Commercial Systems Treating both High and Low Strength Perchlorate Applications Utilizing Ion Exchange

By

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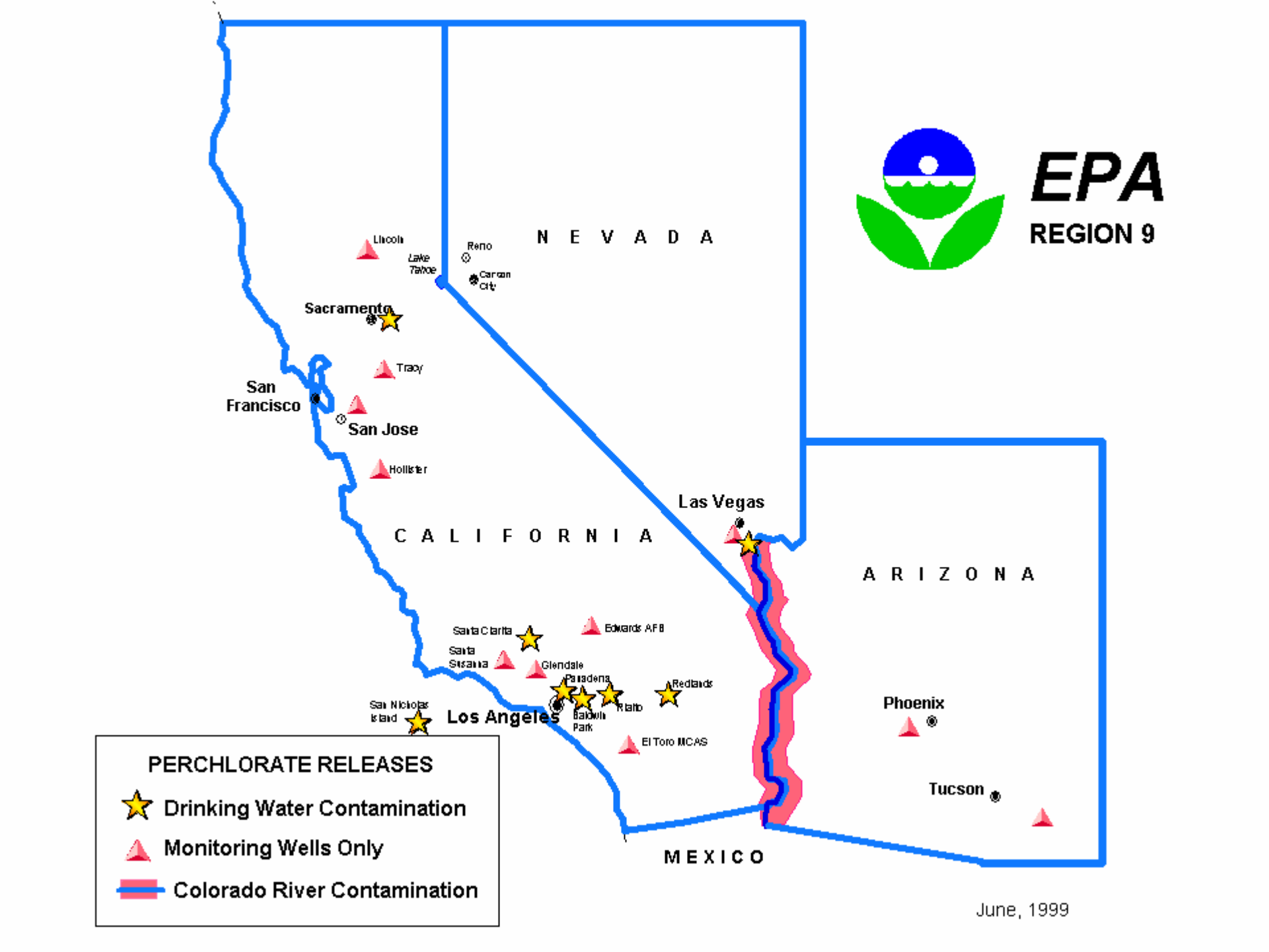
Agenda

- IX Development Chronology
- ISEP & ISEP+ Systems
- Pilot Tests
- Operating Systems
  - High Strength Application
  - Low Strength Application

