Hazen

Brine Minimization for Ion Exchange

Nicole Blute - Hazen
Steve Bigley, Dan Ruiz, and Jesse Aguilar - CVWD

Agenda

- Introduction
- Brine Recycling
- Brine Treatment
- Conclusions

CVWD's Distribution System with Elevated Arsenic and Chromium 6 Concentrations

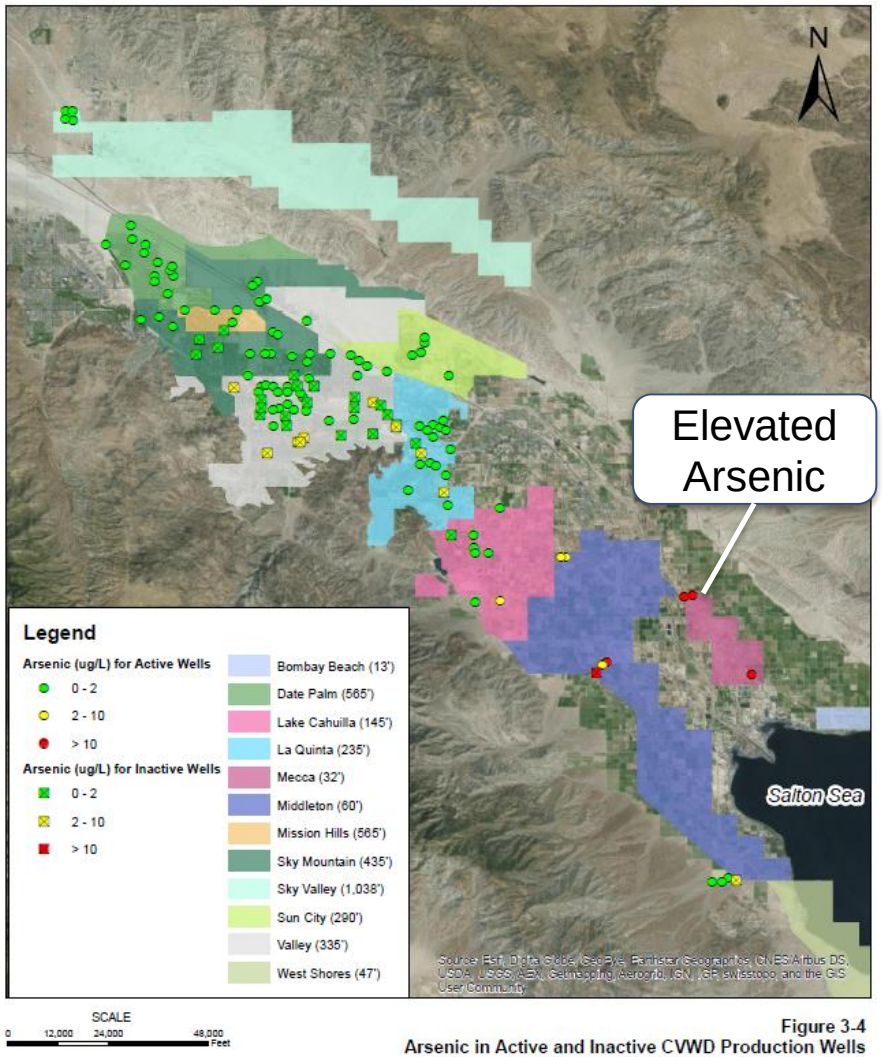


Figure 3-4
Arsenic in Active and Inactive CVWD Production Wells

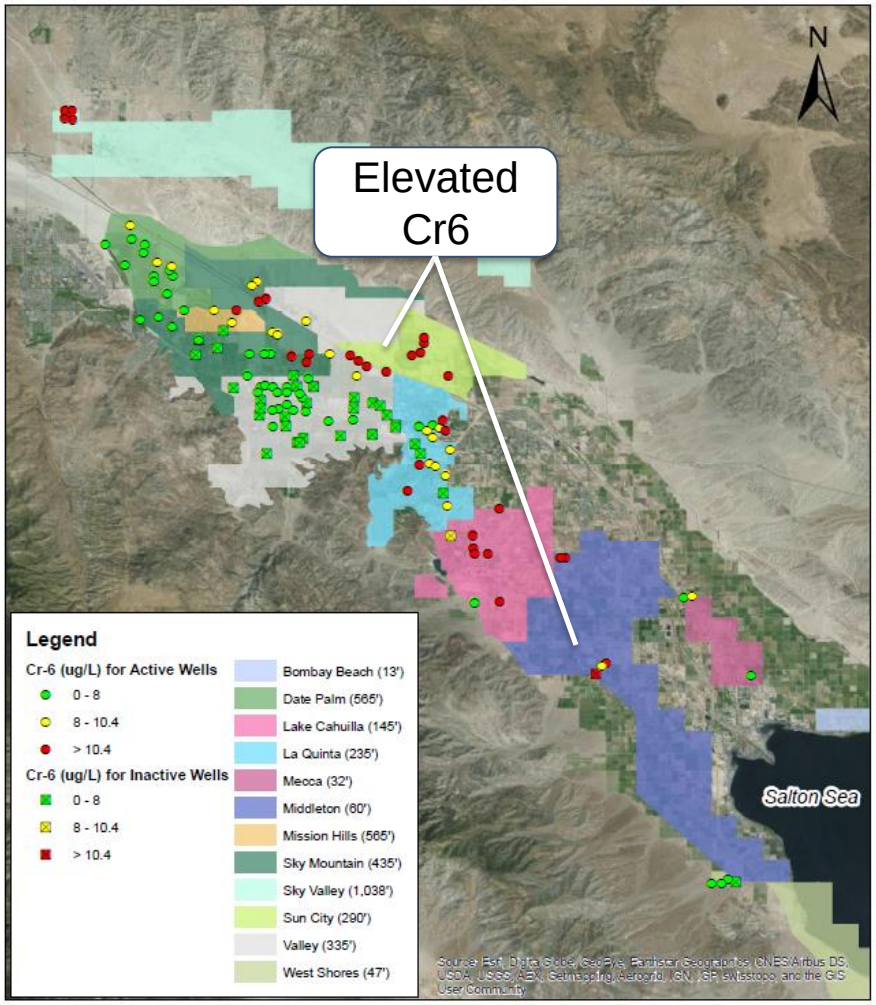
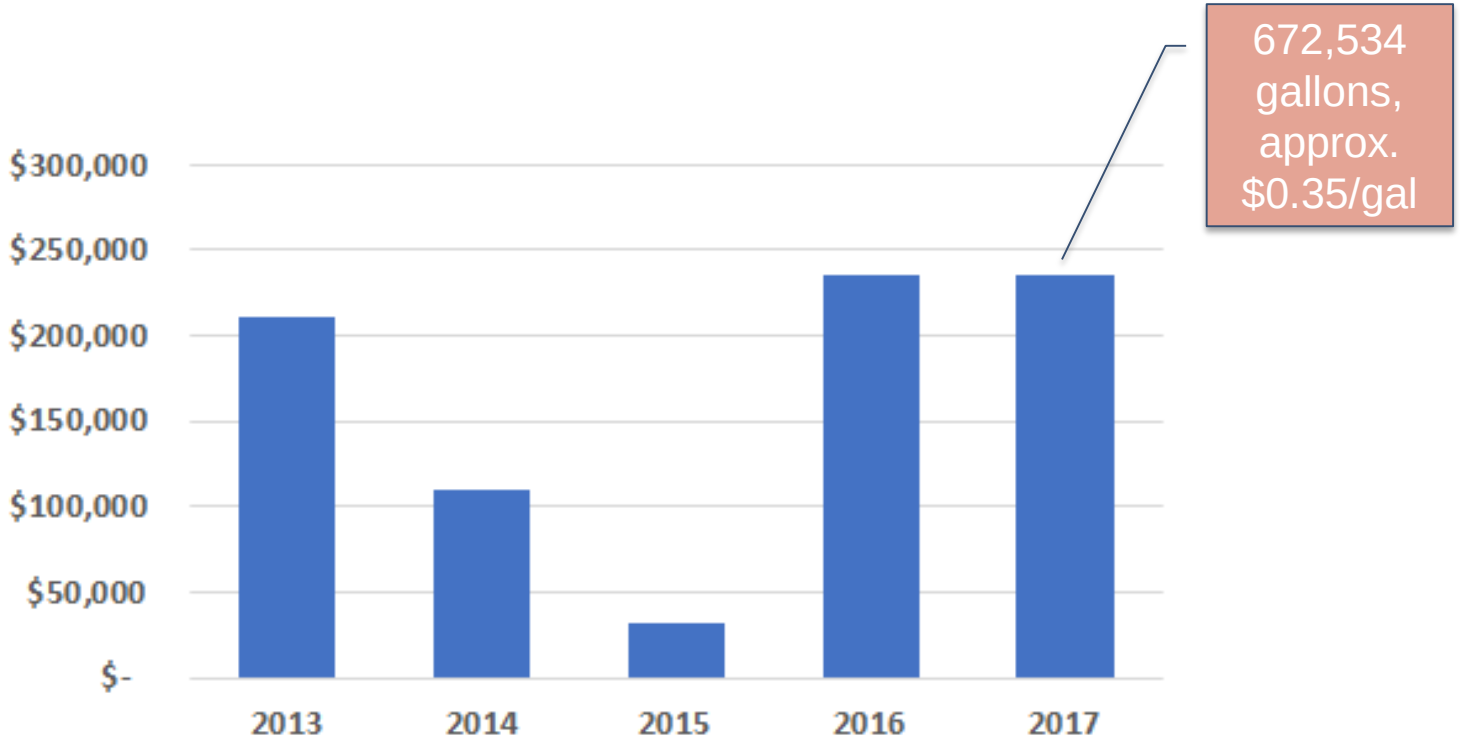


