Flexible Desalination Systems for Variable Salinity Sources

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America's Authority in Membrane Treatment
AMTA
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Improving America's Waters Through Membrane Treatment and Desalting

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The Authoritative Resource on Safe Water®

Preview

- Where are variable sources?
- Resources on the Gulf Coast of Texas
- The System
- Performance results
- Comparison to previous data
- Conclusions

Examples of Variable Sources

- Agricultural drainage water
  - San Joaquin Valley, CA
  - TDS varied from 3,828 mg/L to 28,780 mg/L,
  - Carbonate saturation from 0.86 to 5.7
  - Gypsum from 0.4 to 0.98 (McCool et al. *Des* 261 (2010))
- Brazos River Basin
  - salinity varies from 500 to 15,000 mg/L at the top of the basin (Wurbs and Lee, *J of Hyd* 409 1-2 (2011)

Examples of Variable Sources

- Singapore
  - Coastal canal water supply varies from 30 – 250 mg/L to 35,000 during dry spells. (Seah et al. *J. of Water Sup Res and Tech Aqua* 59 (6-7) 2010)
- Solar or wind energy driven desalination
  - Variable energy input. This is also the case for facilities tied to off peak power rates.

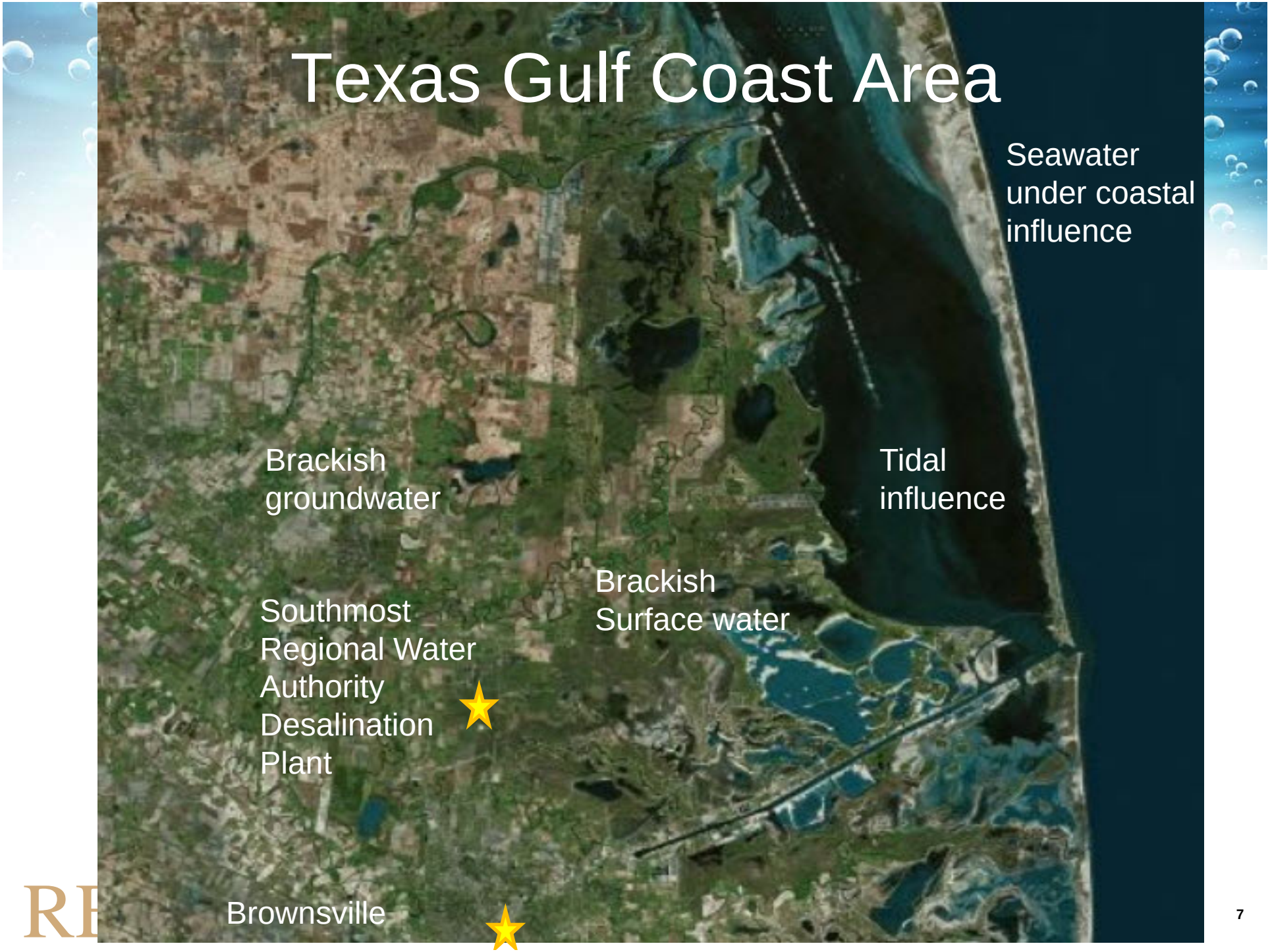
Examples of Variable Sources

- Produced water treatment
  - Facilities treat water with TDS ranging from 200 – 400,000 mg/L
- Emergency response and military expeditionary systems
  - Treat whatever they can find.

Examples of Variable Sources

- Ship board treatment systems
  - Salinity & turbidity range from 20 to 40 g/L and 0 – 100 NTU.
- Coastal areas
  - Access to storm water, brackish groundwater and seawater.

