

OVERVIEW OF LAS VEGAS VALLEY PERCHLORATE REMEDIATION EFFORTS

Prepared for:
Lake Mead Ecosystem Monitoring Workgroup

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Perchlorate Manufacturing Operations Henderson, NV



Pepcon (AMPAC): 1958 – 1988

- May 1988: Destroyed in Explosion
- March 1998: Purchased Manufacturing Line & Customer Base from Kerr-McGee



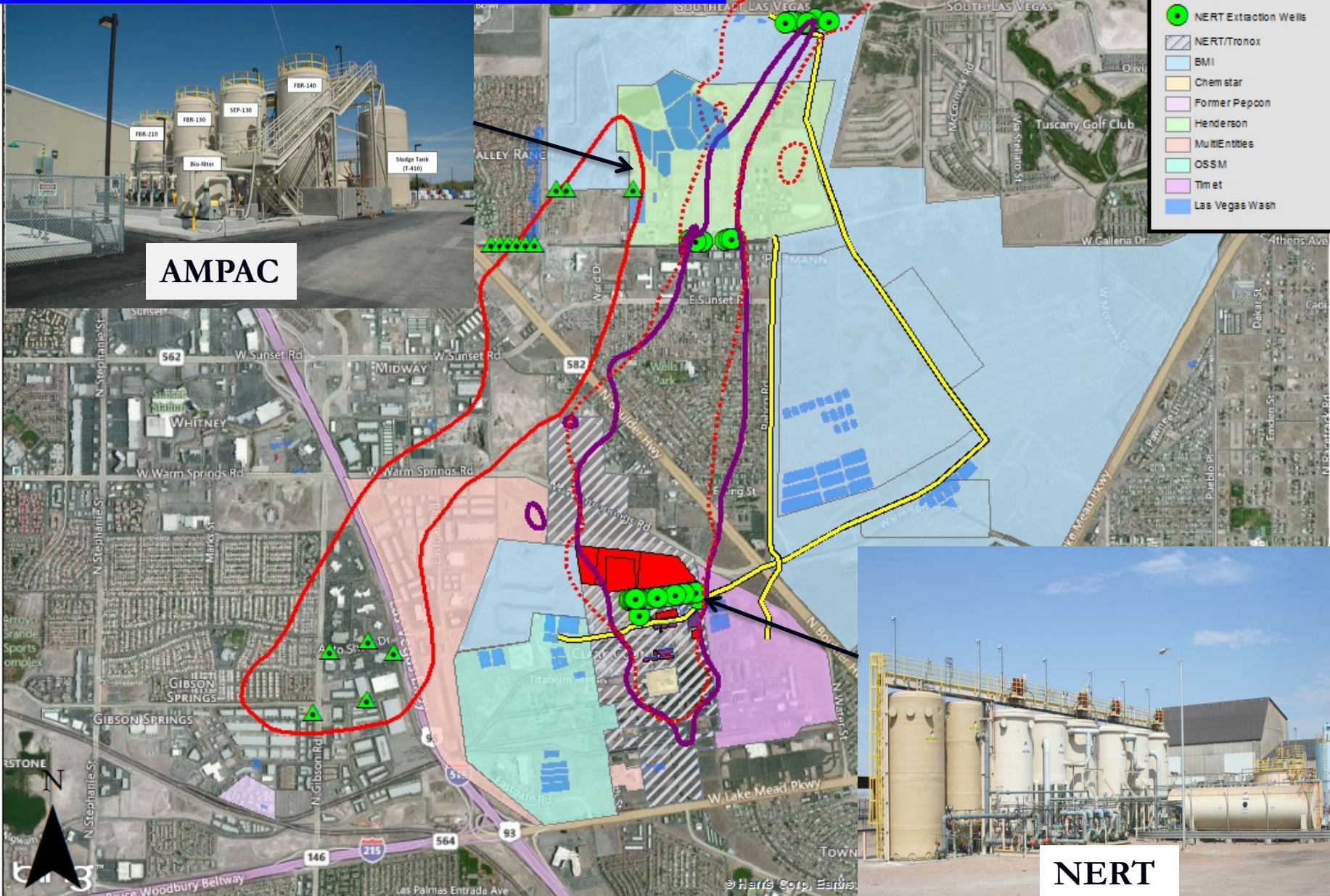
US Government – Navy (1945 – 1962) Tronox (previously Kerr-McGee) & Predecessors (1945 – 1998)

