

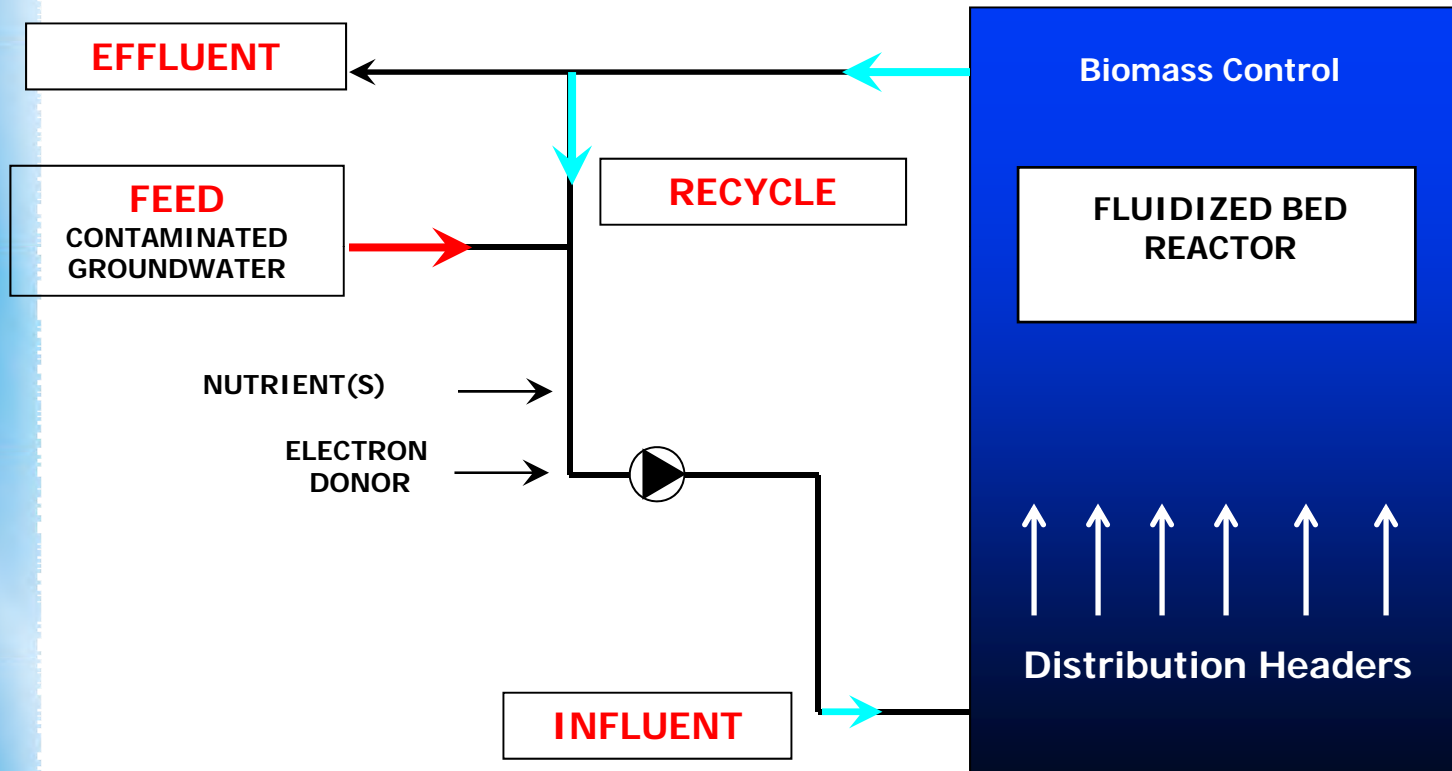


Full-Scale Implementation of a Biological Fluidized Bed Drinking Water Treatment Plant for Nitrate and Perchlorate Treatment