ISEP & ISEP+ Systems

- 1/98 – CCC conducted first lab tests
- 8/98 – Completed first successful field pilot tests
  - San Gabriel Valley, CA
- 1/99 – Completed perchlorate removal and destruction pilot tests
  - NASA's Jet Propulsion Lab – Pasadena, CA
- 11/99 – First remediation system
  - Henderson, NV
- 2/00 – First potable water system
  - LaPuente, CA


EPA
REGION 9
NEVADA
CALIFORNIA
ARIZONA
MEXICO
Lincoln
Lake Tahoe
Reno
Carson City
Sacramento
Tracy
San Francisco
San Jose
Hollister
Las Vegas
Santa Clarita
Edwards AFB
Santa Susana
Glendale
Pasadena
Redlands
Rialto
Baldwin Park
San Nicholas Island
Los Angeles
El Toro MCAS
Phoenix
Tucson
PERCHLORATE RELEASES
Drinking Water Contamination
Monitoring Wells Only
Colorado River Contamination
June, 1999

Ion Exchange Process

- Removal/Regeneration – IX resin

$$ClO_4 + R\text{-}Cl = R\text{-}ClO_4 + Cl$$

$$R\text{-}ClO_4 + NaCl = R\text{-}Cl + NaClO_4$$

(R) – IX resin

- Destruction – Catalytic Reduction

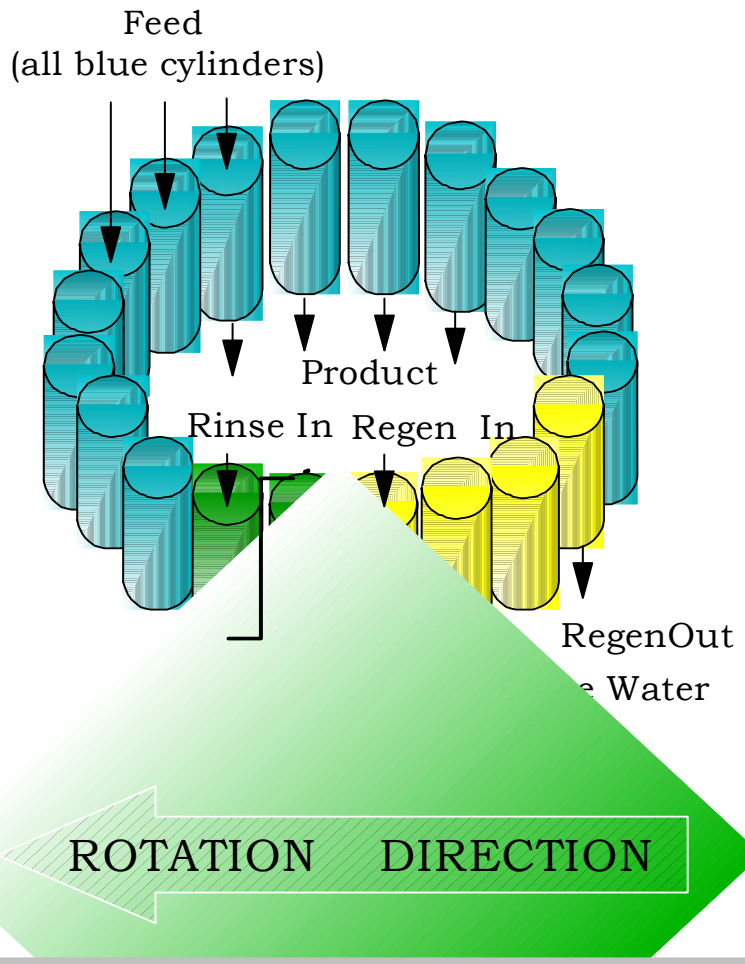
$$NaClO_4 + 8H^* = NaCl + 4\,H_2O$$

(H*) – hydrogen source

ISEP & ISEP Systems

- ISEP System – Continuous ion exchange process to remove perchlorate and nitrate from water
- ISEP+ System – Continuous ion exchange process to remove and **destroy** perchlorate and nitrate from water