- July 1998: Curtailed Perchlorate Production
- March 2002: Process Shut Down

Perchlorate Plumes & Remediation Infrastructure



AMPAC

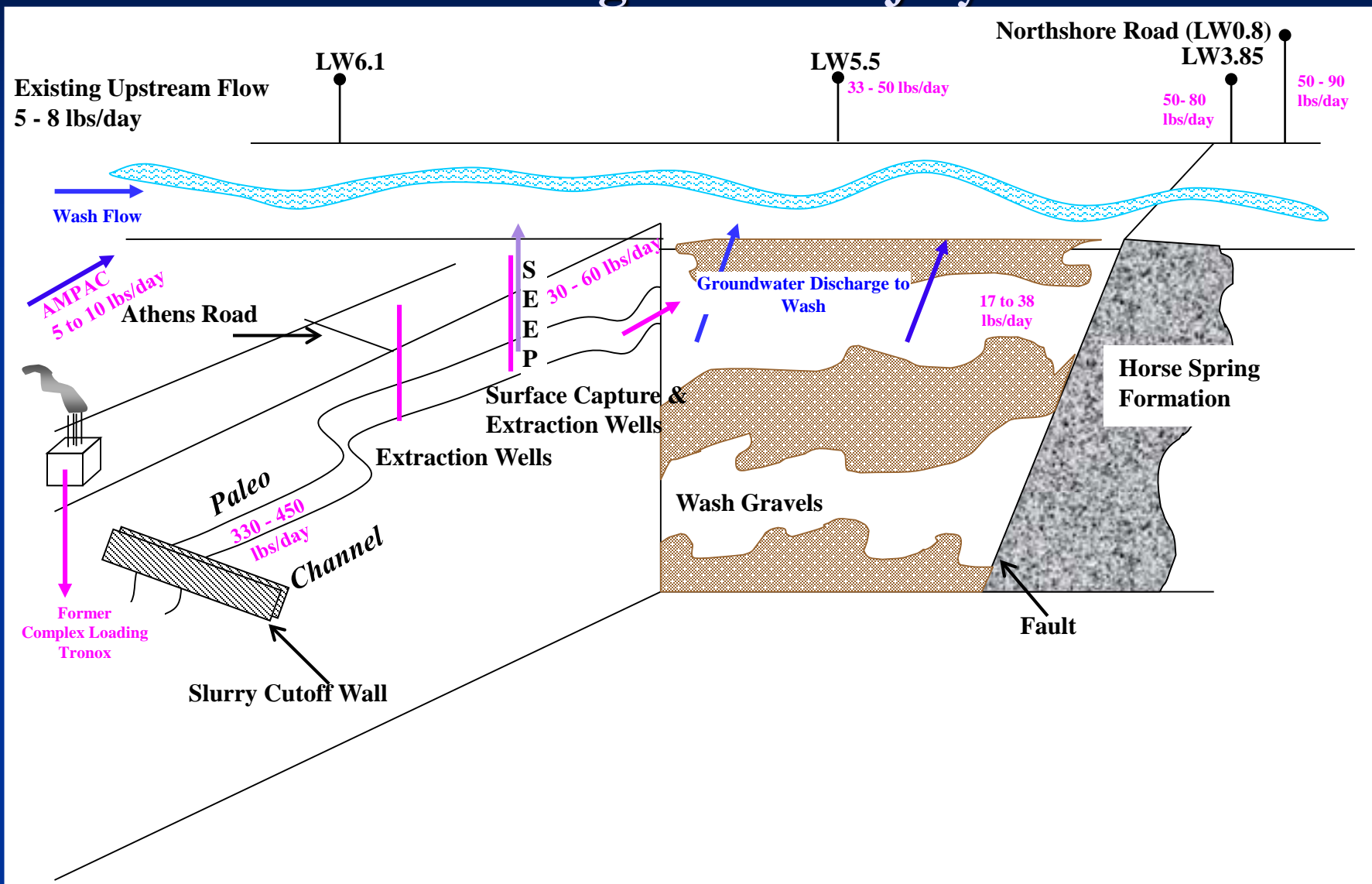


- █ AMPAC
- ⋯ Tronox 2002
- █ NERT 2012
- █ Ditches
- ▲ AMPAC Extraction Wells
- NERT Extraction Wells
- NERT/Tronox
- BMI
- Chemstar
- Former Pepcon
- Henderson
- MultiEntitles
- OSSM
- Tim et
- Las Vegas Wash



NERT

Conceptual Model of Perchlorate Loading to the Las Vegas Wash – July 2013



* The numbers in this slide are estimation and for illustration only

TRONOX

AMPAC

• Initial Discovery 1997

• Initial Discovery

• Initial Characterization
• On-Site Well Field 1998
• GW-11 Pond

• ISB Pilot Test
• UIC Permit - Pilot

• Seep Capture
• Temporary IX 1999
• Perchlorate Cleanup Plan

• Continued Characterization

• Pilot Plants
• NPDES Permit 2000

• Lab Bench Scale Tests

• On-Site Slurry Wall
• All Well Fields 2001
• Extraction Infrastructure

• In-Situ Bioremediation Studies
• Groundwater Modeling

• Full-Scale GW Treatment (ISEP-PDM) 2002
• Expanded Once-Through IX

• Continued Characterization

TRONOX

AMPAC

- Expansion of Seep Area Well Field
- Full-Scale FBR System Constructed

2003

- Phase I & II Characterization

- Transition from IX to FBR

2004

- Aquifer Testing

- Continued FBR Operation

2005

- ISB Area Modeling
- ISB System Installation Initiated

- FBR System Expansion
- Athens Rd Well Field Optimization
- FBR System Optimization

2006