Figure 3-2
Chromium 6 in Active and Inactive CVWD Production Wells

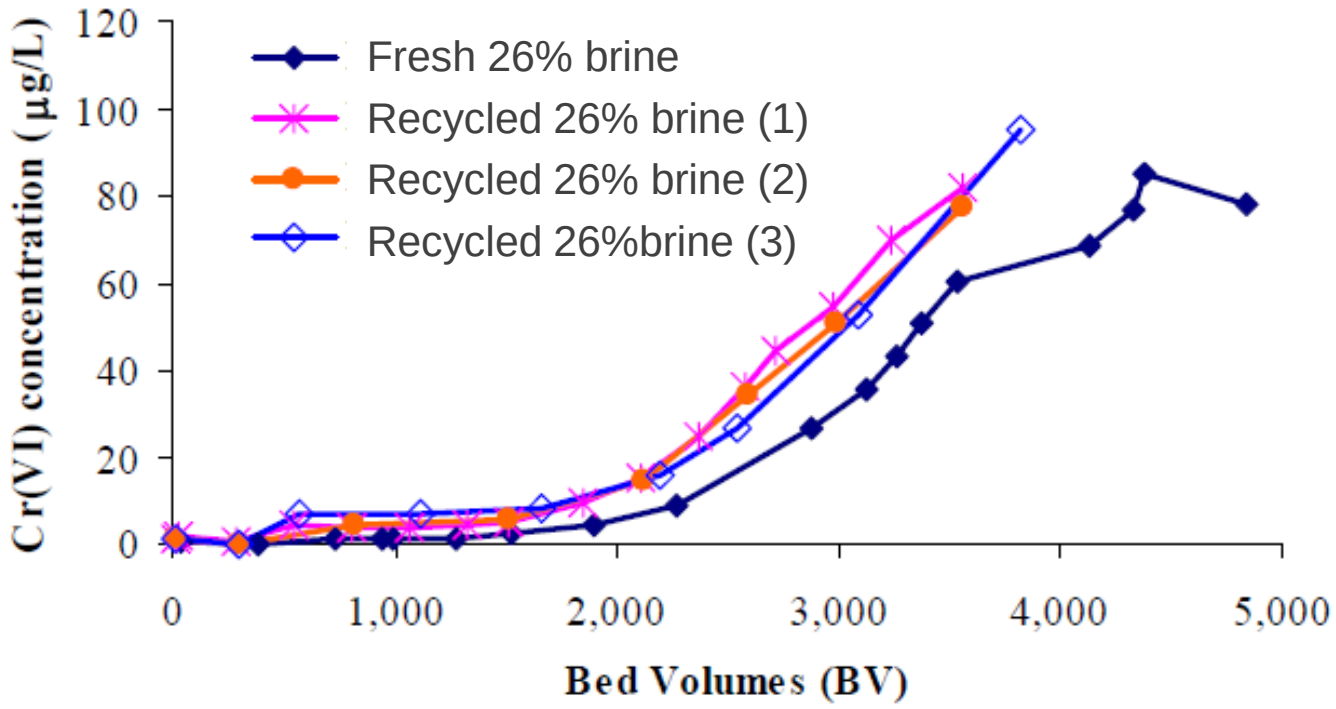
Arsenic Treatment near the Salton Sea with Three Ion Exchange Facilities