Texas Gulf Coast Area



Southmost Regional Water Authority Desal Plant

- ESPA2 Hyd. RO/ w cartridge filtration
- Capacity of 7.5 mgd
- Field of 20 brackish wells within 10 miles
- 8 miles from seawater

Feed Water Quality	
TDS	3,260 mg/L
Alkalinity	383 mg/L
Bicarbonate	467 mg/L
Calcium	138 mg/L
Sodium	955 mg/L
Chloride	737 mg/L
Sulfate	1,032 mg/L
Iron	0.6 mg/L
Arsenic	22.5 µg/L
pH	7.2
Temperature	27.7 °C
Turbidity	2.7 NTU

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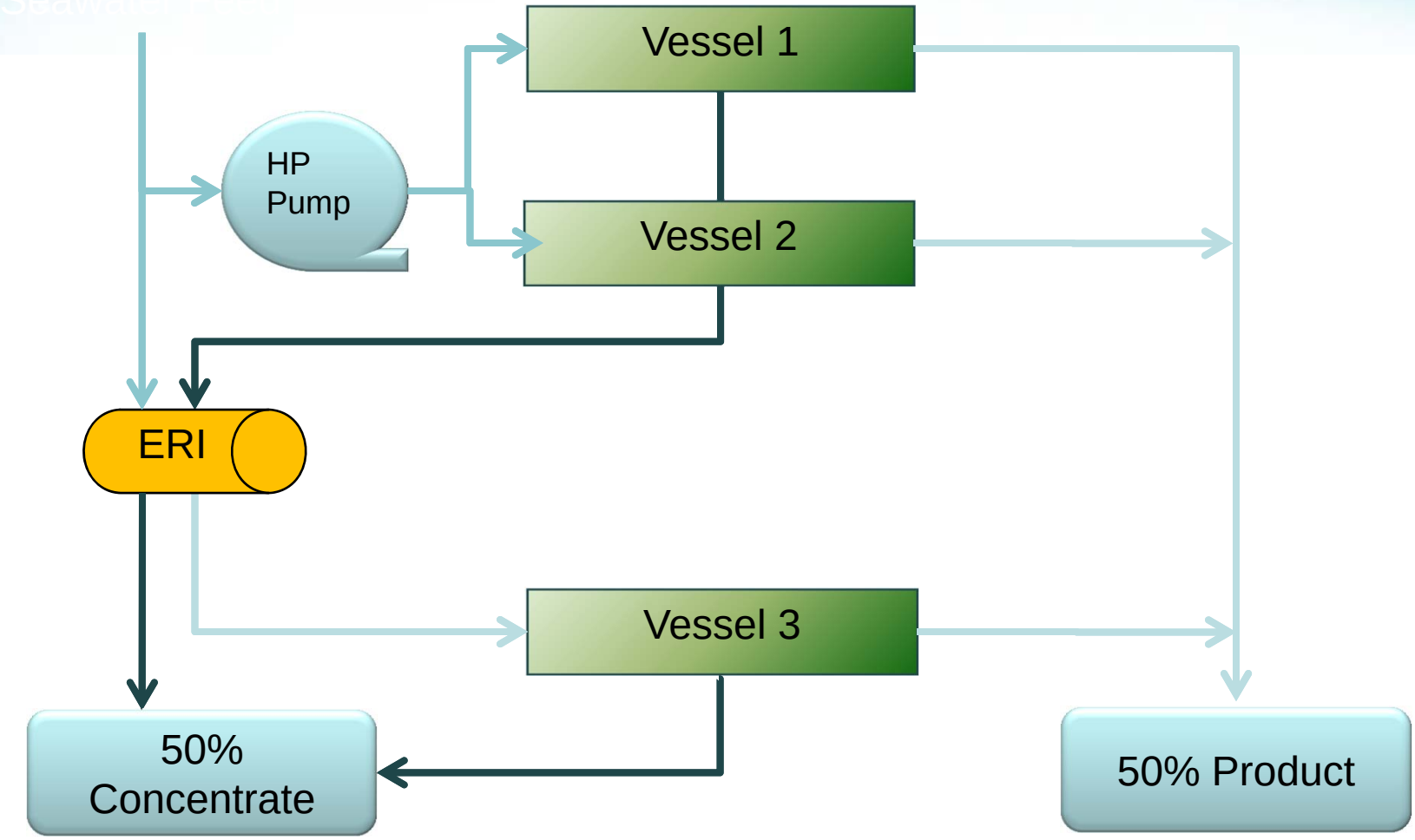
The System: Expeditionary Unit Water Purifier

- Designed by/for military for emergency & expeditionary water production
- UF – RO seawater desalination
- Produce 100 kgal/day from any source
- Space & weight criteria to be C130 transportable.
- Two were built, one with service power & one with diesel pump and generator

Sea Water Arrangement – One stage (as built)