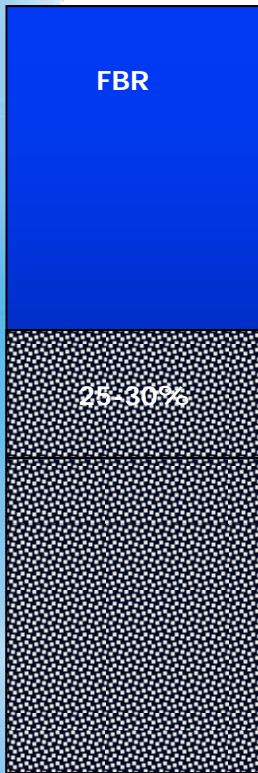
**Todd Webster, Ph.D., P.E.
Envirogen Technologies, Inc.**

**Thomas J. Crowley, P.E.
Assistant General Manager
West Valley Water District**

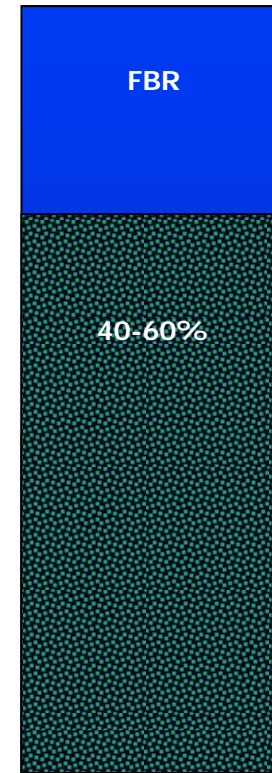
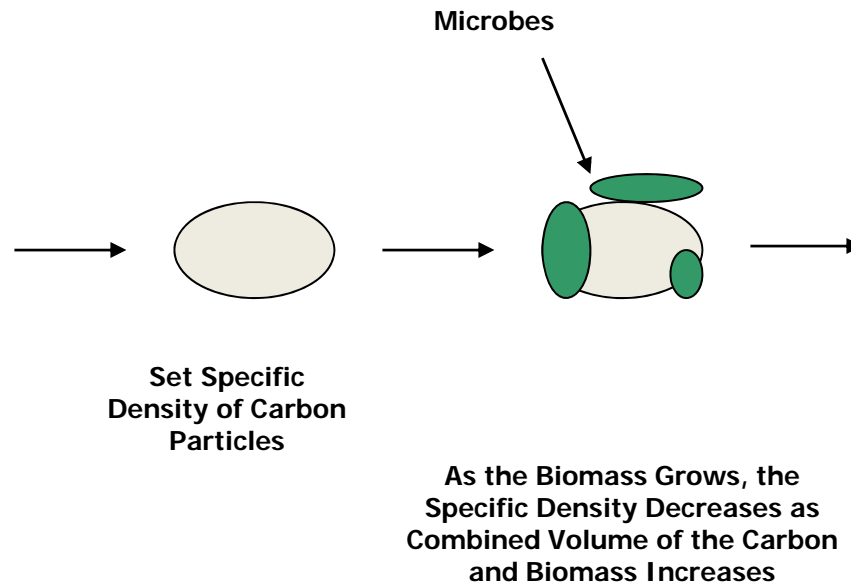
FBR Flow Schematic