- UIC Permit
- ISB System Operational
 - Interim (Jun – Dec)
 - Permanent (Dec – current)

- Athens Rd Modeling
- FBR Operation

2007

- ISB System Optimization

- Groundwater Capture Analysis

2008

- Re-injection Optimization
- ISB System Reconfiguration (GAC Filters)

TRONOX

AMPAC

- Source Area Characterization
- Continued FBR Operation
- Bankruptcy

2009

- Re-injection Trench Installation
- Groundwater / Contaminant Modeling

• Optimization:

2010

- Edible Oil Substrate Bench-scale Project Completed (Off-site)
- Capture Zone Analysis
- Excavation of Perchlorate-Impacted Soils (On-site)

• Bankruptcy:

- NDEP Focused at Maintaining Operating Remediation System

• Expanding Remediation:

- Source Area Well Field
- Existing Facility Tie In

• Change in Remediation Approach:

- Transition from ISB to Ex-Situ
- Evaluating FBR vs. Fixed-Bed
- Continue with ISB thru Transition

TRONOX

AMPAC

- Nevada Environmental Response Trust (NERT):

- On-going Operation of GWTS (On-site & Off-site)

2011

- Development of Remedial Action Objectives

- Development of FS WP:

- Soil Flushing (On-site)

- Edible Oil Pilot Study (Off-site)

- Bankruptcy:

- Creation of NERT

- 02/14/11 Bankruptcy Finalized

2012

- RI/FS Work Plan

- Optimization of GWETS

2013

- Design of FBR:

- Source Area Well Field

- Existing Facility Tie In

- Permitting of FBR

- Bid FBR System

- Continue with ISB thru Transition

- ISB shut down (6/2012)

- FBR start (9/2012)