Drivers for Brine Minimization at CVWD

- Cost of disposal
- Limited disposal options

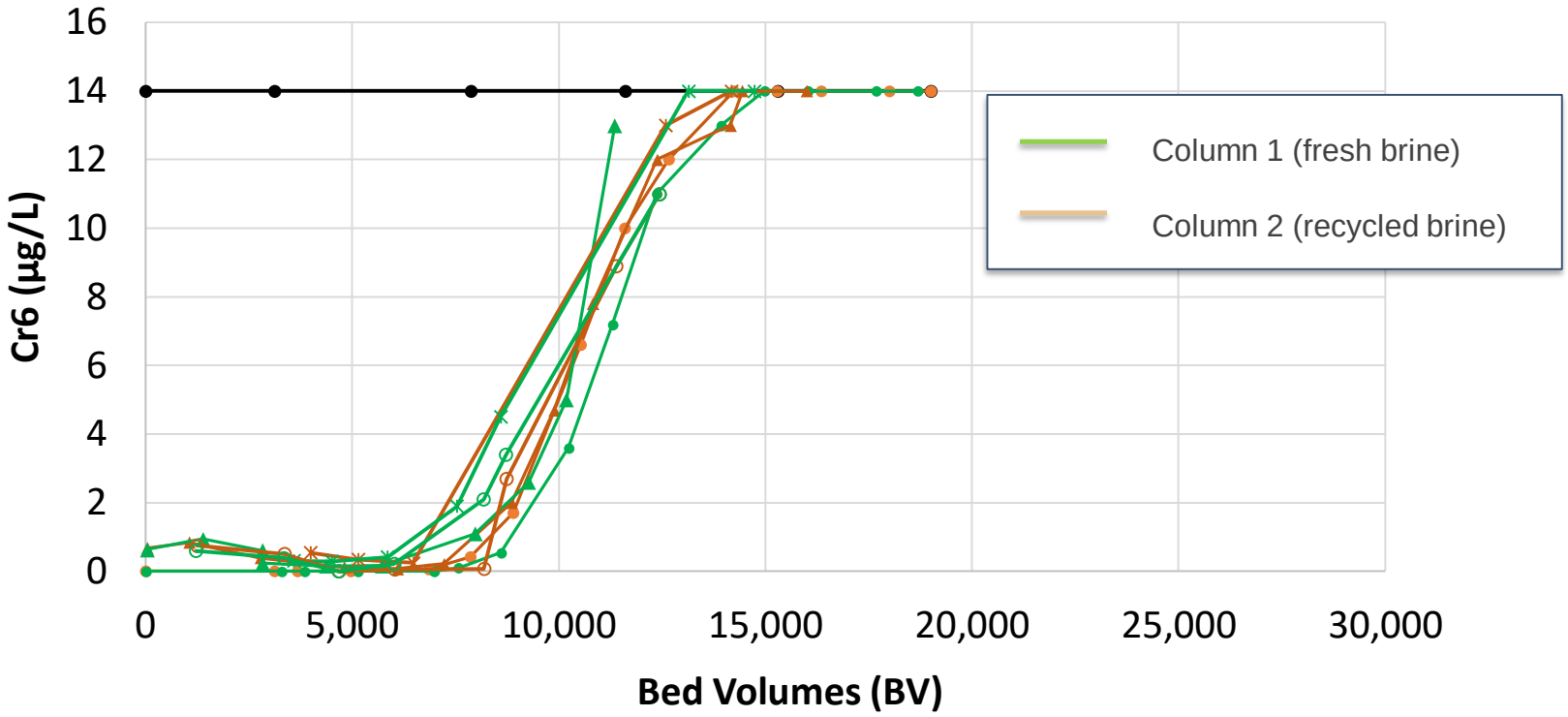


Initial Work on Brine Recycle at Glendale CA

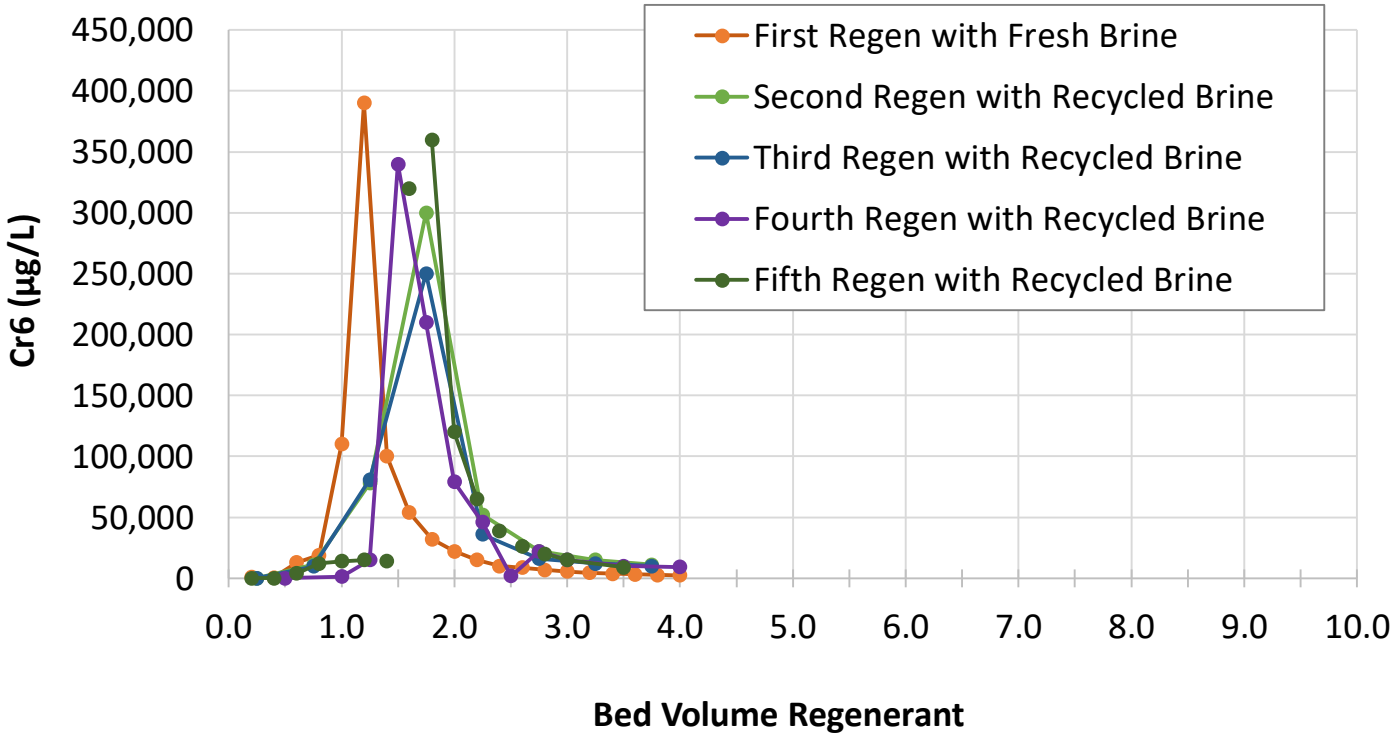


Source: McGuire et al., 2005

