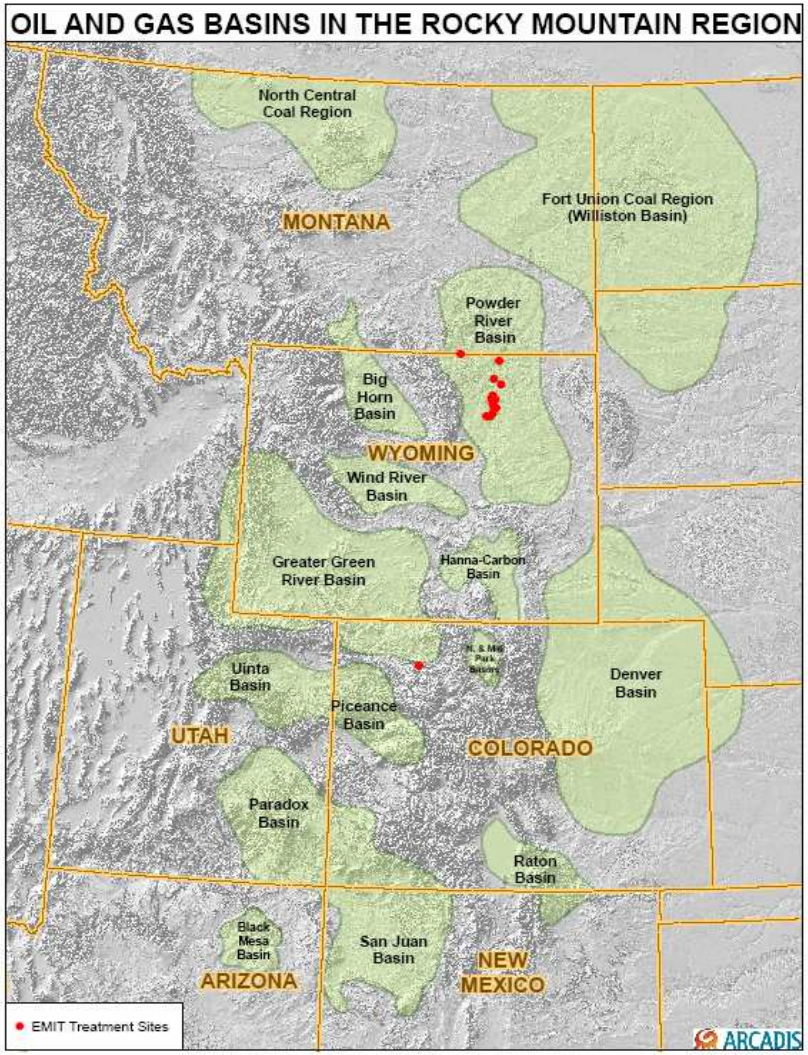
CBM Produced Water Management in the Powder River Basin of Wyoming and Montana

16th Annual IPEC Conference
November 3-5, 2009
Douglas Beagle – EMIT WDT, Exterran Water Solutions