Tronox Perchlorate Remediation System: Fluidized Bed Reactor



AMPAC Perchlorate FBR



Capture & Treatment

NERT/
TRONOX

Full-Scale System: ~ 3000 lb/day

- Athens Road Well Field
- On-Site Ponds (GW-11 & AP5)
- On-Site Well Field / Slurry Wall
- Seep Area Collection - GW & Surface
- Fluidized Bed Reactor (FBR) Treatment System

AMPAC

Full-Scale System: ~ 1000 lb/day

- Athens Road Well Field
- Athens Pen Well Field
- Auto Mall Well Field
- Performance Monitoring Wells

**NERT/Tronox
Perchlorate Removal Rate:
March 2013**

Location	Extraction (gpm)	Mass (Pounds per Day)
Seep Area	579	52
Athens Road	281	610
On-Site	68	1,070
Total	928	1,732

**NERT/Tronox
Perchlorate Removed from the Environment:
December 1998 Through March 2013**

Location	Mass (Tons)
Seep Area	432
Athens Road	1,346
On-Site	2,118
Total	3,897

AMPAC
Perchlorate Removal Rate:
July, 2013

Location	Extraction (gpm)	Mass (Pounds per Day)
APEW	64	19
AREW	273	30
AMEW	352	1,067
Total	689	1,116

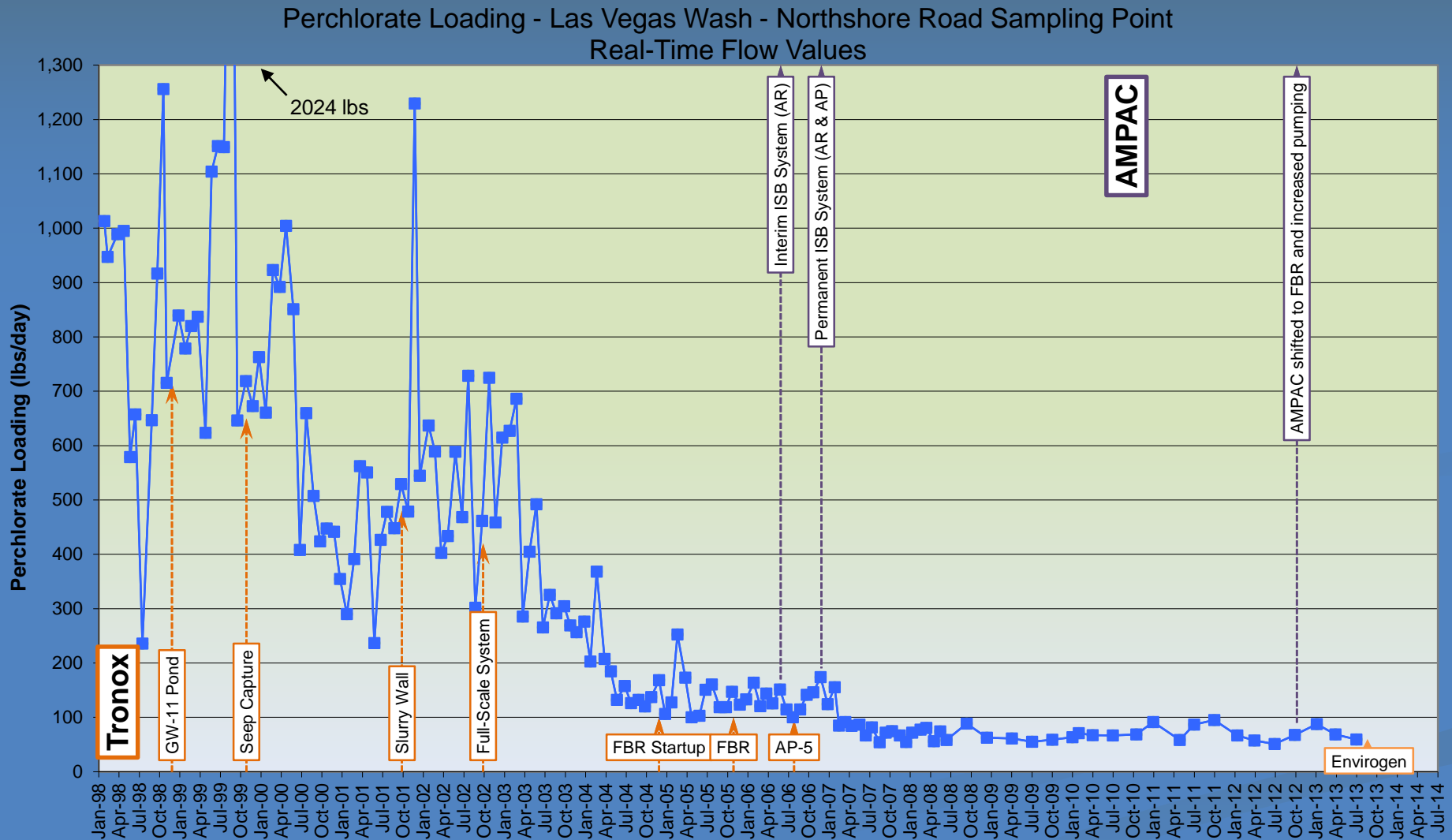
AMPAC
Perchlorate Removed from the Environment:
(June 2006 and July 31, 2013)