ISEP Illustration

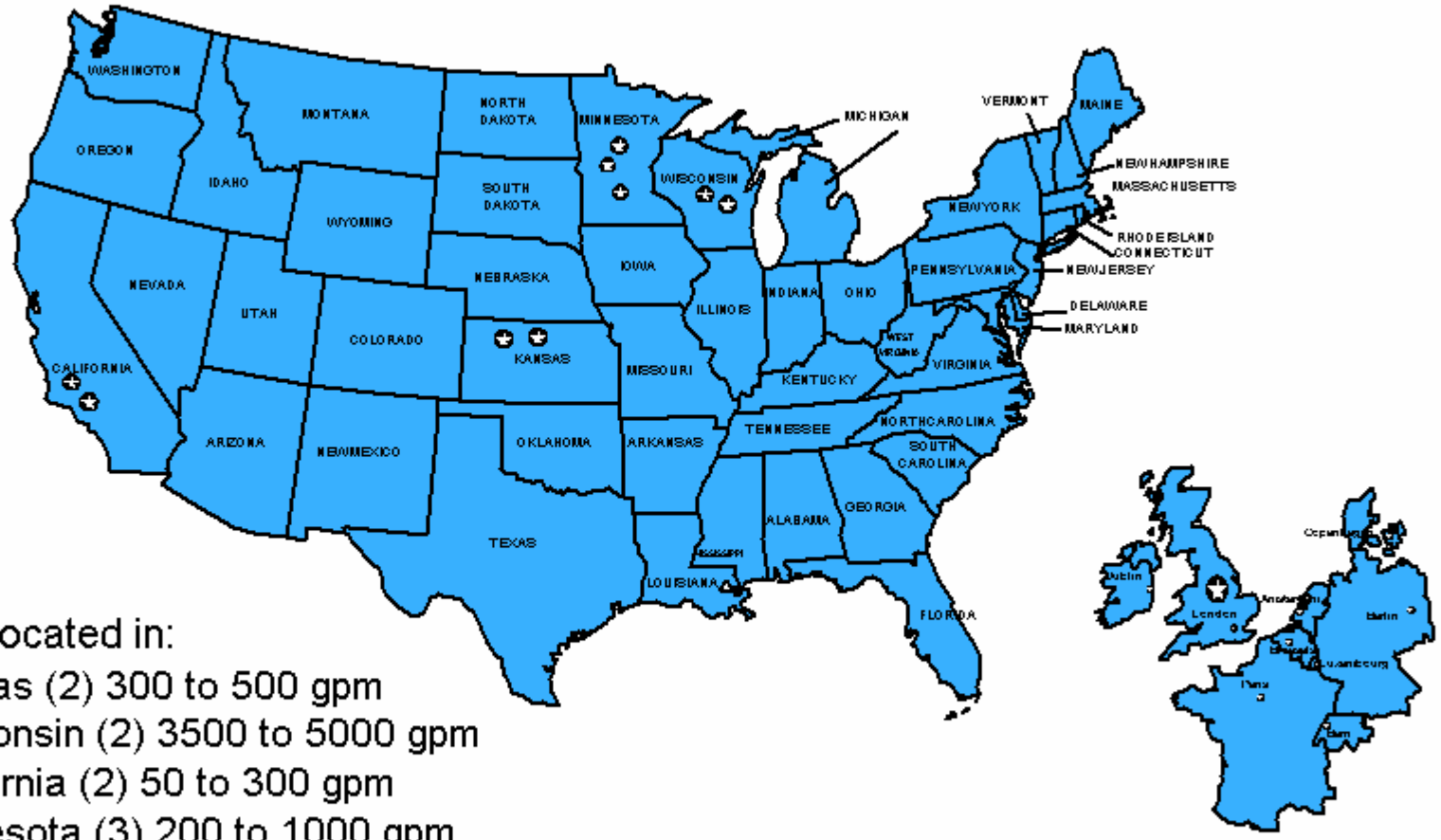


ISEP Design Features

- Configuration flexibility
- Reduced resin inventory
- Simplified control philosophy
- Reduced regeneration chemicals
- Steady state operation

Calgon Carbon ISEP Experience

Drinking Water Plants



- Plants located in:
  - Kansas (2) 300 to 500 gpm
  - Wisconsin (2) 3500 to 5000 gpm
  - California (2) 50 to 300 gpm
  - Minnesota (3) 200 to 1000 gpm
  - United Kingdom (1) 1000 gpm