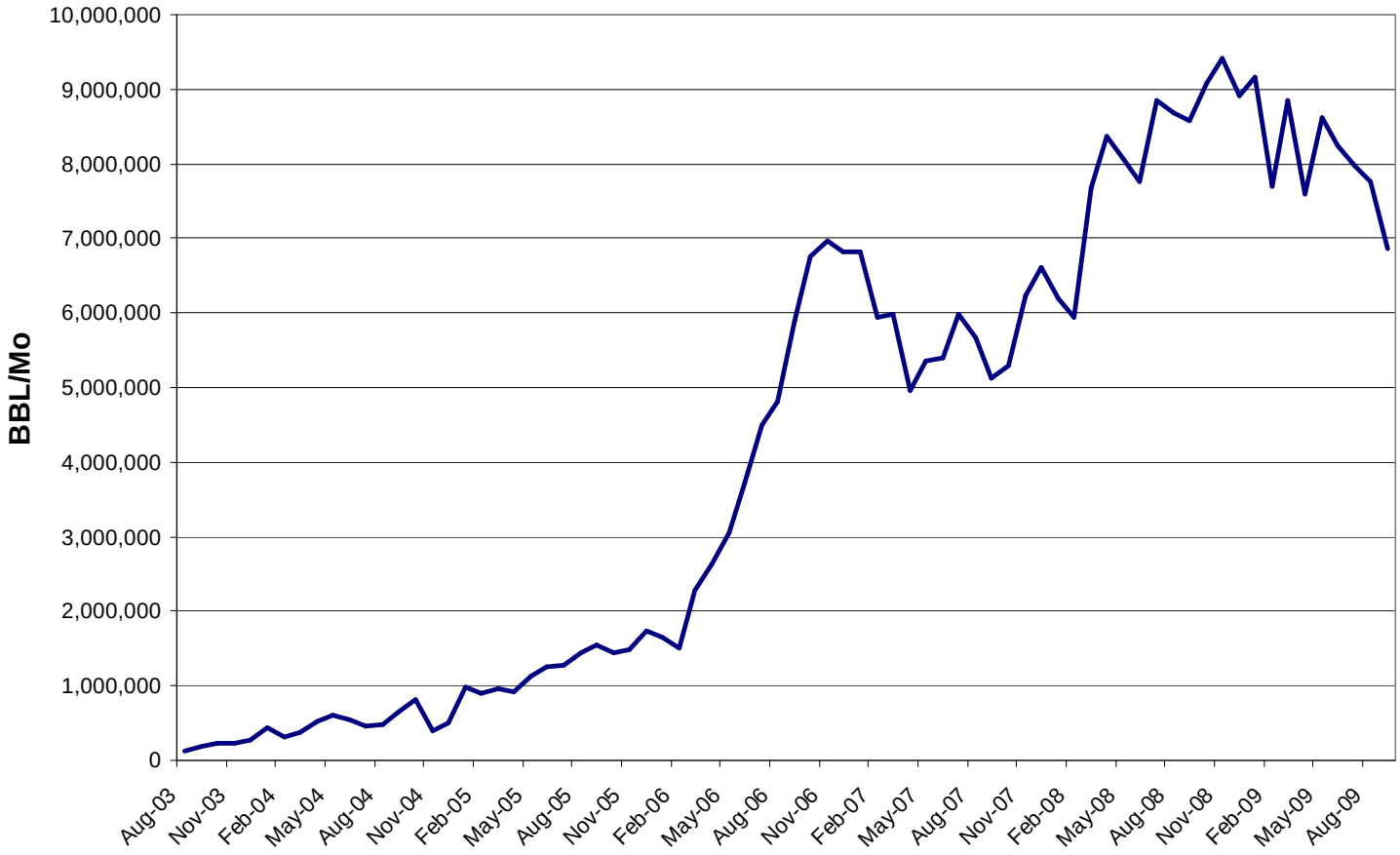
EMIT Water Discharge Technology: Exterran Water Solutions

- Created in 2002 to Develop and Provide a Treatment Solution for PRB CBM Water
- Aligned with Severn Trent Services to deploy Higgins Loop ™ CCIX (Continuous Countercurrent Ion Exchange) Technology
- Complete Water Management Service
  - Design, Build, Operate Treatment Systems
  - Compliance Monitoring
  - Assimilative Capacity Load Management
  - Discharge Permit
- 25 Treatment Units
- 320,000,000 BBL Treated
- Purchased by EXTERRAN 7/31/2008