Location	Mass (Metric Tons)
APEW	9
AREW	26
AMEW*	143
Total	178

*AMEW started to operate in Oct., 2012

Perchlorate Loading - Las Vegas Wash - Northshore Road Sampling Point

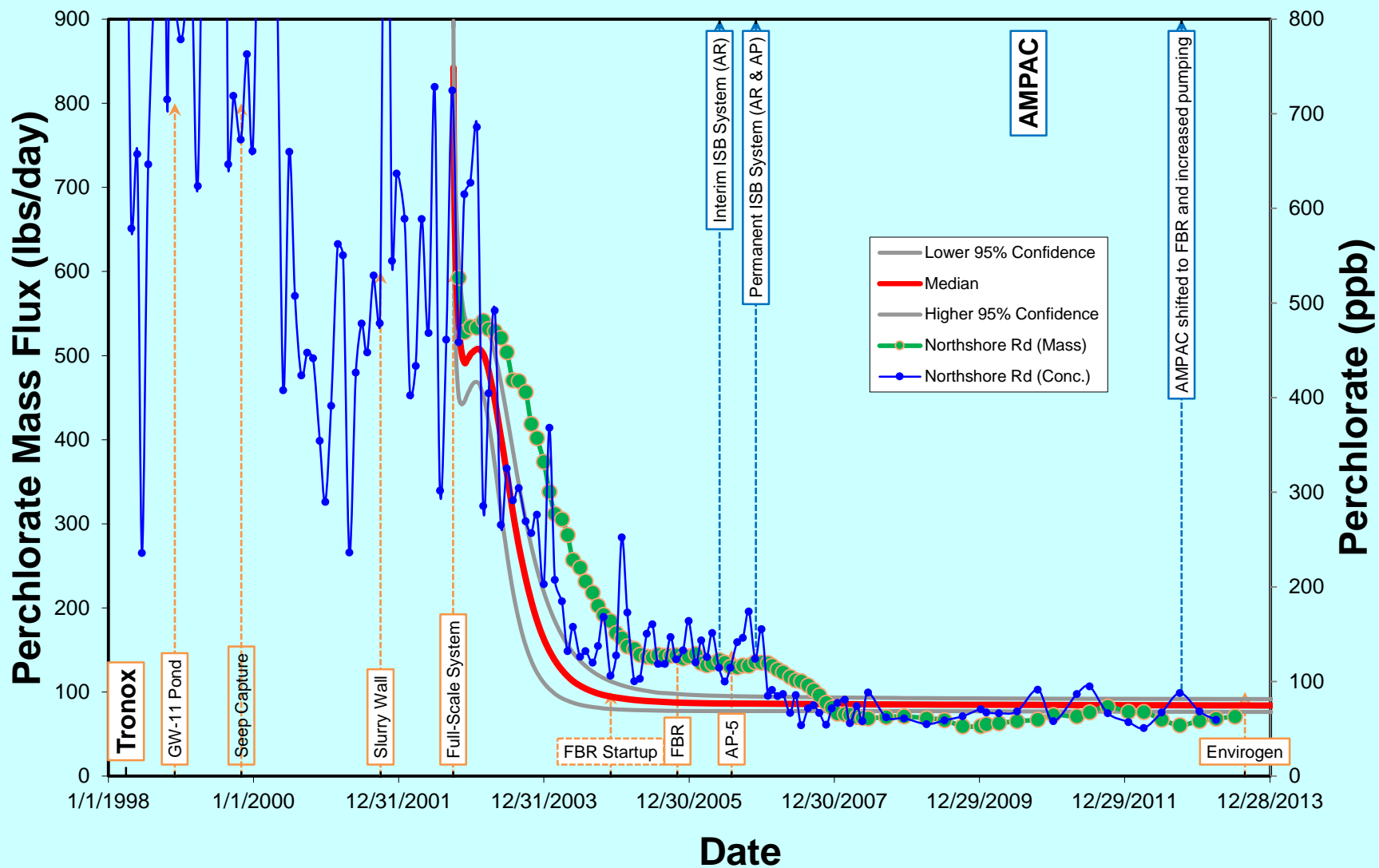
Real-Time Flow Values



Notes:* Perchlorate concentration sampled during the first full week of the first month of the quarter.
