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SulFeLox®

Low Hazard Iron Solution

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CWWA – NWWC
Winnipeg, MB
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Introduction

Ashley Boulter
Territory Manager – Canada

USP Technologies is the leading provider of full-service chemical treatment programs for municipal and industrial water and wastewater treatment applications

We offer the following solutions for municipalities:

Hydrogen Sulfide Control

- Collection Systems
- Headworks
- Primary Clarifiers
- Thickeners
- Digesters
- Dewatering

Plant Optimization

Starts in Collection System

- Phosphorus Management
- Struvite Control
- Enhanced Clarification
- Dewatering
- Biogas Production
- Supplemental D.O.
- Disinfection

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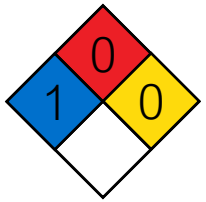
SulFeLox® Product Overview

Low-hazard buffered iron solution:

SulFeLox®	Calcium Nitrate	Magnesium Hydroxide
		

- Active Ingredient: Ferrous (Fe^{2+}) - 13%
- pH: 4 ±0.5 @20°C, 100.0% 1/10,000th acidity of standard $FeCl_2$
- Specific Gravity: 1.330 @ 20°C
- Density: 11.1 lbs/gal

- Equal performance to Ferrous Chloride ($FeCl_2$)
- Municipal applications show superior performance to Calcium Nitrate
  - 50 to 75% less product required for equal performance

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Why SulFeLox®?

Nitrates
↑ ORP
↑ N-Load

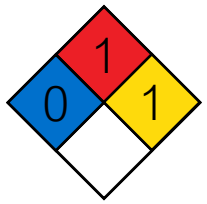
↓ Soluble BOD
↓ VFAs
↓ Sulfides
↓ Alkalinity

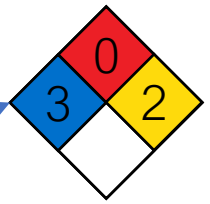
Mag
↑ pH/alkalinity
↑ Struvite Formation
Dissolved Sulfide↑↓ (neutral)

Vapour H2S↓

Iron
↑ VFAs
↑ Regeneration Potential (w/ H2O2)

↓ ORP
↓ Sulfides





Wanted to provide a low hazard option with the benefits of iron

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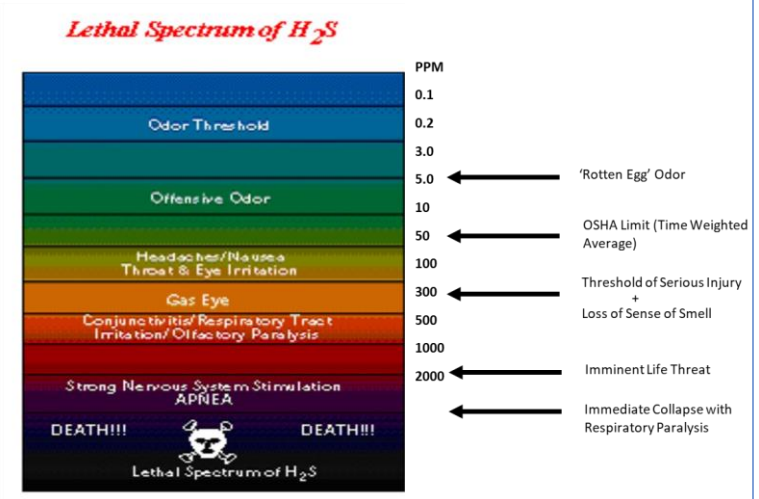
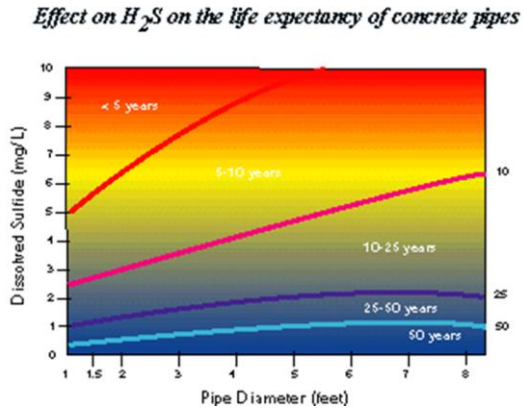
Disruptive Nature of H_2S