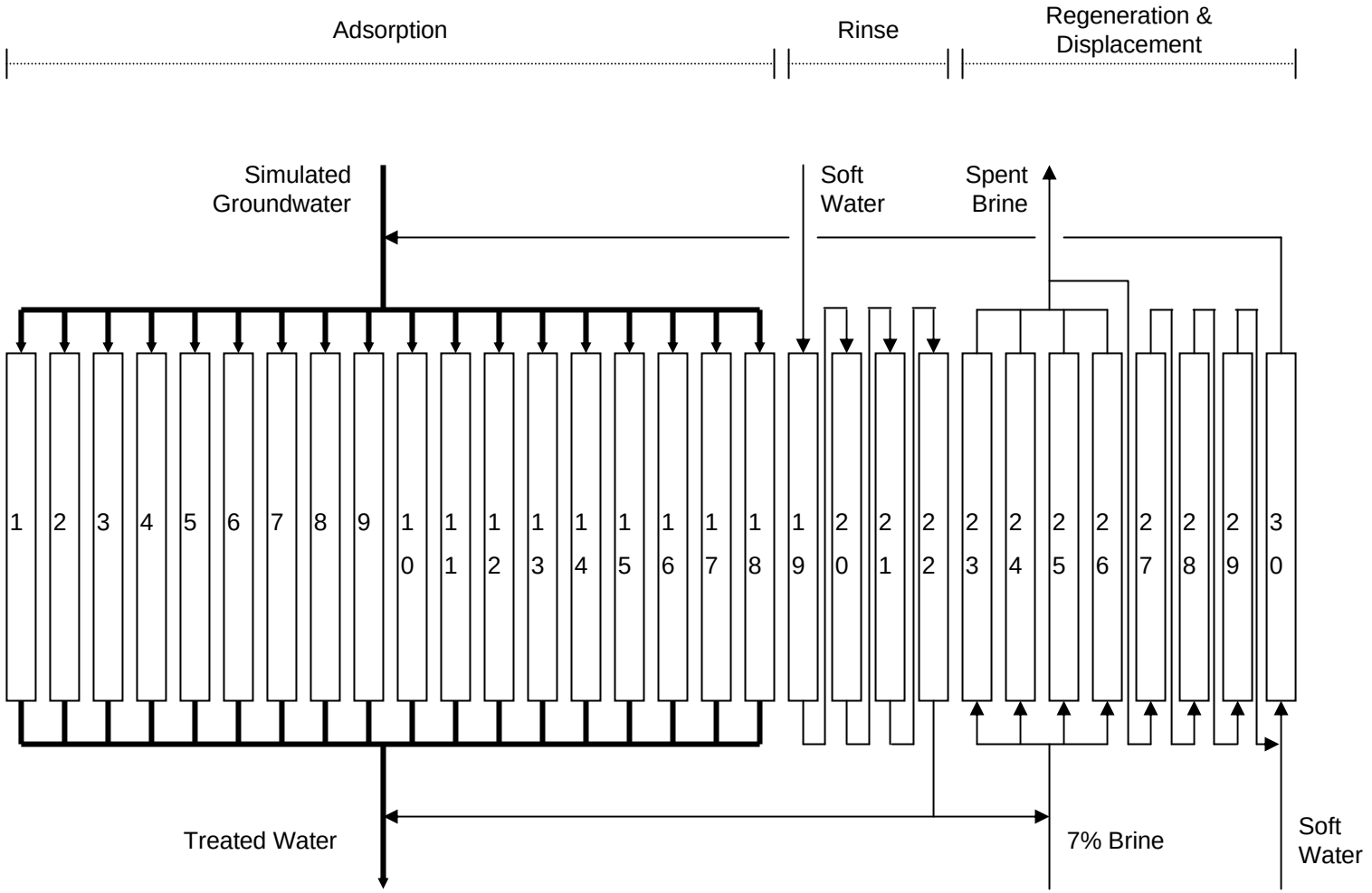


Figure 