Breakthrough in CVWD Pilot Testing was Consistent with Recycled Brine



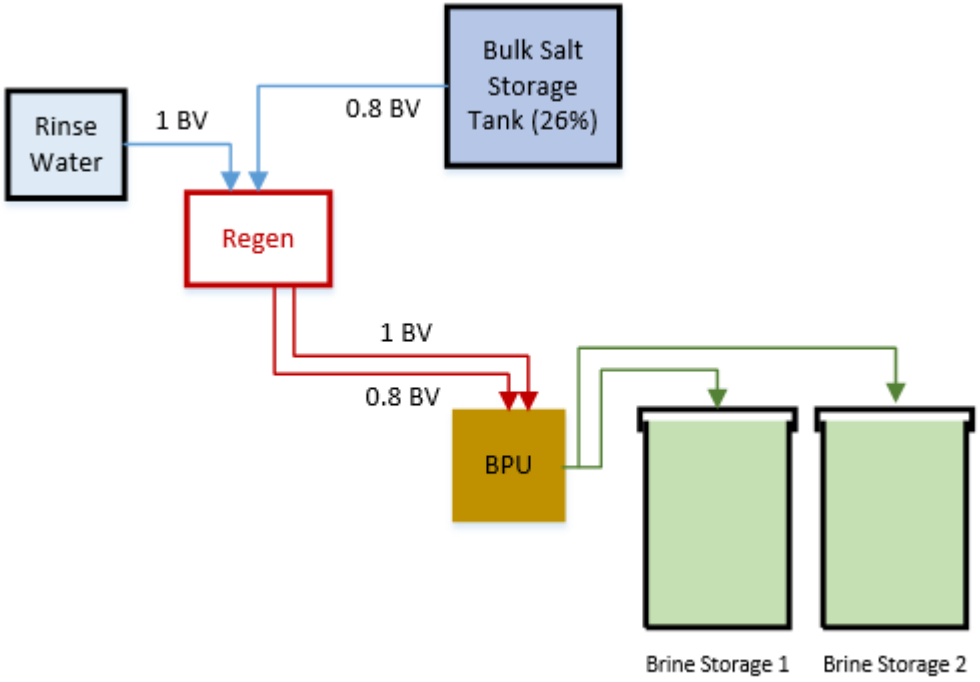
Similar Width of Elution Profiles during Regeneration at CVWD



Brine Recycling

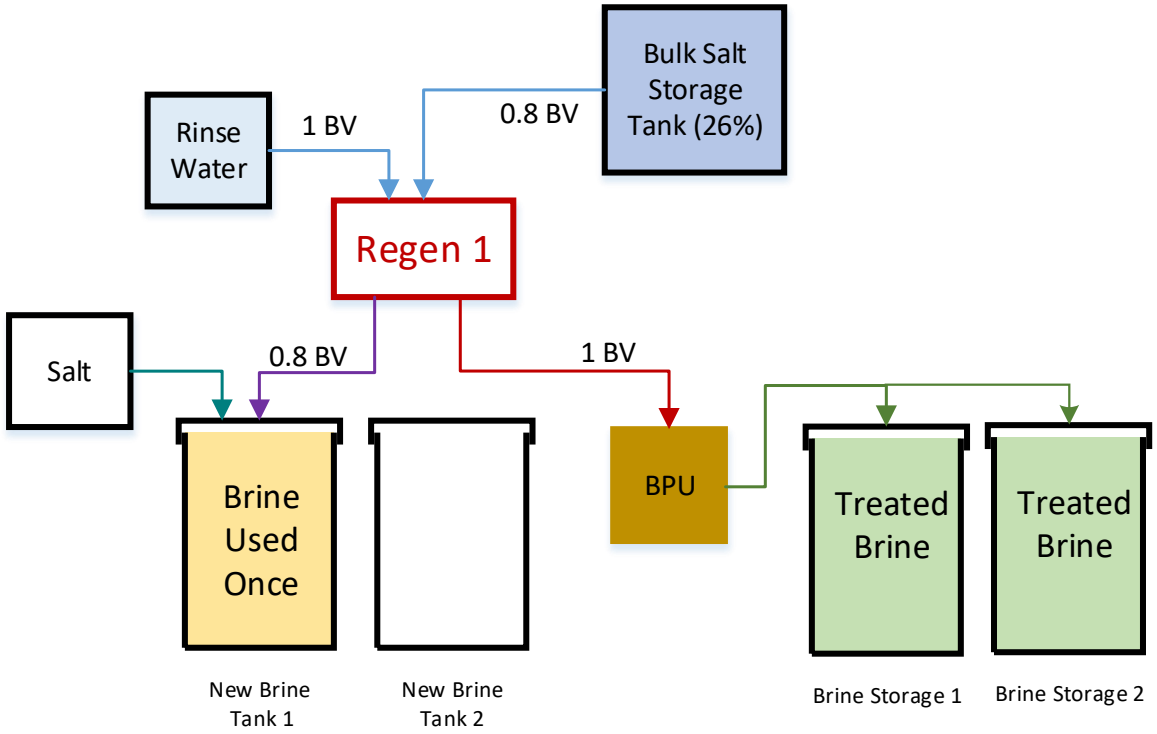
- **Current Process**
- **Integration of Recycling**