 * Northshore Road sampling point positioned approximately one-half mile upstream from confluence of Las Vegas Wash and Lake Mead.
 * Northshore Road sampling point should measure all perchlorate inputs entering the Colorado River System from the Las Vegas Valley via Las Vegas Wash.
 * Approximate Location: 36°07' 20" N by 114°54' 15" W

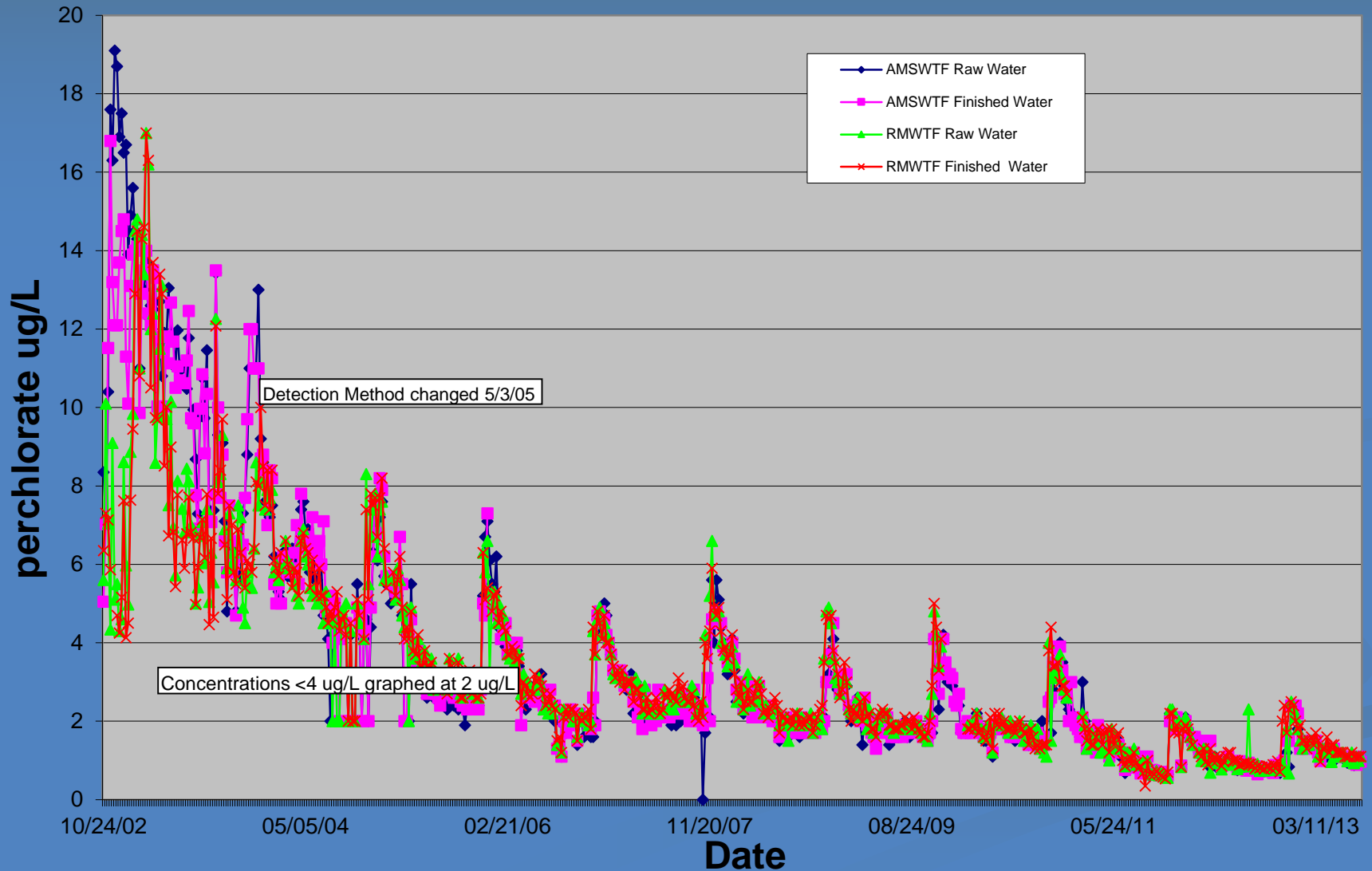
Breakthrough Curve: 90% Efficient Model Results