1. Schematic of the ISEP® Ion Exchange Process

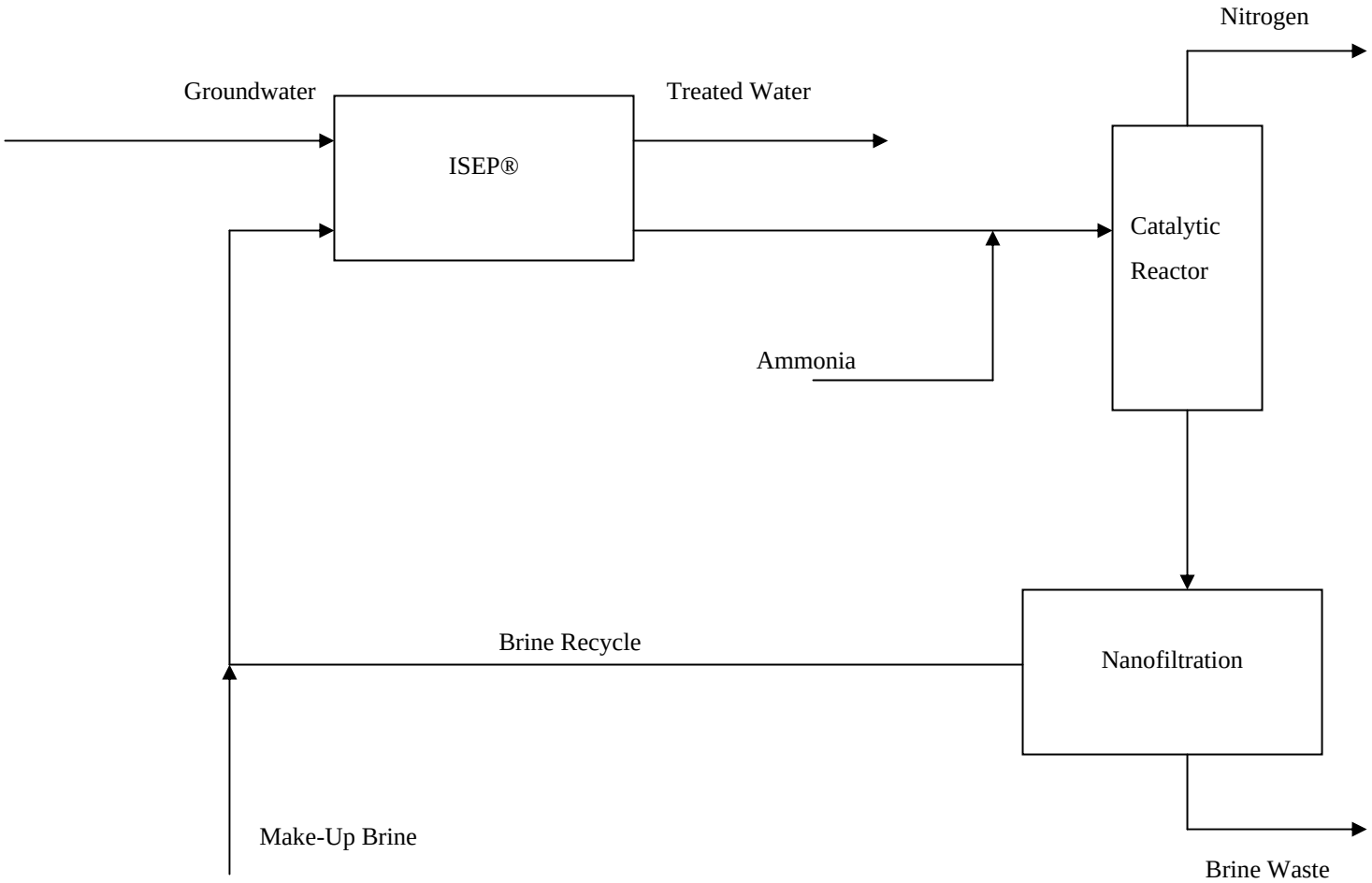
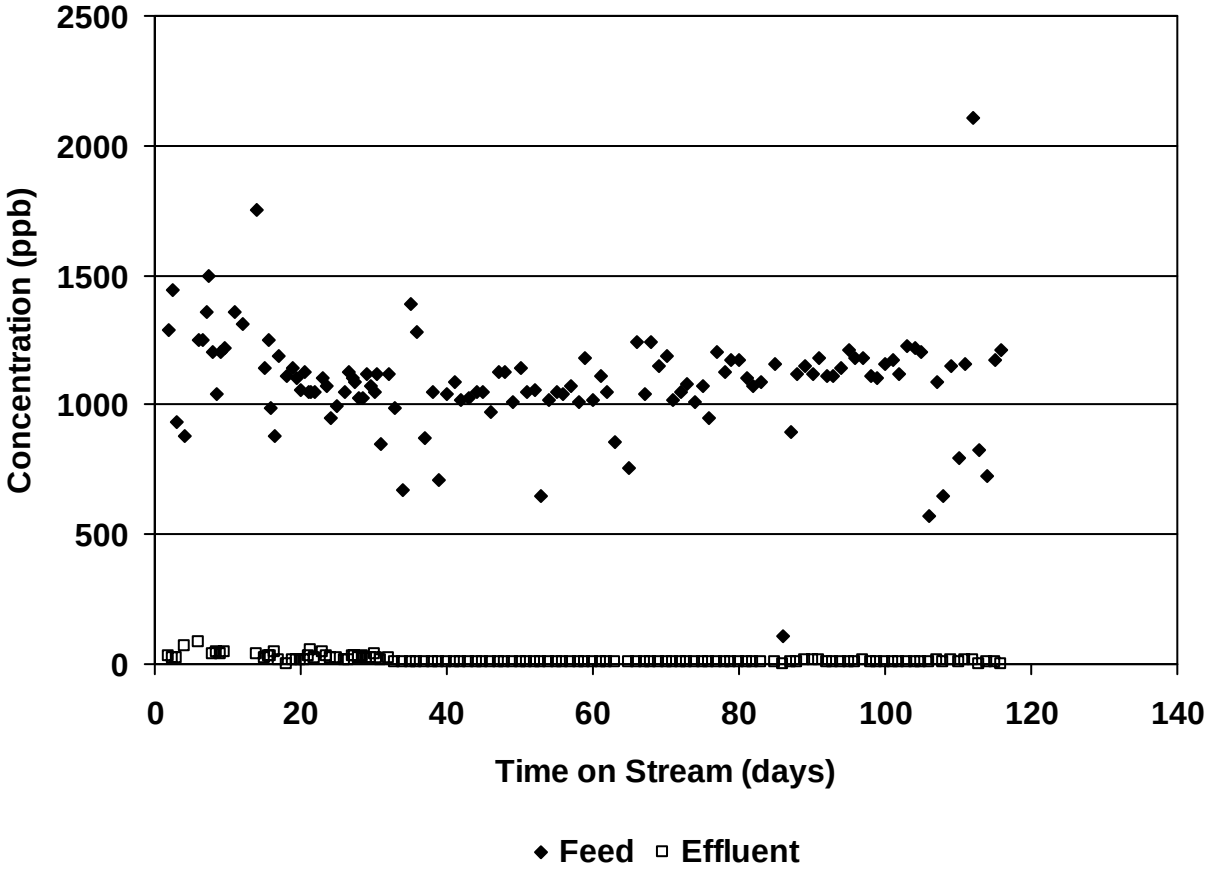