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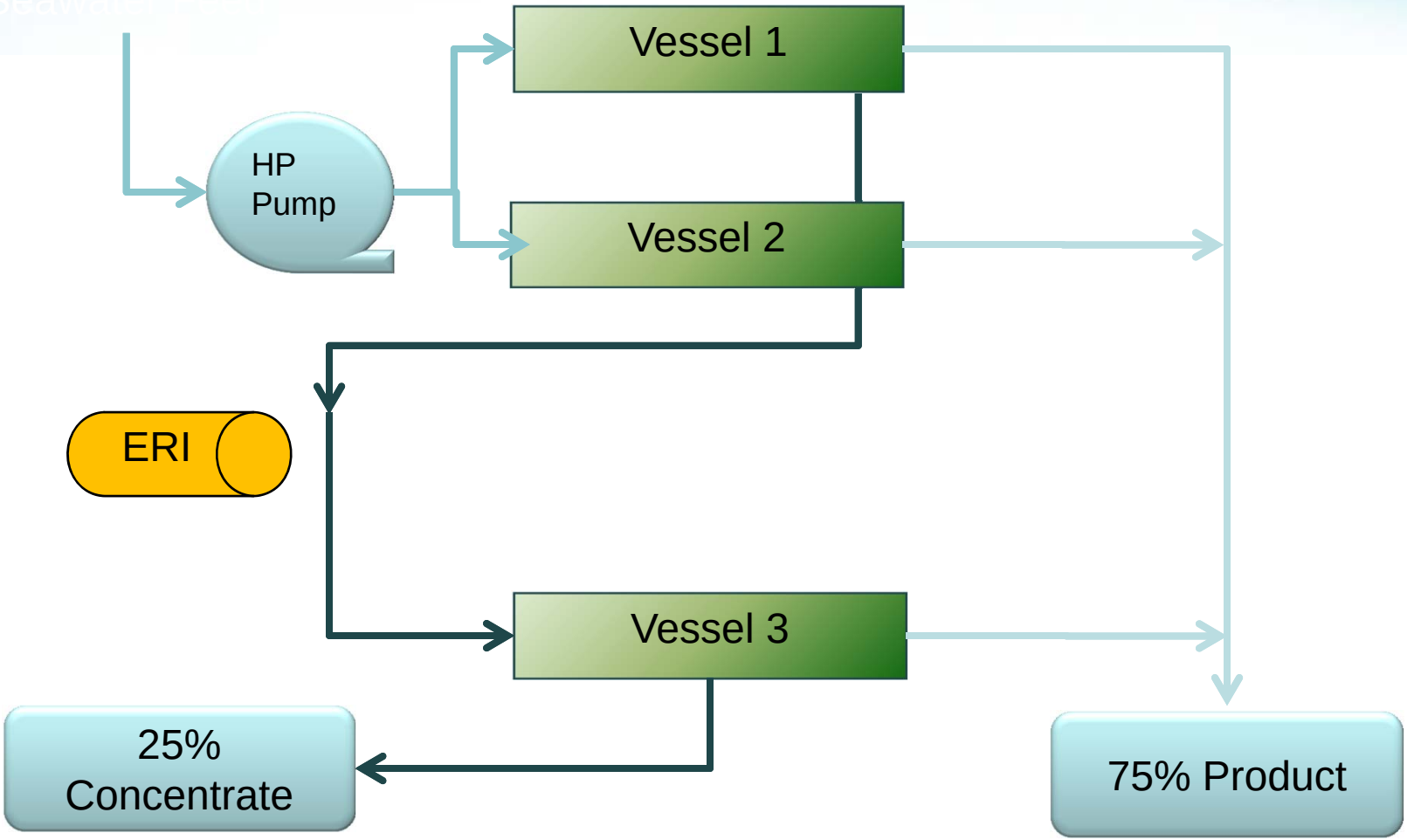
Brackish Water Arrangement – Two stages (modification)