Fluidization of Media

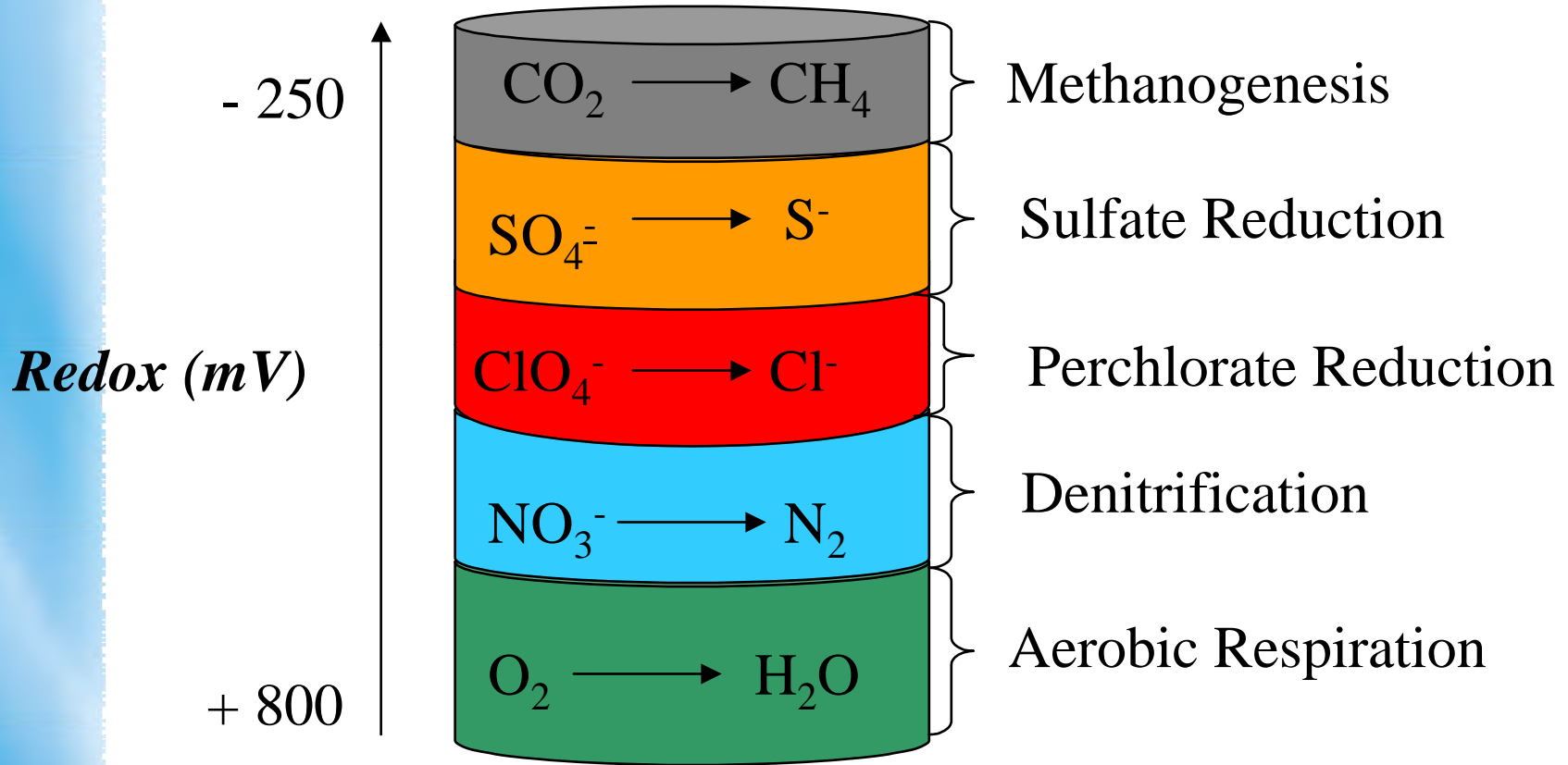


Start-up



Post Start-up

How Do the Microbes Work?