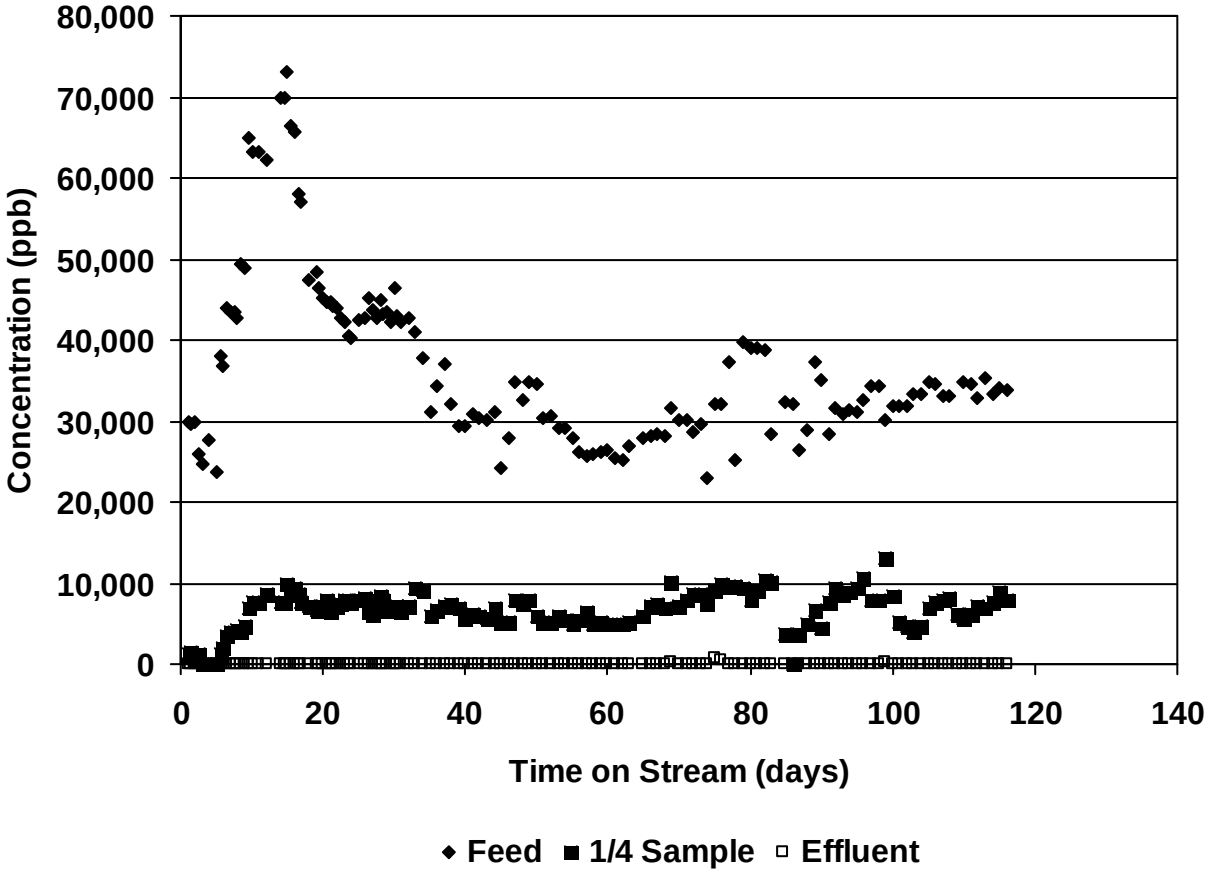