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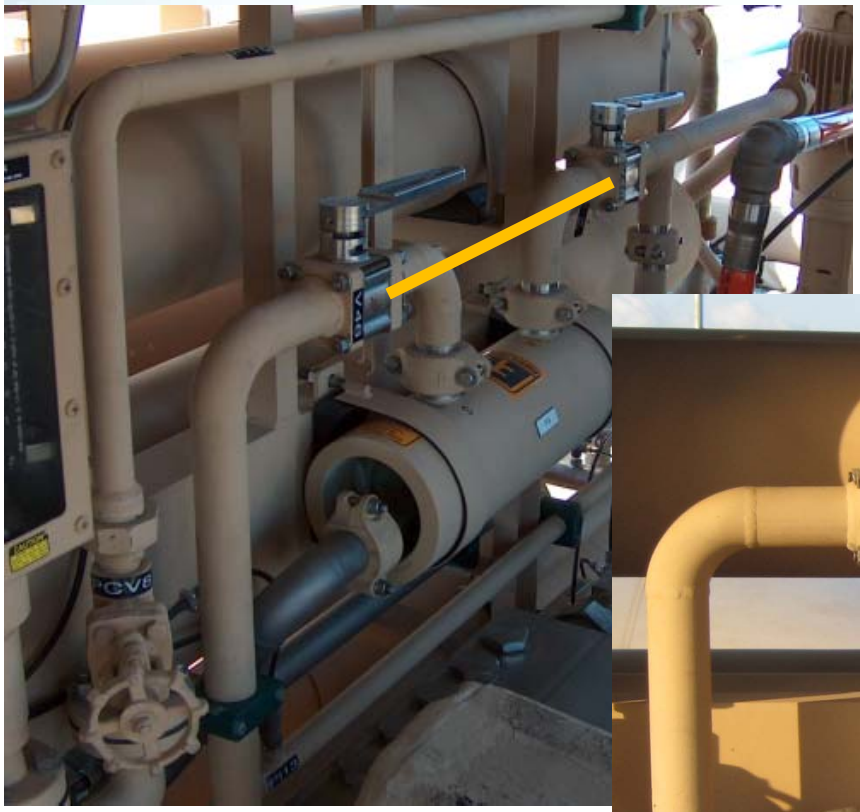
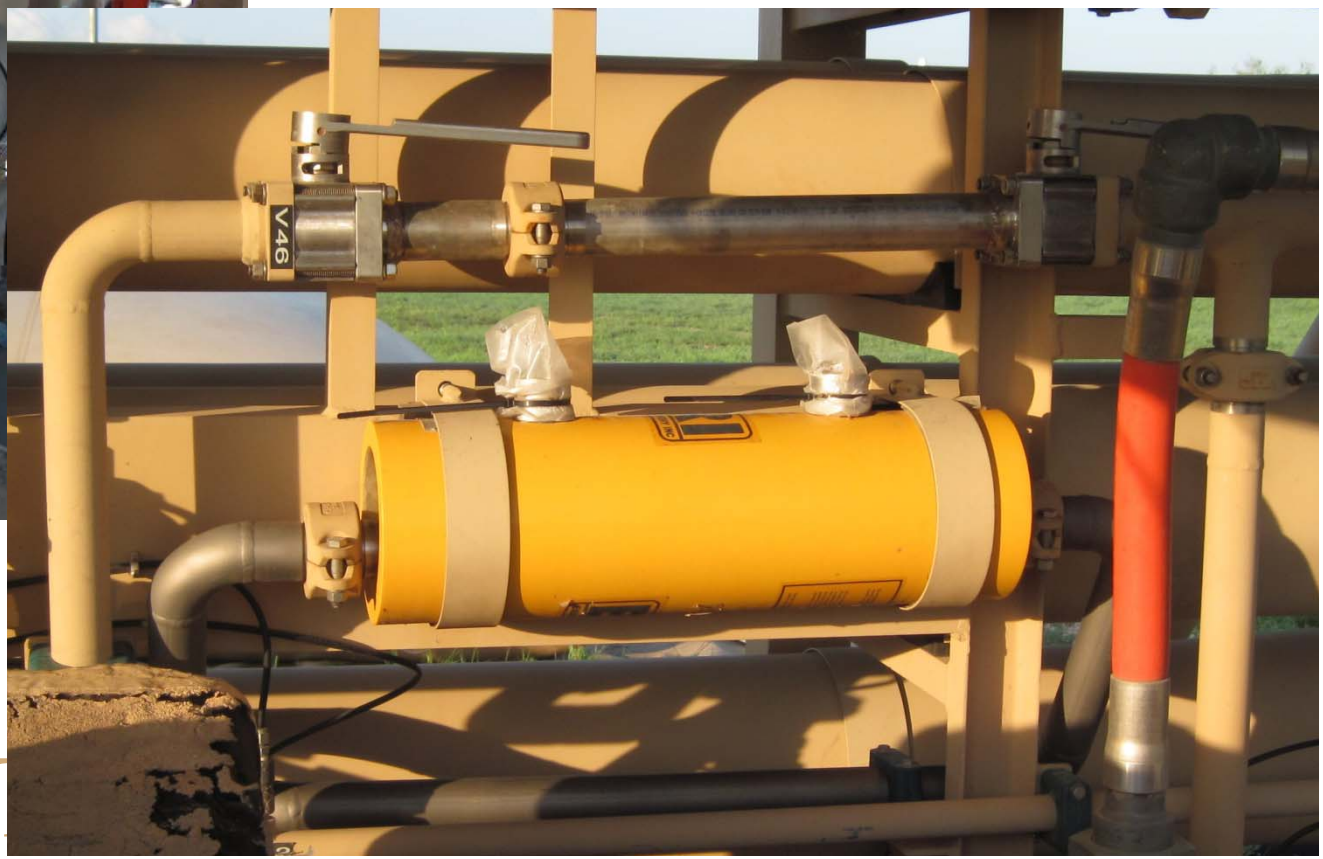
Bypassing Energy Recovery



- Remove 90° connections & install straight pipe.



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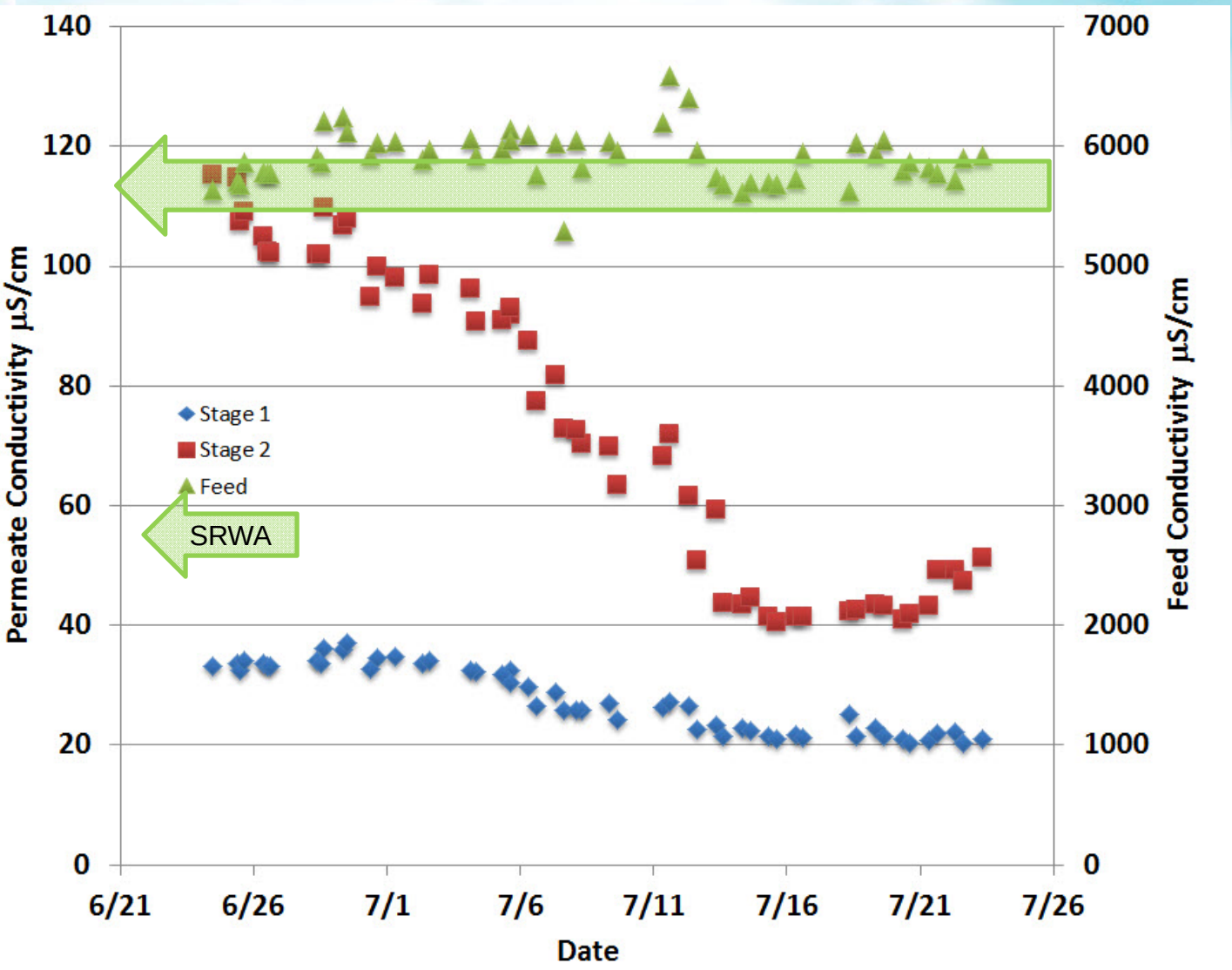
Permeate & Feed Conductivities