Current Regeneration Process



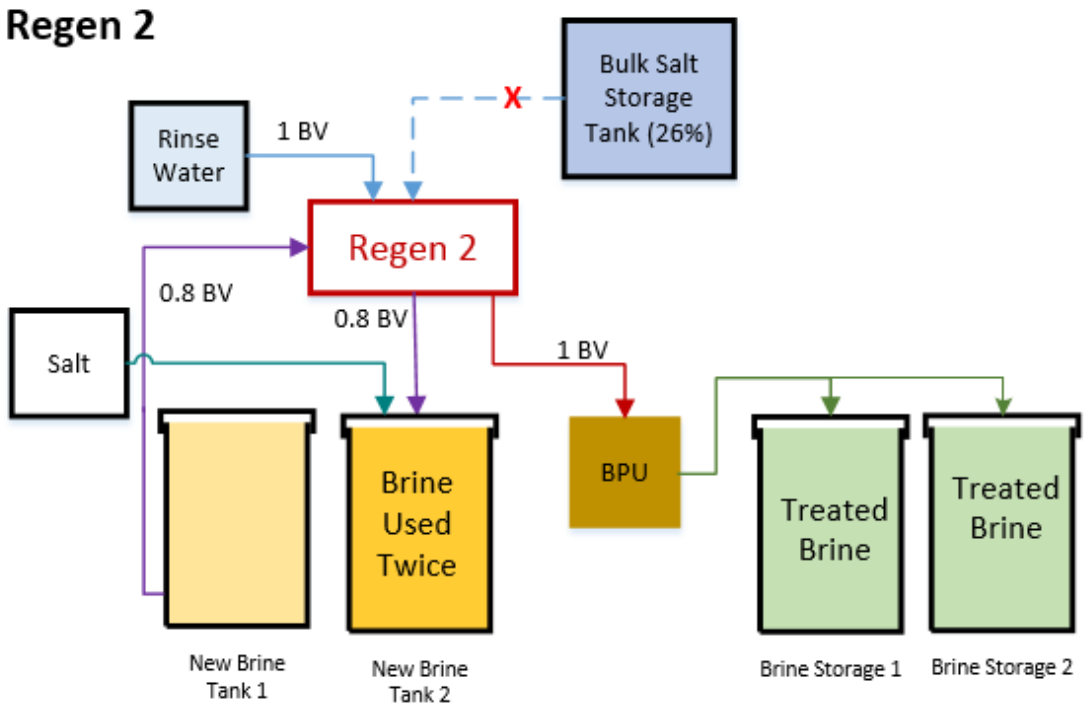
- **Current:** 1.8 BV goes to Brine Processing Unit (BPU) for treatment
- **Proposed:** 0.8 BV can be recycled to substitute the saturated salt (26%) addition for up to three regenerations

First Brine Reuse



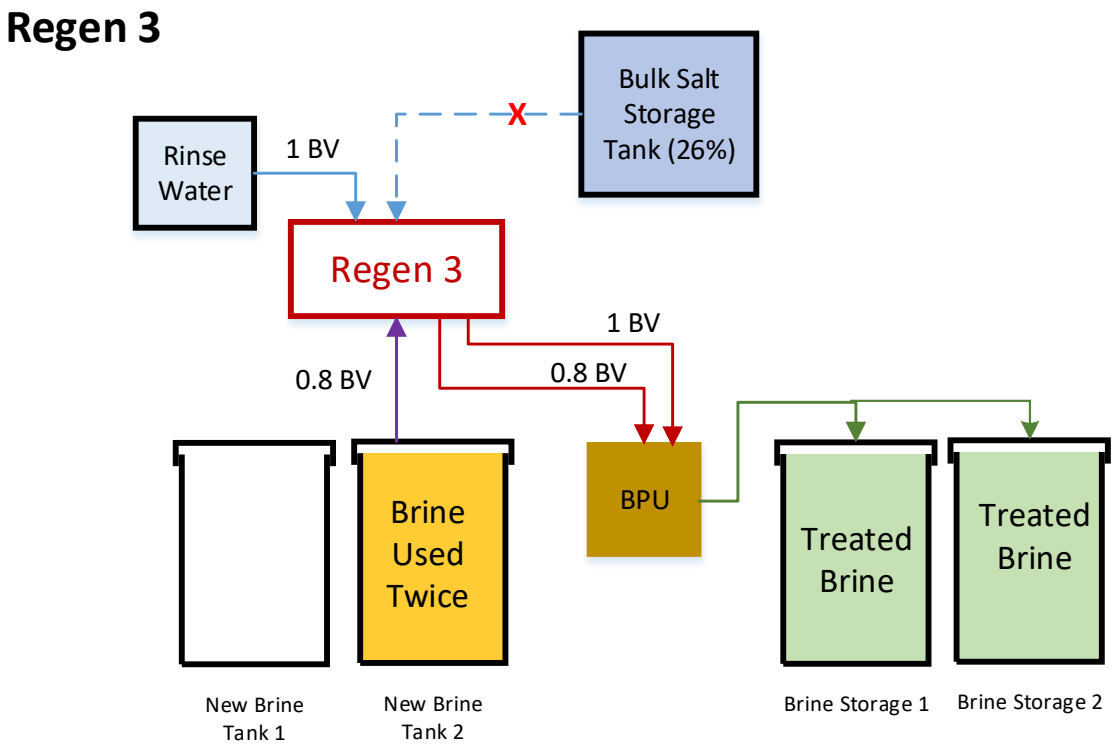
- Add two new smaller tanks as salt tanks/used brine storage
- Store one regen
- Salt is added to NBT-1 to increase NaCl concentration to 26% (saturation)

Second Brine Reuse



- Use 1 BV from NBT-1 to regen
- NBT-2 contains brine used twice
- Salt is added to NBT-2 to increase NaCl concentration to 26%

Second Brine Reuse



- Regen uses 1 BV from NBT-2
- Brine has been used 3 times and all waste brine in this step will go to BPU (1.8 BV)
- NBT -1 tank will be empty at the end of this step, and ready to receive waste brine in the next regeneration step