Figure 2. Block-Flow Diagram of the ISEP+™ Process



Non-Detectable ClO_4^- Levels Recorded as 4 ppb

Figure 3. Perchlorate Removal in the ISEP®



Non-Detectable ClO_4^- Levels Recorded as 100 ppb

Figure 4. Destruction of Perchlorate in the Reactor

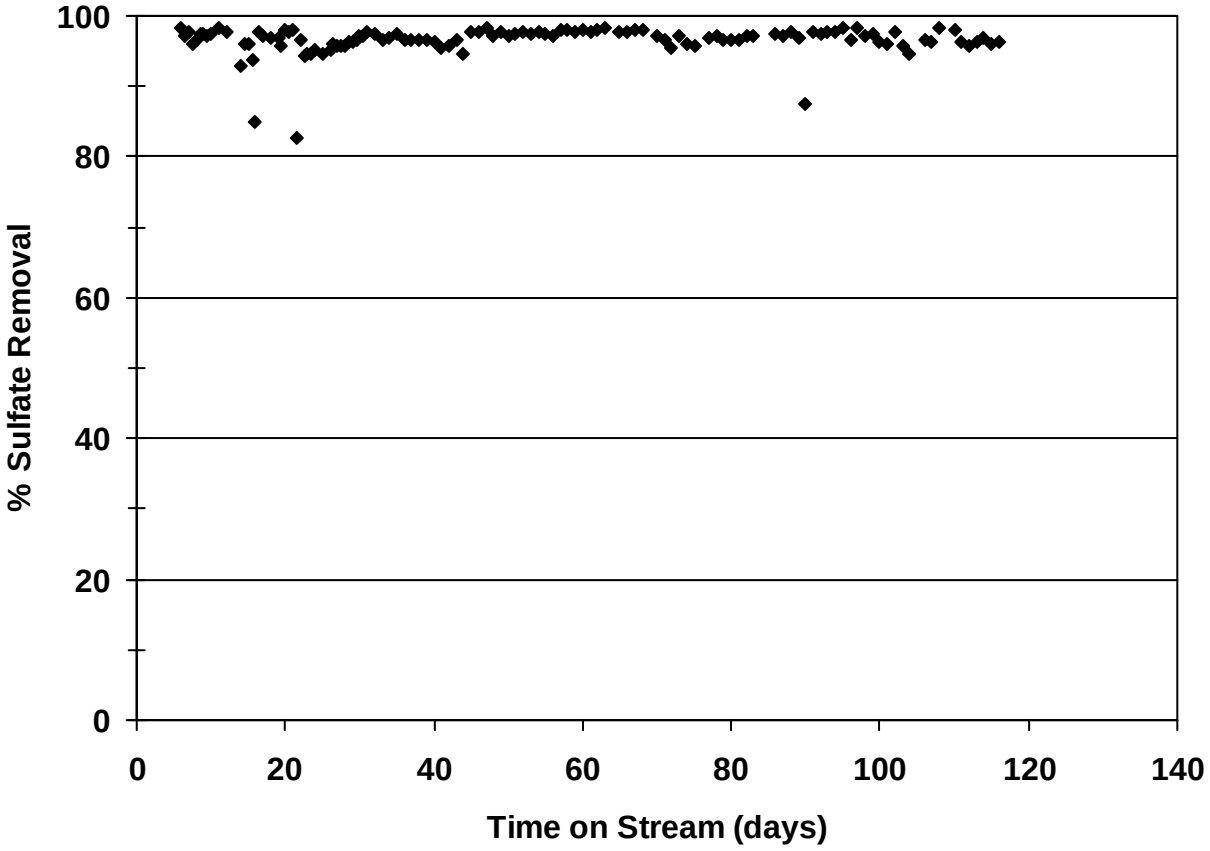


Figure 5. Sulfate Removal in the Nanofiltration Process

Henderson, NV Remediation

- Remediation application
- Instillation designed to treat perchlorate containing seep water draining into Lake Mead
- System was commissioned in November 1999 and has been in continuous operation since that time

Henderson, NV Remediation

- Ion exchange system is designed to remove 100 ppm of perchlorate
  - Actual levels have varied from 80 – 110 ppm
- System designed to treat 450 gpm of water
  - Flow rates have varied from 200 – 560 gpm
- System designed to achieve 97 % perchlorate removal
  - Typical effluent perchlorate effluent levels are non detectable on an ion selective electrode (<2 ppm)

La Puente Valley County Water District ISEP System

- 2500 gpm drinking water application
- Designed to treat perchlorate, volatile organics, NDMA, and 1,4-dioxane
- System was commissioned in February 2000

La Puente Valley County Water District

- ISEP System accepted by CADHS for perchlorate and nitrate drinking water applications
- Operating permit currently under review by CADHS – Metropolitan District
- Emergency use permit approved
- Currently ISEP system is operating 19 hr/day to control perchlorate plume

Capital Costs

- Estimated Capital January 1999
- $4,600,000

- Actual Capital 03/31/00
- $4,070,041
- Engineering and permits for DOHS Testing
- $882,608 (Budgeted $314,399)
- Total $4,952,649
- Overrun $352,649

La Puente Operational Costs

	Budget 1/99	Actual
Wells*	$21/AF	$21/AF
Air Strippers	$7/AF	$7/AF
Booster	$7/AF	$7/AF
ISEP	$69.98/AF	$52.34/AF
Brine Disp.	$21/AF	$4/AF
Rayox	$89.72/AF	$42.61/AF
Peroxide	$16.32/AF	$7/AF
Maint/Labor	$59.18/AF	$86.71/AF
Total	$291.20/AF	$227.66/AF
Savings		$63.54/AF

Summary

- ISEP Systems capable of treating both high and low strength perchlorate applications at very low waste brine levels
- ISEP+ Systems capable of treating and destroying perchlorate at very low or zero waste levels