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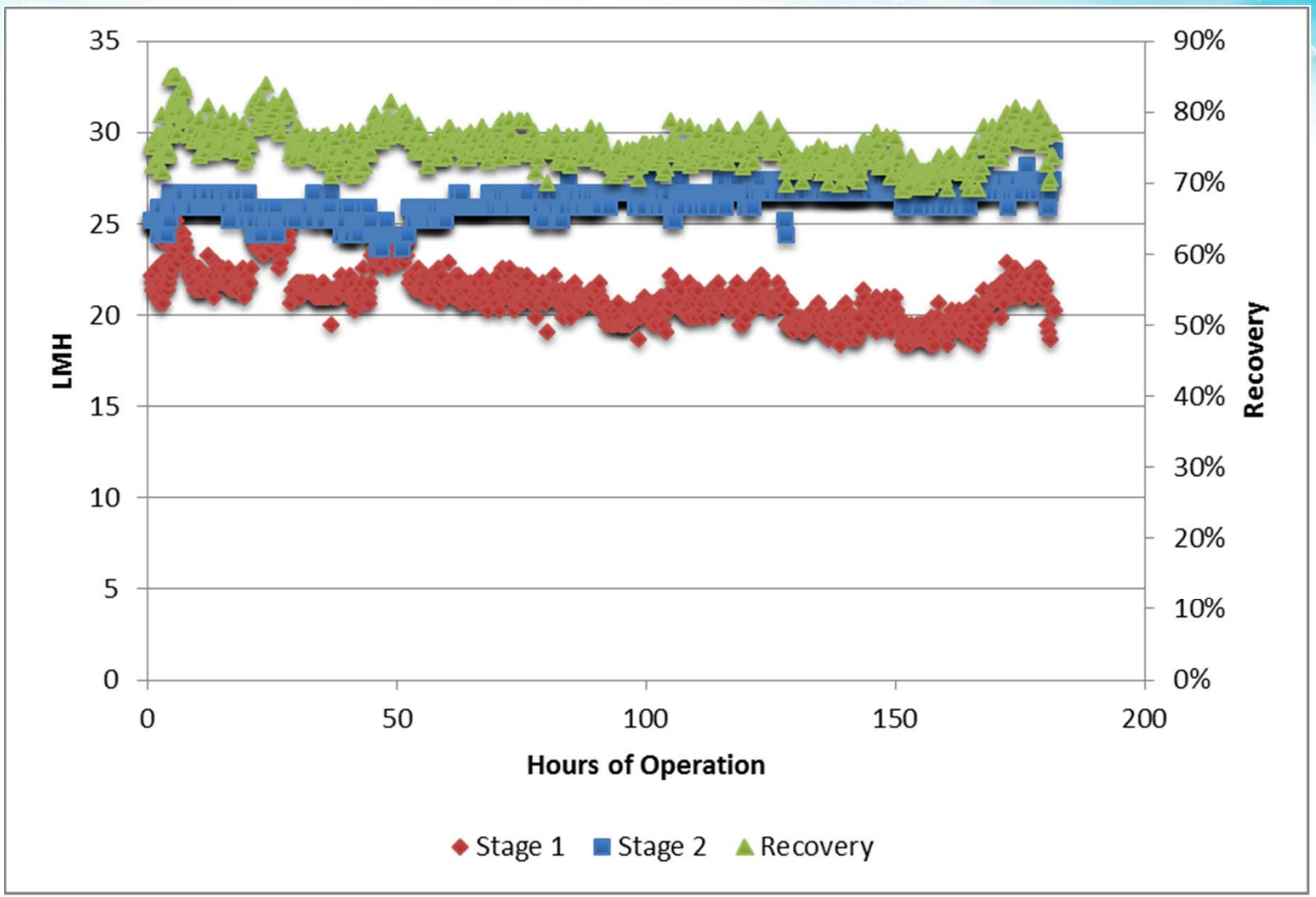
Flux by Stage & Recovery