Breakthrough Curve: 90% Efficient Model Results, Mass



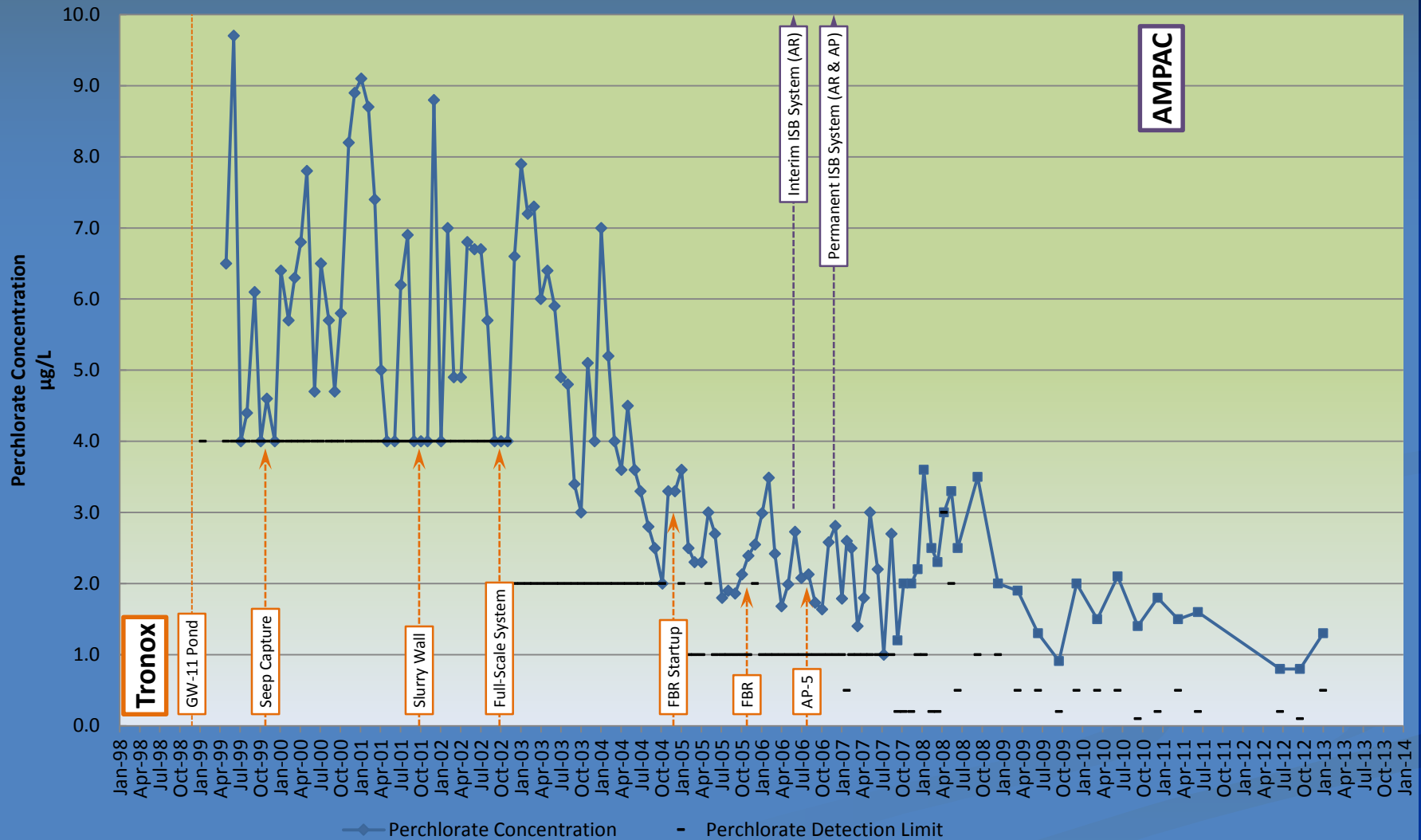
Perchlorate Concentrations Lake Mead Source Water