Groundwater
+ Substrate

Non-Potable FBR Full-Scale Systems

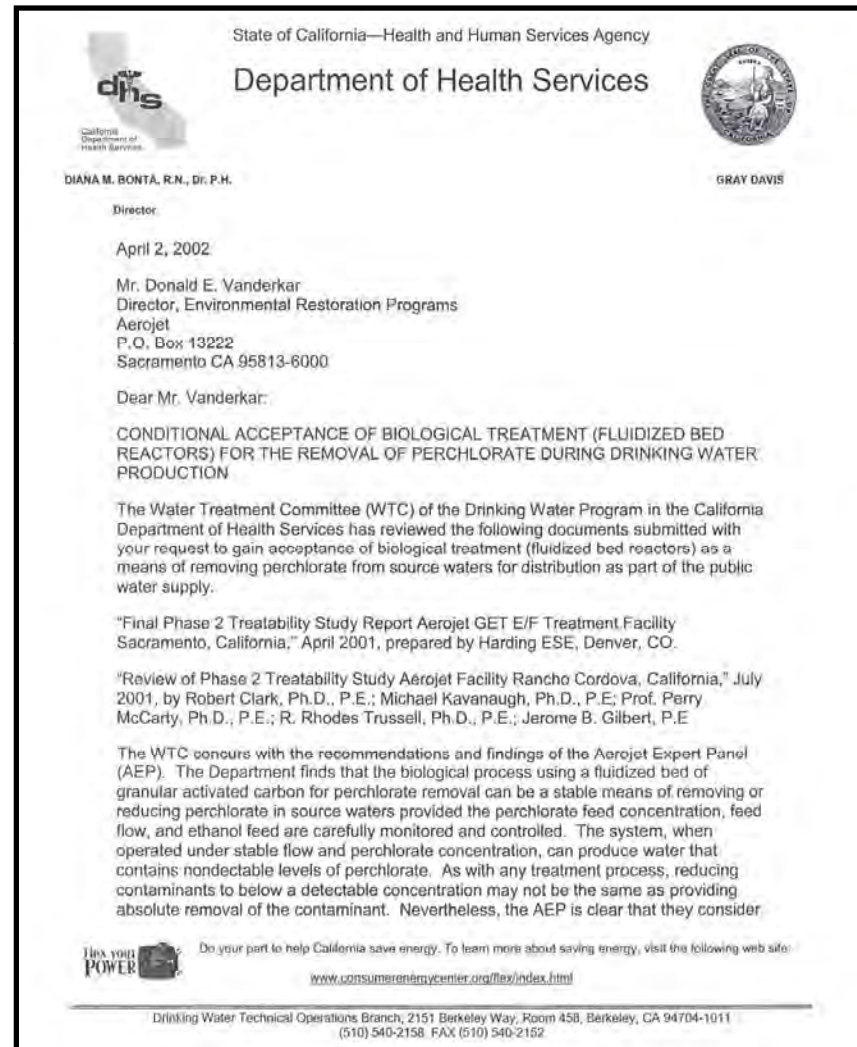


FBRs and Drinking Water

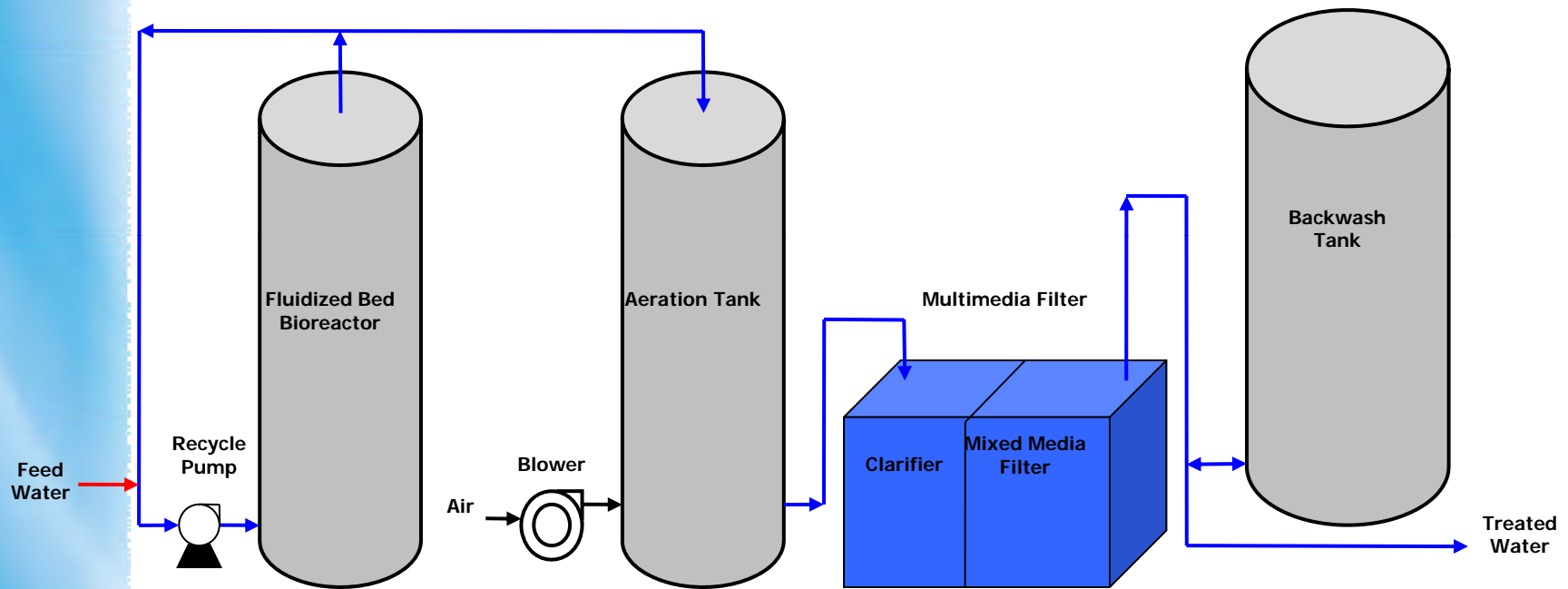


Conditional Acceptance issued April 2, 2002 by DHS of "biological treatment (FBR) as a means of removing perchlorate from source waters for distribution as part of the public water supply."