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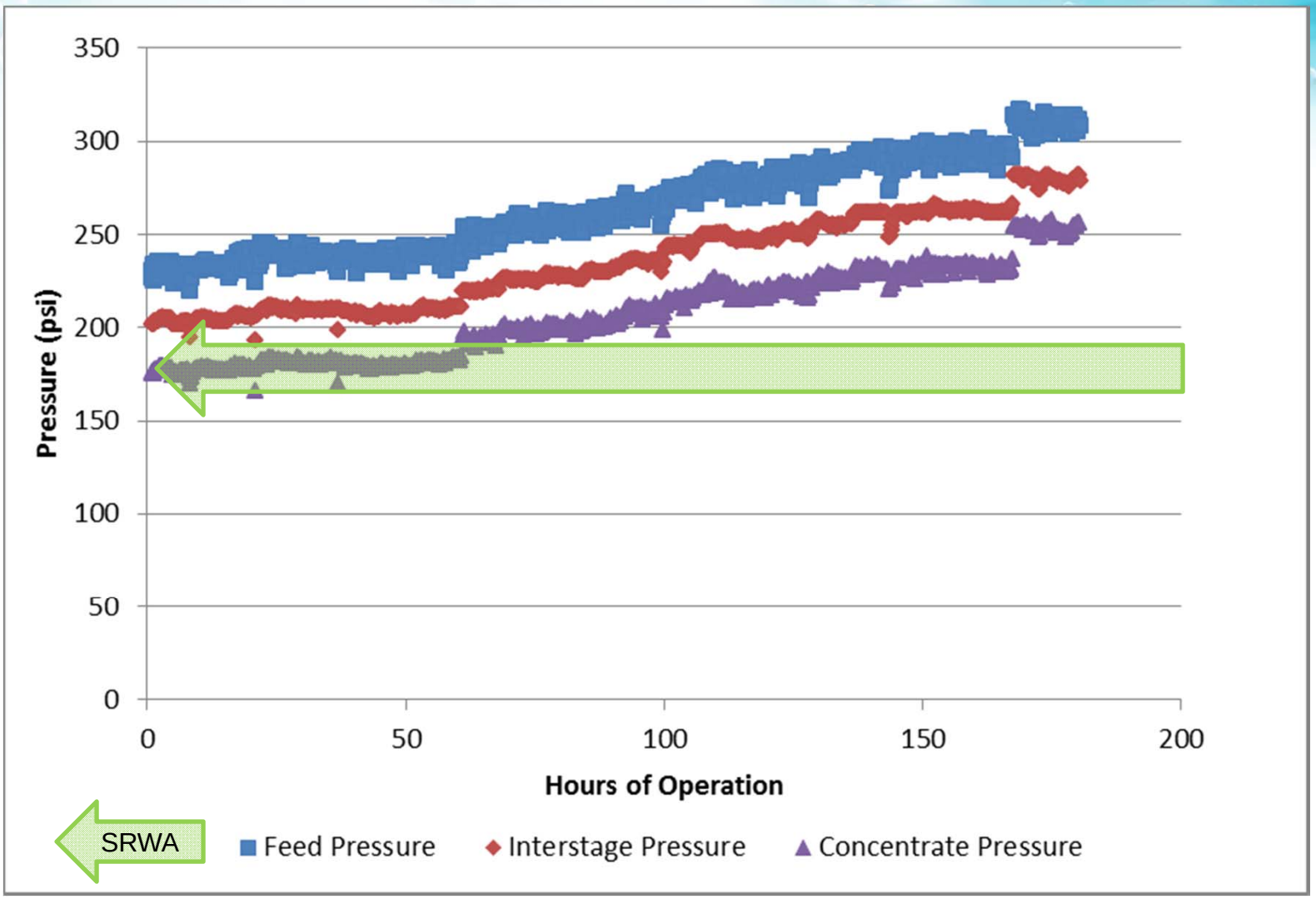
RO System Pressures