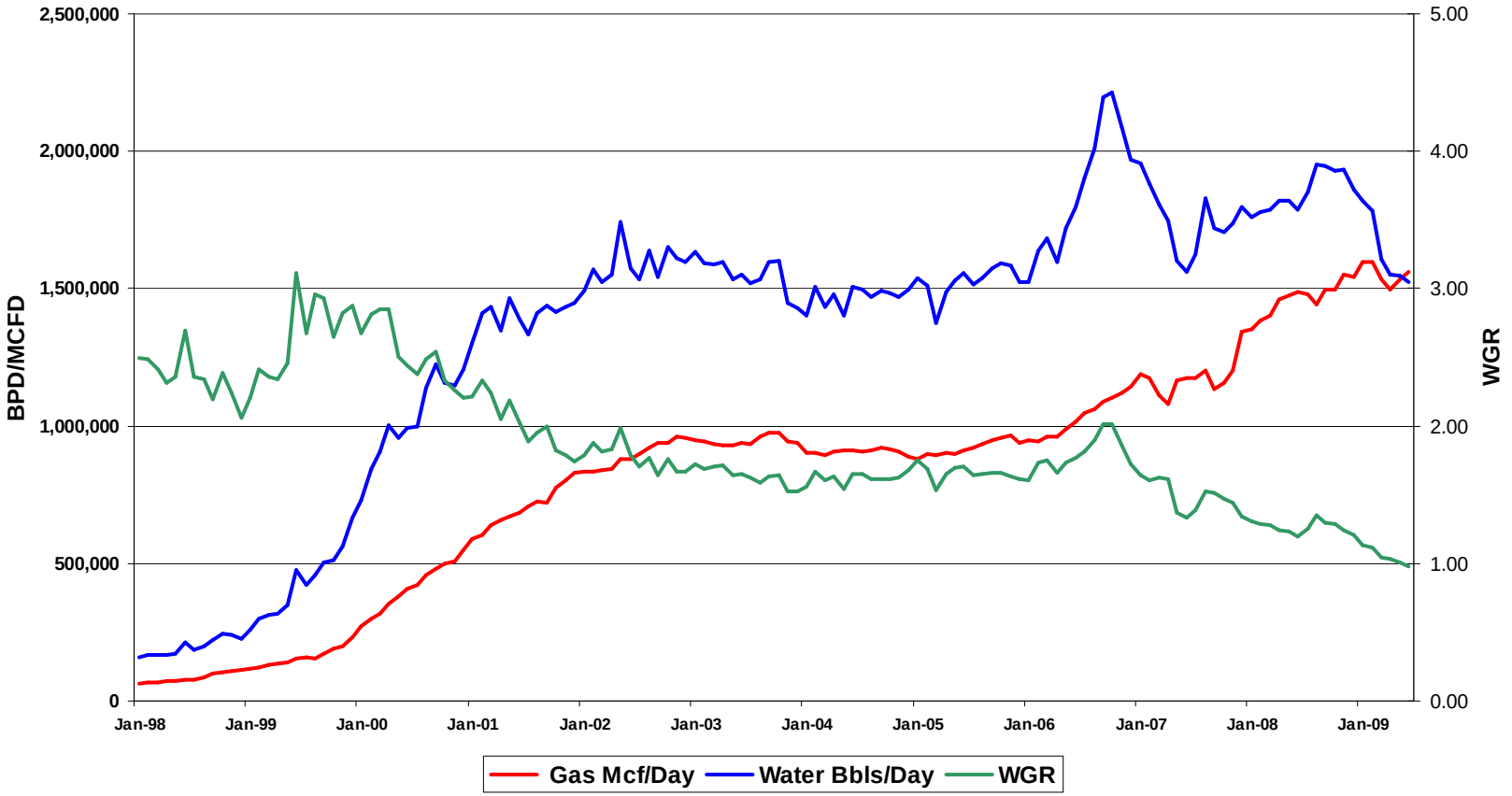


EMIT Water Treatment Locations

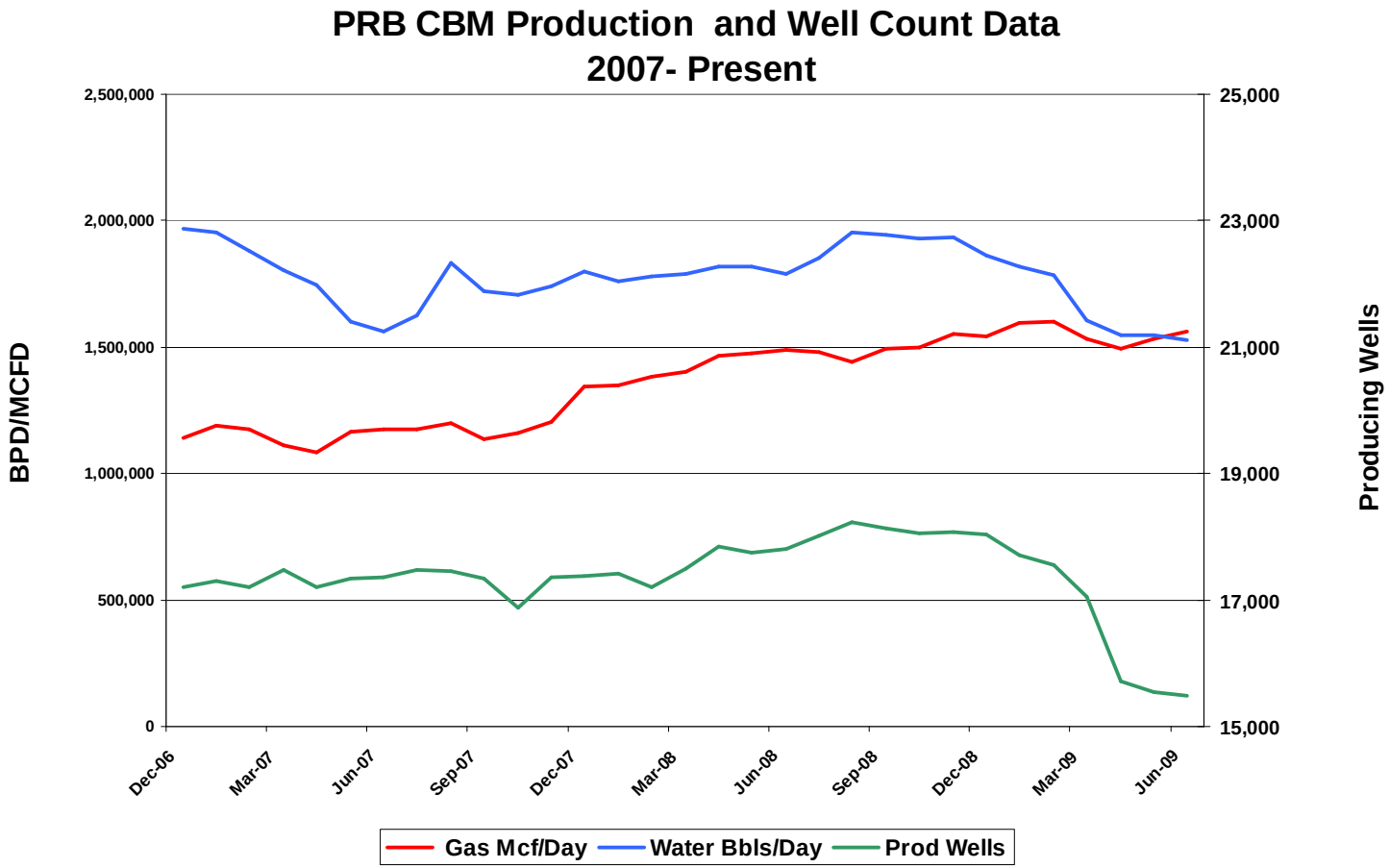
TREATED BBLS



PRB CBM Production Data



Source: WOGCC



Source: WOGCC

PRB CBM Water Management Methods

- Direct Discharge
- Irrigation
- Injection
- Infiltration and Evaporation (Pits)
- **Treatment**