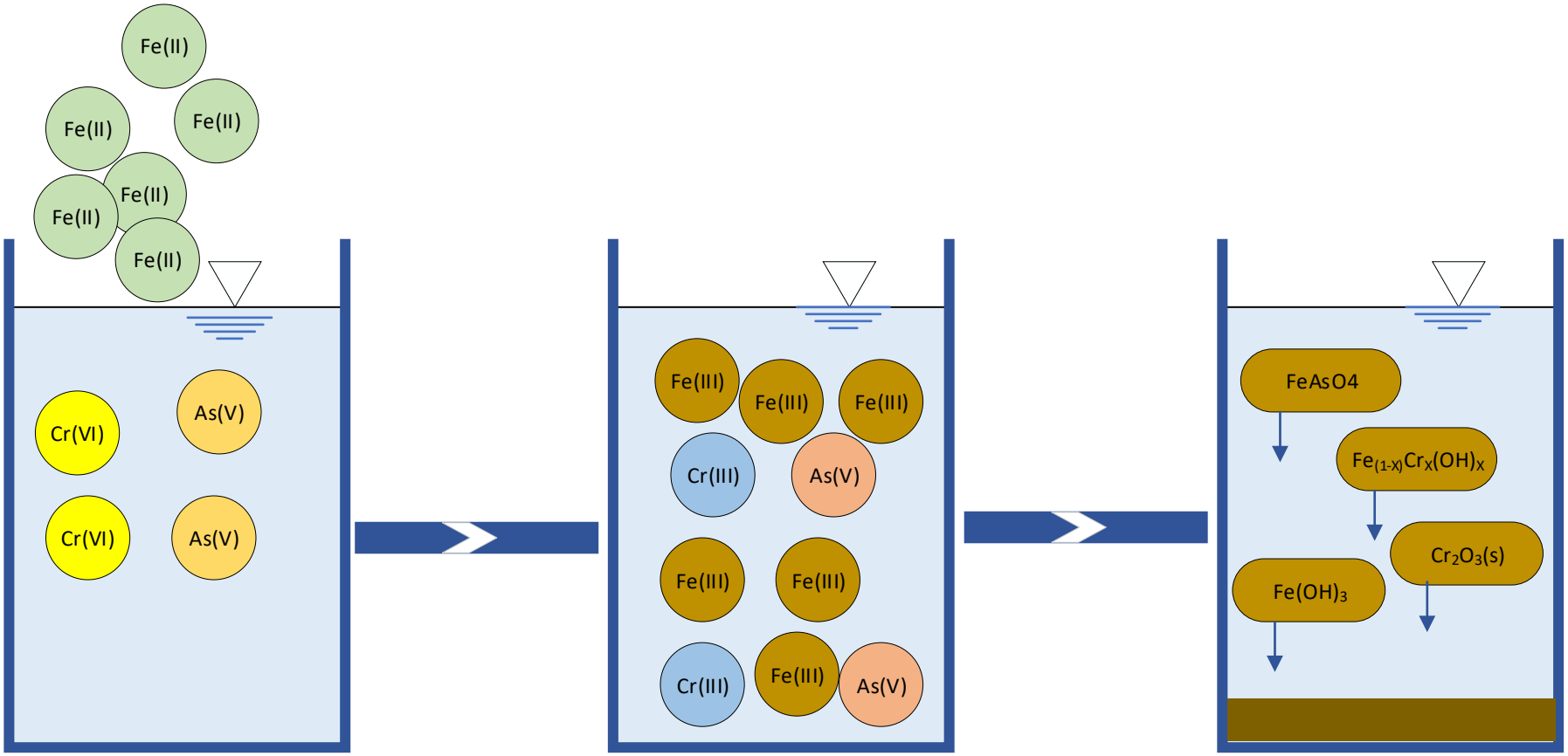
Annual Brine Recycling Cost Savings

	20.5% Plant Use		30% Plant Use	
Plant Configuration	IXTP[1)]	IXTP with Brine Recycle	IXTP	IXTP with Brine Recycle
Cost of Brine Disposal	$235,400	$165,722	$344,488	$242,519
Cost of Solids Disposal	$12,000	$12,000	$12,000	$12,000
Cost of Salt for Regeneration	$69,475	$52,106	$101,670	$76,253
Additional Annualized Equipment	-	$69,000	-	$69,000
Additional O&M[2), 3)]	-	-	-	-
Total	$316,875	**$298,827**	$458,158	**$399,772**
Savings with Brine Recycle		**$18,047**		**$58,386**