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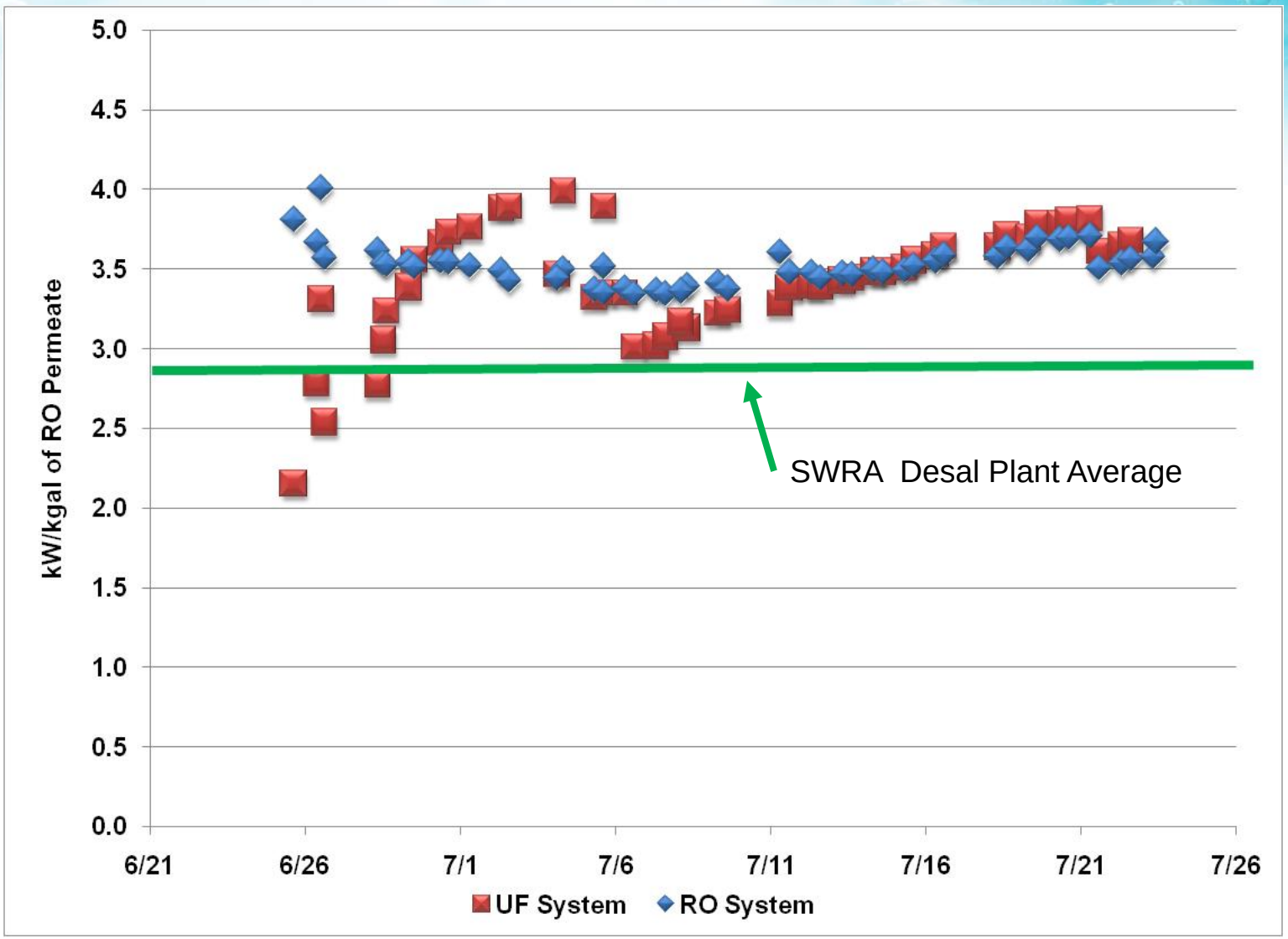
UF & RO System Power Use



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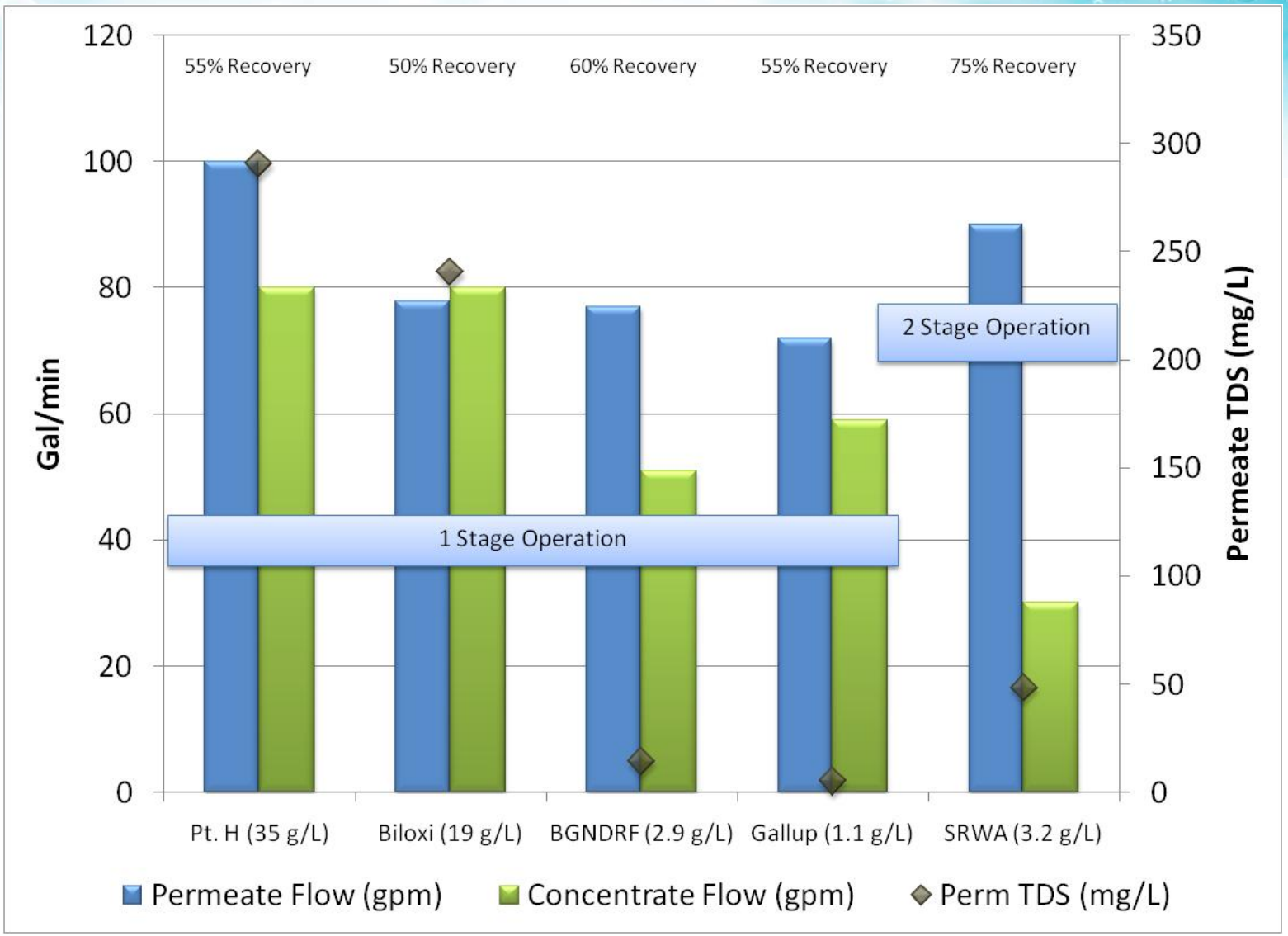
Comparison to Previous Operation