"The Department finds that the biological process...can be a stable means of reducing perchlorate...can produce water that contains non-detectable levels of perchlorate"



FBR Plant Treatment Train



*Webster et al., *JAWWA*, May, 2009



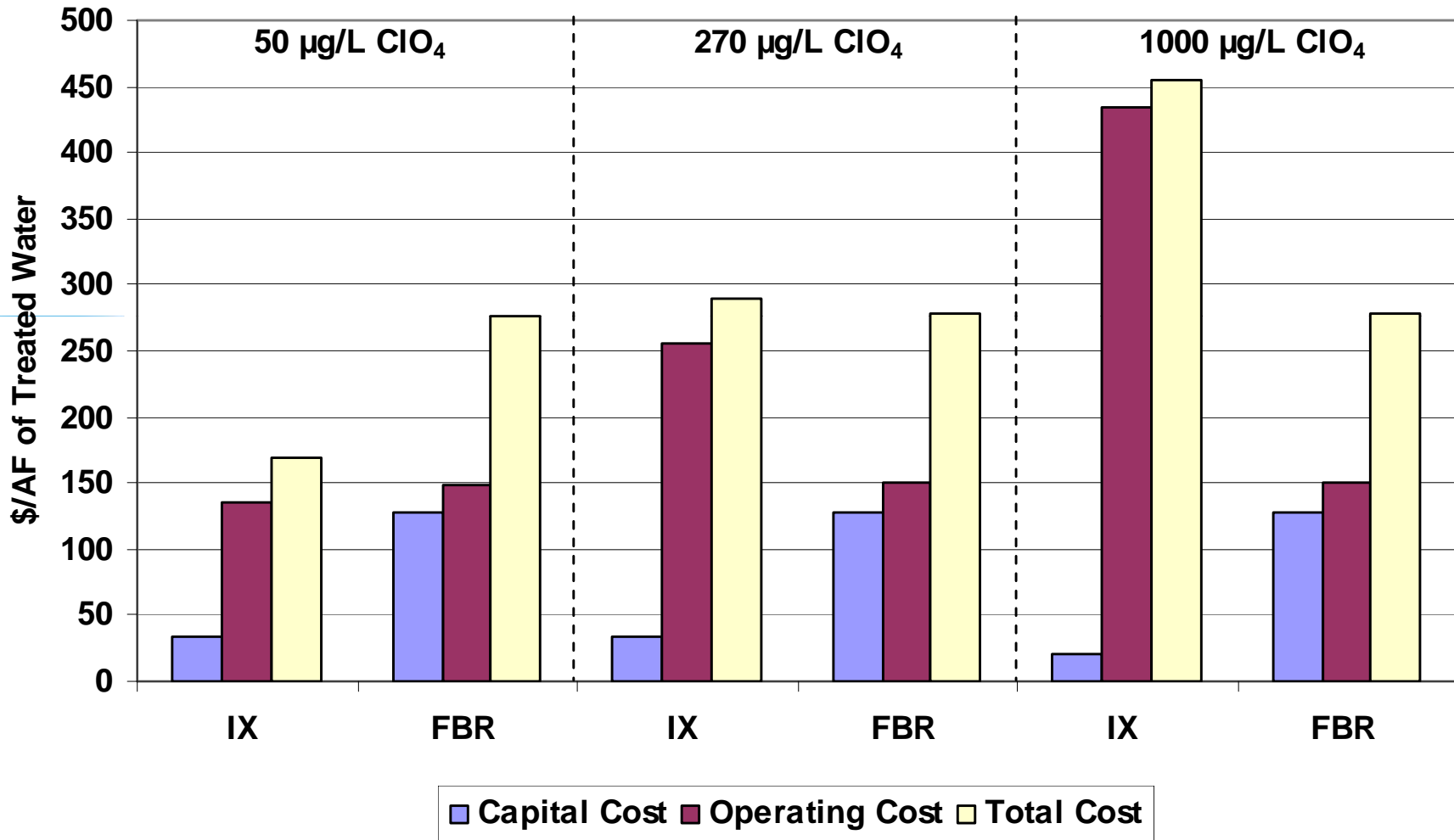
Demonstration-Scale FBR Drinking Water Treatment Plant