SNWS Raw and Finished Perchlorate Concentrations



Willow Beach Sampling Point

Perchlorate Concentration ($\mu\text{g/L}$)



Notes: * Perchlorate concentration & Specific Conductance sampled on or about the 18th of each month.

* Willow Beach AZ sampling point is located along the east bank of the Colorado River approximately 11 miles downstream from Hoover Dam (Lake Mead).

* Approximate location: 35° 52' 26" N by 114° 39' 43" W

PERCHLORATE CONCENTRATION RANGES

(1) LAKE MEAD

- Historic: 4 – 24 ppb
- Current: 0.35 – 3.0 ppb

(2) WILLOW BEACH, AZ

- Historic: 4 – 10 ppb
- Current: 0.8 – 1.6 ppb

(3) WHITSETT

- Historic: 3.6 – 9 ppb
- Current: 0.5 – 1.5 ppb

*Note: Historic: pre-2004
Current: 01/11 - 04/13



On-Going Activities

- Investigation of LV Wash & BMI Areas to Evaluate Other Potential Perchlorate Sources
- Continued Evaluation of Remedial Technologies
- Consideration of Opportunities to Further Refine Capture & Treatment

Entities Involved

- NV Division of Environmental Protection
- US Environmental Protection Agency
- Southern Nevada Water Authority
- Metropolitan Water District
- Central Arizona Project
- City of Henderson
- NERT
- AMPAC
- BMI

Future Work

- Tronox/NERT
 - Additional Remediation
 - Source Area
 - Down-gradient Area
 - Athens Road Well Field (Capture Zone Evaluation)
 - 2013 Optimization
 - Remediation System Operation – Post Bankruptcy
- AMPAC
 - Remediation Optimization
 - Transition to Sustainable, Long-term Remediation System

Significant Benchmarks

- Full-Scale Remediation Systems
 - NERT – FBR
 - AMPAC – FBR
- ~90% Reduction in Perchlorate Loading to Las Vegas Wash
- Significant Improvement in Colorado River Water Quality
- Benchmarks Achieved Lacking Enforceable Standard