSO4 / ksp * 100, %	0	0	0	400
SrSO4 / ksp * 100, %	0	0	0	1200
BaSO4 / ksp * 100, %	0	0	0	10000
SiO2 saturation, %	4	10	11	140
CaF2 / ksp * 100, %	0	0	0	50000
Ca3(PO4)2 saturation index	0.0	0.0	0.0	2.4
CCPP, mg/l	0.00	0.00	0.00	850
Langelier saturation index	0.00	0.00	0.00	2.8
Ionic strength	0.02	0.04	0.05	
Osmotic pressure, bar	0.8	2.1	2.3	

Product performance calculations are based on nominal element performance when operated on a feed water of acceptable quality. The results shown on the printouts produced by this program are estimates of product performance. No guarantee of product or system performance is expressed or implied unless provided in a separate warranty statement signed by an authorized Hydranautics representative. Calculations for chemical consumption are provided for convenience and are based on various assumptions concerning water quality and composition. As the actual amount of chemical needed for pH adjustment is feedwater dependent and not membrane dependent, Hydranautics does not warrant chemical consumption. If a product or system warranty is required, please contact your Hydranautics representative. Non-standard or extended warranties may result in different pricing than previously quoted. Version : 2.231.90 %



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Concentrate recirculation	2.50 m3/h										0.0 years				
Feed water pH	8.40										5.0				
Chem dose, mg/l, -	H2SO4										1.00				
Specific energy	1.47 kwh/m3										7.0 %				
Pass NDP	2.3 bar														
Average flux rate	17.9 lmh														
Feed type															
Pass -	Perm.	Flow / Vessel		Flux	DP	Flux	Beta	Stagewise Pressure			Perm.	Element	Element	PV# x	
Stage	Flow	Feed	Conc		Max			Perm.	Boost	Conc	TDS	Type	Quantity	Elem #	
	m3/h	m3/h	m3/h	lmh	bar	lmh		bar	bar	bar	mg/l				
1-1	0.4	1	0.9	18	0.1	18	1.13	1	0	5.4	120.1	ESPA4-LD-4040	3	3 x 1M	
Pass -	Element	Feed	Pressure	Conc	NDP	Permeate Water	Permeate Water	Beta	Permeate (Stagewise cumulative)			Ca	Mg	Na	Cl
Stage	no.	Pressure	Drop	Osmo.		Flow	Flux		TDS						
		bar	bar	bar	bar	m3/h	lmh								
1-1	1	5.5	0.08	2.3	2.3	0.1	18	1.13	120.1		0	0	46.361	71.58	

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Project name

Cray Barn

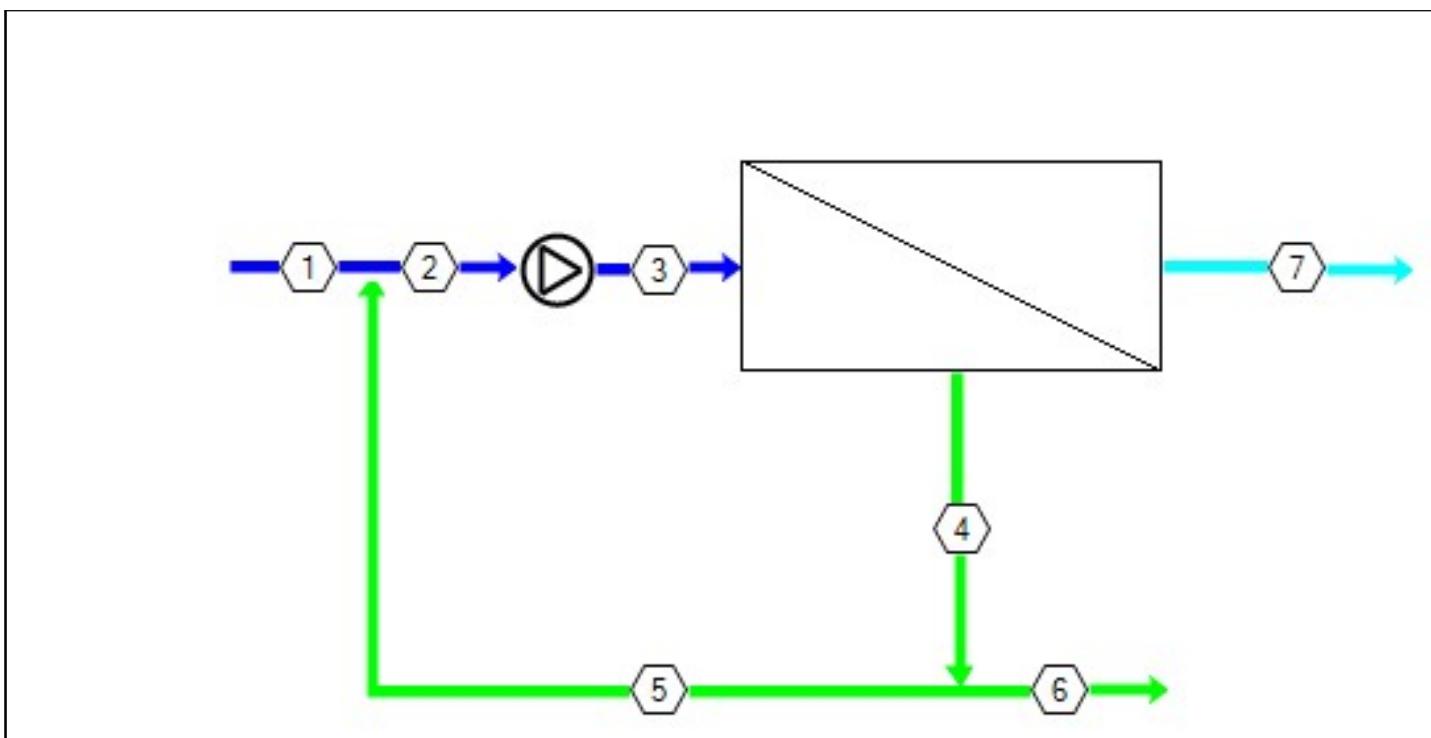
Page : 3/3

Temperature :

25.0 °C

Element age, P1 :

0.0 years



Stream No.	Flow (m3/h)	Pressure (bar)	TDS (mg/l)	pH	Econd (μs/cm)
1	0.570	0	977	8.40	2010
2	3.07	0	2618	8.78	4842
3	3.07	5.47	2618	8.78	4842
4	2.67	5.40	2992	8.83	5465
5	2.50	0	2992	8.83	5465
6	0.170	0	2992	8.83	5465
7	0.400	1.00	120	7.50	257

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