Cost Analysis

- **Cost Drivers**
 - NSF Acetic Acid
 - NSF Phosphoric Acid
 - NSF Polymer
 - NSF Coagulant
 - Electricity
 - Maintenance
- **Market Factors**
 - Bulk additive costs vary
 - Electrical costs fluctuate
 - Maintenance costs vary with project
- **Problem Definition**
 - 6 mg/L NO₃-N
 - 6 mg/L O₂
 - 50/270/1000 µg/L ClO₄
 - 1000 gpm
 - Amortized 30 yrs, 4.9% bonding, 2008 dollars
 - Compared w/single pass IX
 - Many assumptions. Refer to the *ESTCP Technology Final Report, Demonstration of a Full-Scale Fluidized Bed Bioreactor for the Treatment of Perchlorate at Low Concentrations in Groundwater*, Project #200543, June, 2009, www.estcp.org

CAPITAL, OPERATING & LIFE-CYCLE COSTS



Demonstration-Scale Study

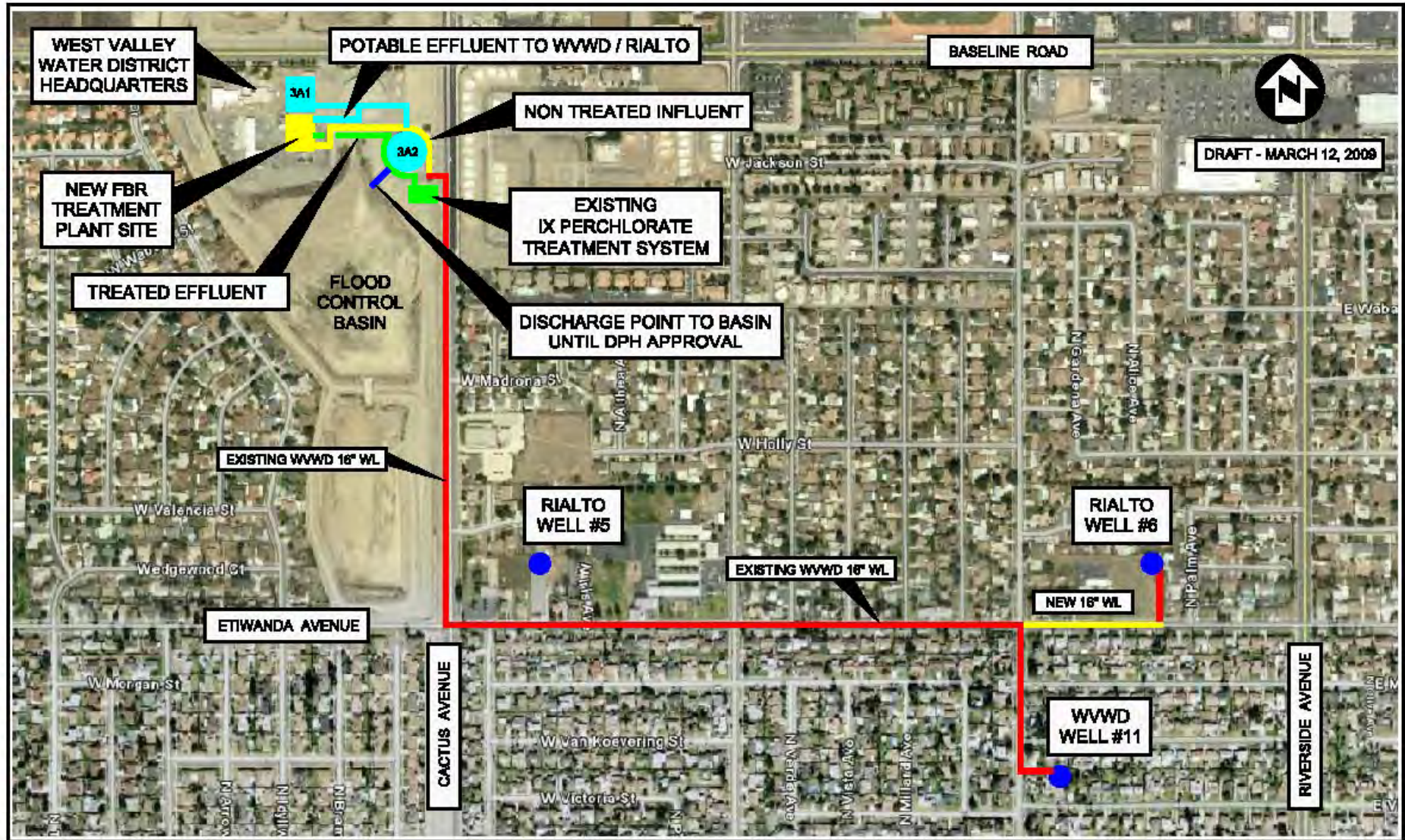
Conclusions



- An indigenous microbial population seeded the system within 21 days of start-up
- Complete nitrate and perchlorate treatment to below CA State Maximum Contaminant Level (MCL) standards using feed forward control logic based on flow and stoichiometry
- Water produced from plant effluent met all MCL requirements (color, odor, turbidity, no pathogens, etc.)
- Challenge experiments demonstrated rebound performance of the FBR as low as 2 hours (no more than 24 hours)