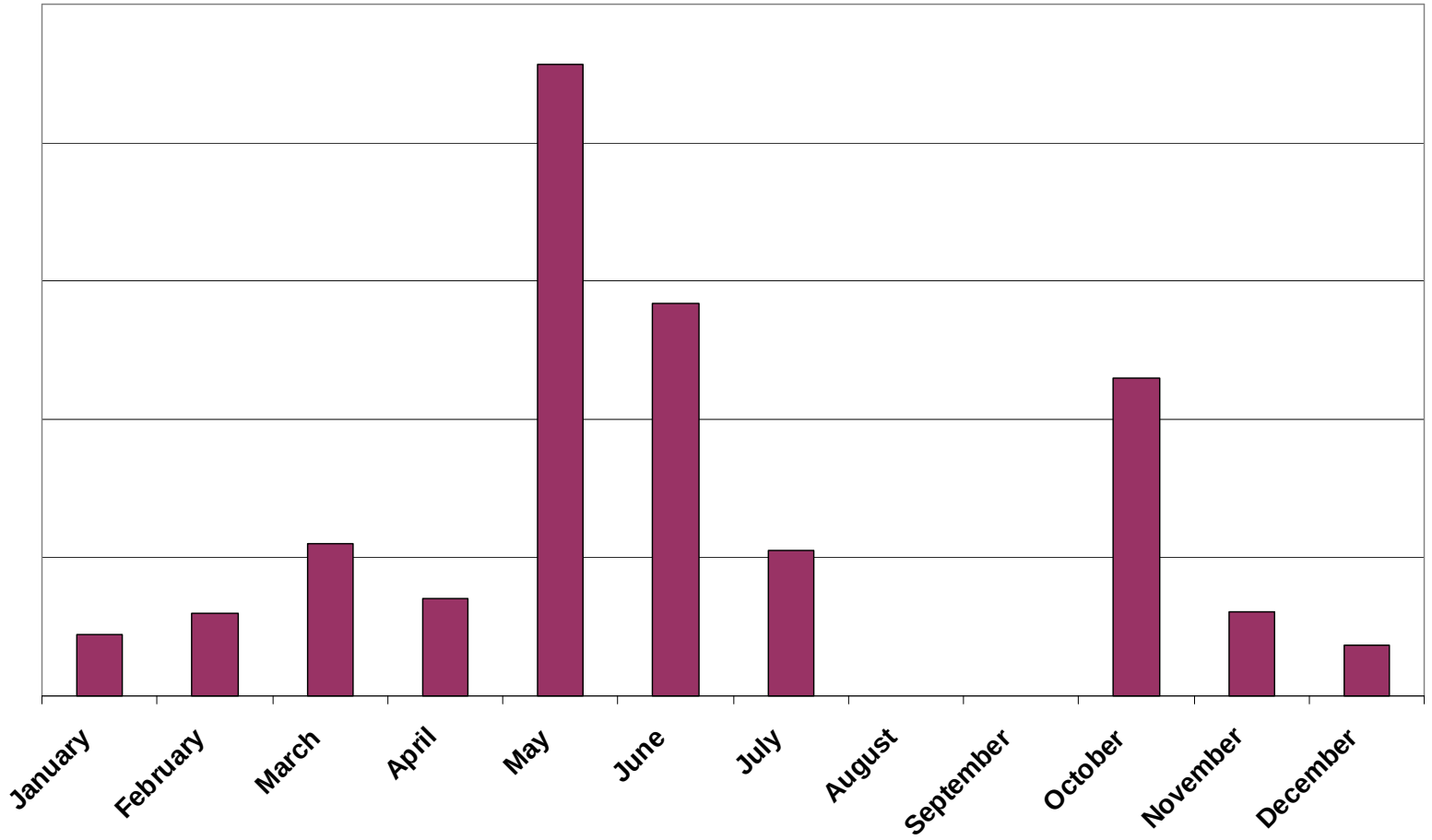
What's New in Treatment

- Re Allocation of Unused Assimilative Capacity Credits
- Radium Treatment
- Consolidation of Facilities

Powder River Assimilative Capacity

- Wyoming DEQ Program
- Assimilative Capacity based on historic ambient concentrations and flows.
- Limits monthly discharge loads of Na and TDS rather than limiting discharge concentrations.
- Significant monthly variation in available loads.
- Load applied to WYPDES permit.
- Allocation of load to operators based on coal volume.
- **Unclaimed loads (30% of total) were reallocated to operators**

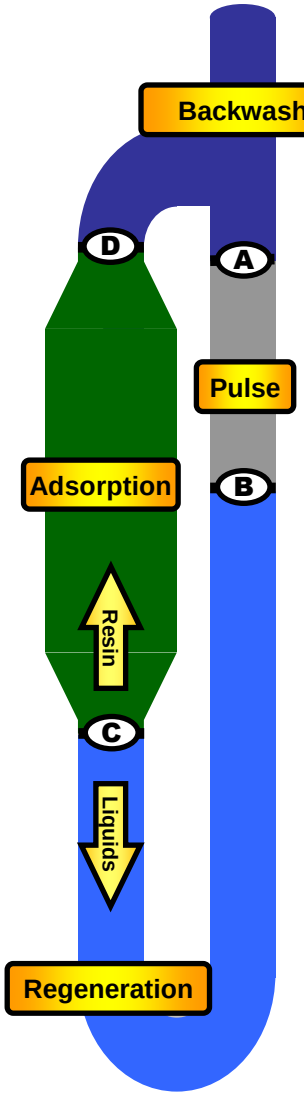
Powder River Na Assimilative Capacity



Radium Treatment

- New Discharge Standards
  - Includes Ra 228 + Ra 226
  - Powder River discharge limit 1.0 pCi/L
  - Produced Water: < 1 to > 6 pCi/L
- Higgins Loop ™ well suited for Ra removal
  - Process adjustment only – no extra equipment
  - Selective Removal of Ra
  - Radium Removal and Assimilative Capacity Credit Utilization

Higgins Loop™ Technology



Cylindrical Resin Loop

⇨ 4 Vessels Separated by Loop Valves

- Adsorption - Ion Loaded onto Resin
- Regeneration - Ion Desorbed from Resin
- Backwash - Fines & Solids Removal
- Pulse - Controls Resin Flow through Loop