Brine Treatment

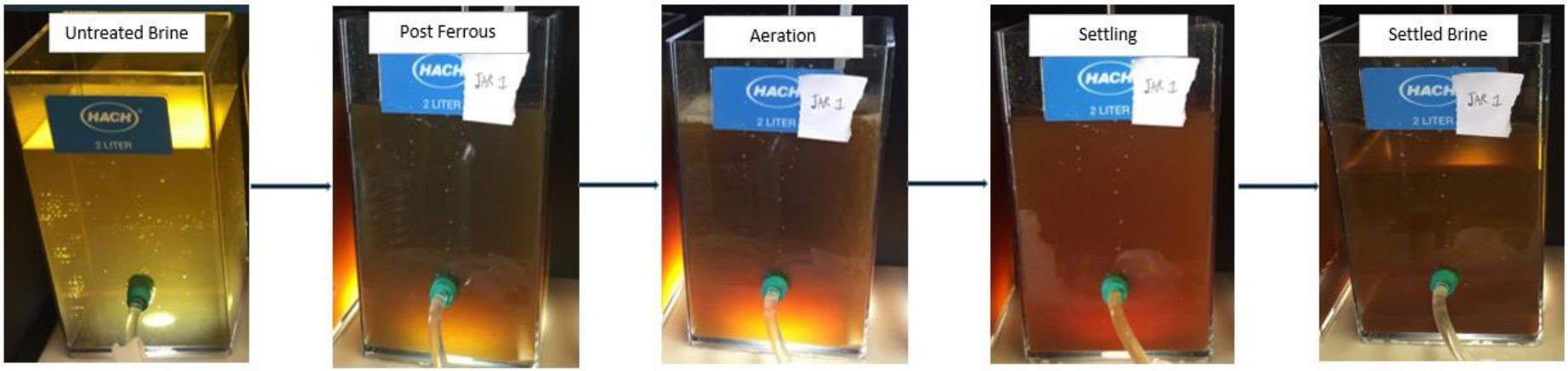
- **Chemical Coagulation**
- **Electrocoagulation**

Chemical Coagulation

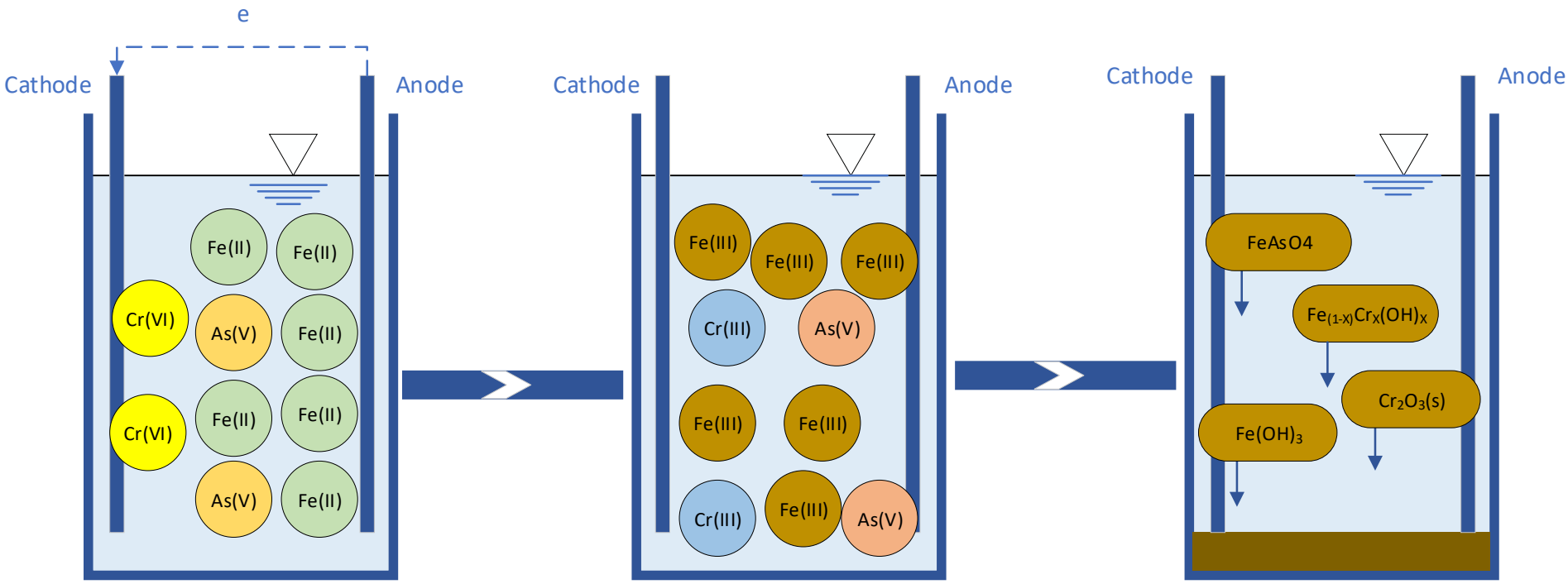


- Arsenic is adsorbed to ferric hydroxides
- Chromium 6 is reduced to chromium 3 by oxidizing ferrous to ferric iron
- The process yields iron-arsenic and iron-chromium solid precipitates

Chemical Coagulation – Brine Treatment



Electrocoagulation



Source: Washington University, Contaminant Removal from Water through Oxidation-Reduction and Adsorption of Iron Oxides Generated during Electrocoagulation, 249th Annual American Chemistry Society Meeting, Denver CO, March 2015.

- Oxidation of Fe(II) to Fe(III)
- Reduce Cr6 to Cr3 with ferrous iron + reduction at cathode

Conclusions

- **Brine recycle can minimize disposal quantities and provide a cost-effective solution**
- **Treatment options are available for precipitating the hazardous components from the brine**
- **Next steps include pilot testing of brine processing using recycled brine**

Hazen

Nicole Blute
310-266-6212
nblute@hazenandsawyer.com