

COMPARISON OF BRACKISH RO CONCENTRATE DISPOSAL APPROACHES - HYPOTHETICAL PHOENIX CASE

Basis and Assumptions:

- 20 MGD of Brackish Water RO Concentrates from various RO Plants in the Phoenix area
- Consider disposal via a long-distance pipeline to Sea of Cortez,
- Build a very large natural Evaporation Pond
- Evaporation Pond and Volume Reduction Options involving:
 - * Thermal Evaporation followed by Evaporation Pond
 - * High Recovery RO Membrane Treatment followed by Thermal Evaporation followed by Evaporation Pond
 - * High Recovery RO Membrane Treatment followed by Evaporation Pond
- Pipeline and evaporation pond analysis from Bureau of Reclamation study
- Thermal options by Mickley & Associates
- Thermal options assume \$30/ton for solids disposal and \$0.05/kwhr for power
- Annual costs figured at 40 years and 7.125% interest

COST PARAMETERS	CONVENTIONAL DISPOSAL OPTIONS		STATE-OF-THE-ART RECOVERY OPTIONS		
	Pipeline to Sea	Evaporation Pond	- Thermal Evaporation - Evaporation Pond	- High Recovery RO - Thermal Evaporation - Evaporation Pond	- High Recovery RO - Evaporation Pond
Capital Cost (US \$)	310 MM	410 MM	136 MM	76 MM	92 MM
Operating Costs (US \$ / Year)	0.8 MM	1.6 MM	33 MM	29 MM	21 MM
- Labour (\$ MM/Year)			1.1	3.1	2
- Energy			31	3.9	1
- Chemicals				6.2	5
- Sludge Disposal				14.7	12
- Evaporation Pond			0.8	0.8	0.8
Annual Cost (US \$ / Year)	24 MM	33 MM	43	35	27
Water Lost	20 mgd	20 mgd	0.8 mgd	0.8 mgd	2.5 mgd
Annual Cost Incl. Water Credit (*)					
- \$2 / 1000 Gallons Saving	24 MM	33 MM	29.0	21.0	14.2
- \$4 / 1000 Gallons Saving	24 MM	33 MM	15.0	7.0	1.5

REF. "Membrane Concentrate Management", State-of-the-Science Report, Mickley & Associates, Boulder (CO), October 2, 2005

(*) Using a typical water credit of \$2-\$4 per 1000 US Gallons. Ref. "Desalination Technology Development", Mike Hightower, SNL, NM, USA (2005)