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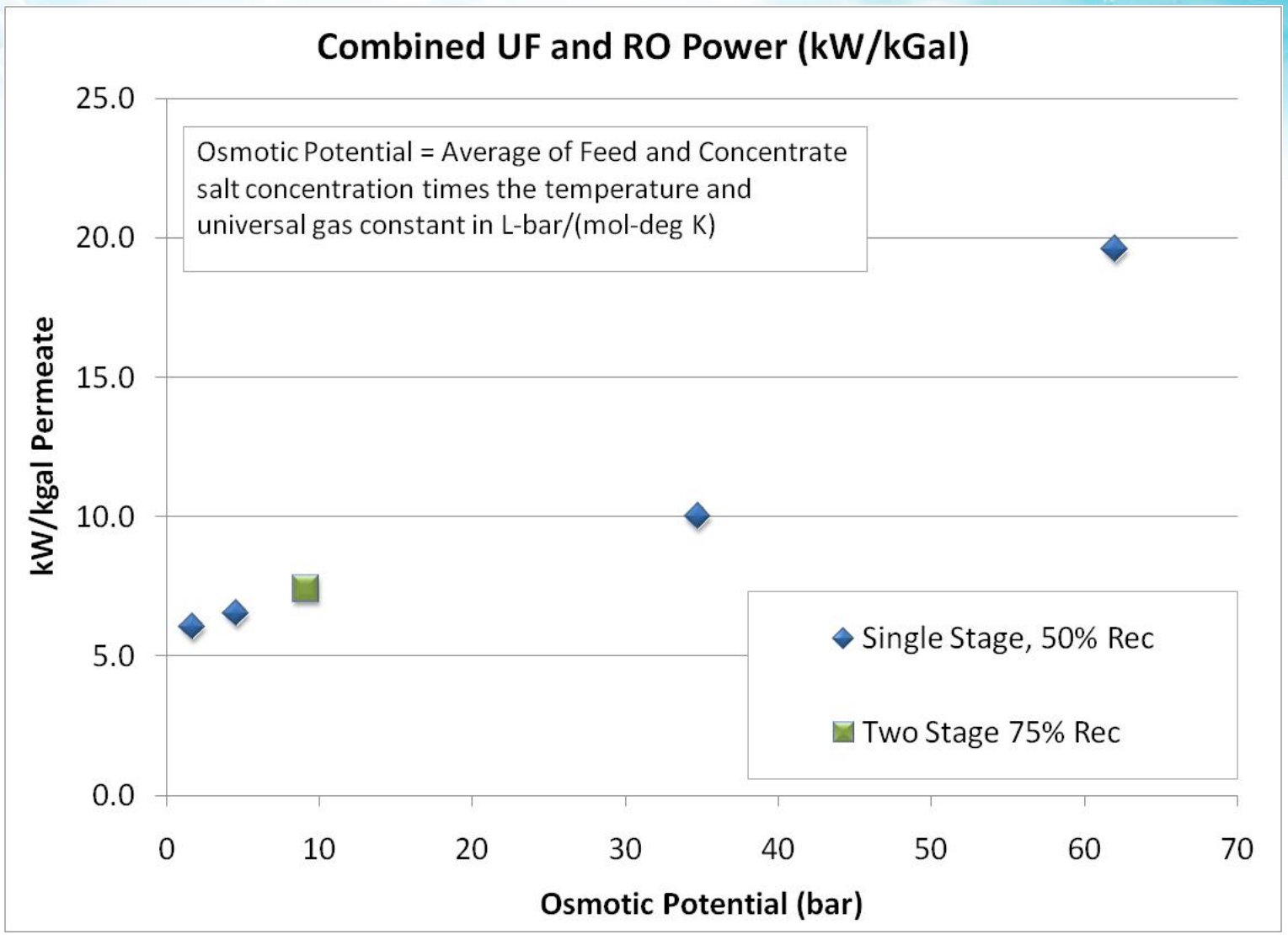

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Observations and Implications

- A flexible design needs a control system that detects changes in water quality and signals the need to implement changes to the design configuration
- Pretreatment geared for the most challenging source
- Municipal systems will need to plan ahead to expand their permit for the range of source waters

Design considerations

- Ingenuity is the only limit for industrial design flexibility
- Tools to enhance flexibility.
  - Wide variety of membrane products and potential staging and array configuration
  - Energy recovery devices can serve as booster pumps for a second stage or pressurize additional first pass arrays as with the EUWP.
  - Dual pumping systems can be used to for widely different source waters.
  - Extra product water storage for short term changes.
  - Materials need to be compatible with the most corrosive source.
  - Innovative sensors to help respond to changes in source water.

Next step…

- Build and demonstrate

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Visit our web site:
http://www.usbr.gov/research/AWT/

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