- Nitrate analyzers and perchlorate analyzer were effective in real-time analysis
- Spiked perchlorate concentrations to 1000 µg/L treated to below California MCL
- Operating costs demonstrated to be \$125-150/AF
- At perchlorate concentrations above 200 µg/L, with nitrate-N at 6 mg/L, FBR technology shown to be most cost-effective

Perchlorate/Nitrate

Existing Infrastructure



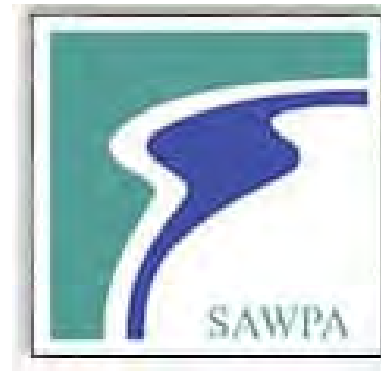
Discharge

CEQA

Full-Scale System

- **In 2009, completed design of a 2000 gpm (3 MGD) FBR Drinking Water Treatment Plant with the ability to expand to 4000gpm**
- **Plant built to mimic the West Valley's local Oliver P. Roemer Surface Water Treatment Plant**
- **Process Train**
 - **Two 14' diameter x 24' tall FBRs**
 - **Two 12' diameter x 24' tall aeration vessels**
 - **Two Siemens Trident Filters**
 - **One Chlorination Contact Chamber- CT of 4 @ 4000 gpm**
 - **One DAF unit for solids processing**
 - **On-line perchlorate and nitrate analysis system**
 - **Feeds to existing WVWD reservoir(s)**

Funded By:



Current Status

- Fully funded to cover costs of project construction, permitting, and plant start-up.
- Site to be prepared in early-2011
- Construction to begin mid-2011
- 3 MGD plant potentially operating in 2012