Countercurrent Flows

⇨ Resin Moves Clockwise Intermittently

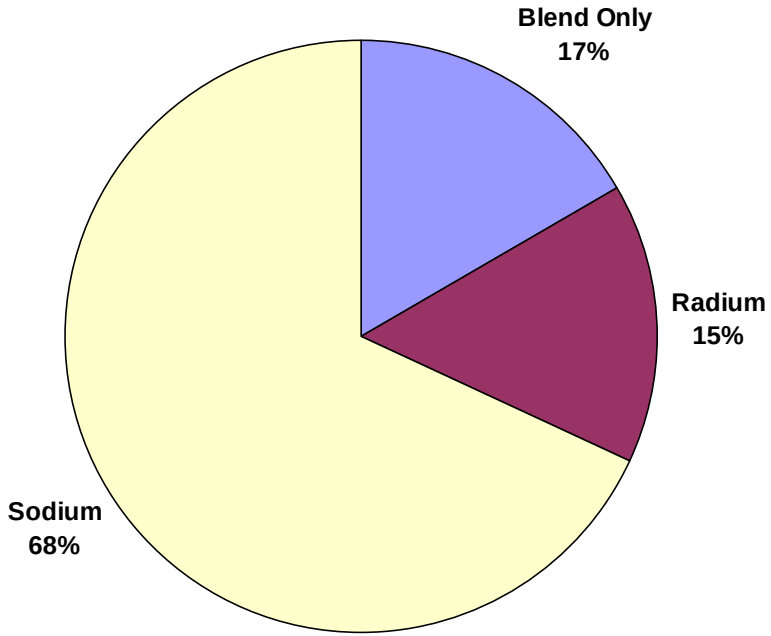
⇨ Feed & Regen Flows-Counterclockwise

Resin Selectivity

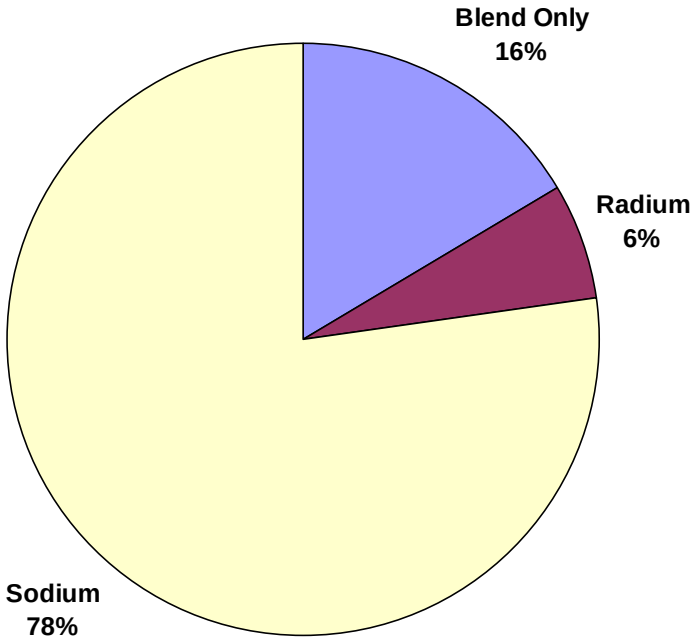
Cations	Index
Li+1	0.76
H+1	1
Na+1	1.2
NH4+1	1.44
K+1	1.72
Mg+2	2.23
Zn+2	2.37
Cs+1	2.02
Co+2	2.45
Ni+2	2.61
Cu+2	2.49
Ca+2	3.14
Sr+2	3.56
Ag+1	3.58
Pb+2	4.97
Ba+2	5.66
Tl+1	5.08

Increasing Selectivity

2009 Volume Split by Treatment Type



2008 Volume Split by Treatment Type



Facilities Consolidation

- Improves Utilization
- Increases Flexibility
- Easier to Manage Operations
- Multiple Field and / or Client Utilization

Single Treatment Unit

25,000 BPD Capacity

Consolidated Treatment Facility

100,000 BPD Capacity

Summary

- Economics
  - Fewer bbls Produced
  - Lower WGR
- Regulatory
  - Assimilative Capacity Changed TDS Removal Requirements
  - Radium Removal
- Consolidation of Treatment Systems and Improved Operating Efficiencies

- Lower $/MCF for Water Management

That's the Good News!