Toxicity Spectrum (Safety and Odour)



- Nuisance odours = community dissatisfaction
- High H_2S levels = worker safety concerns with potentially fatal consequences

Corrosion and Infrastructure Damage



- Shortened infrastructure life
  - Pipe and manholes corrosion
- Increased service and maintenance costs
  - Line repairs
  - Line break cleanup
  - Pump station corrosion

Plant Process Disruptions

- Increased primary settling costs
- Increased polymer demand
- BNR Interference
- Lower cake solids / higher solids disposal costs
- Digester fouling and inefficiency
- Increased plant operating costs (aeration, power costs)

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SulFeLox® Benefits

Equal performance to $FeCl_2$ w/o pH suppression	Ideal for hazard sensitive dose sites	Complimentary to WWTP processes
Less H_2S volatilization & improved FeS binding efficiency	Lower hazard level than calcium nitrate	Carbon (VFA) preservation
Superior durational control	Lower volumes = less deliveries	Positioned to leverage PRI-TECH® applications
Available for PRI-SC® regeneration and downstream H_2S control		Headworks and plant wide (biosolids) odour and corrosion control
		Improve P-removal
		Struvite control
		Improve dewatering / reduce disposal costs

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USP's SulFeLox®

Use: Precipitates sulfide

Equal performance to $FeCl_2$ w/o pH suppression

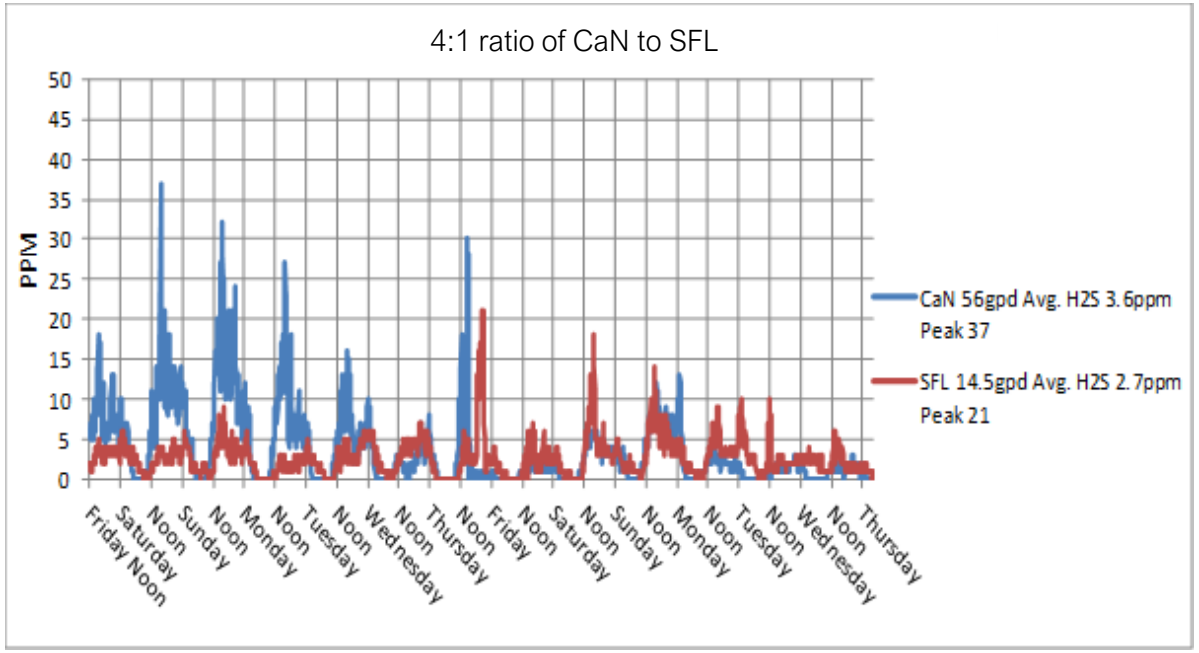
- Less H_2S volatilization & improved FeS binding efficiency
- Superior durational control
- Available for downstream PRI-SC® regeneration and H_2S control

Ideal for hazard sensitive dose sites

- Similar hazard level to calcium nitrate
- Lower feed rates = fewer deliveries

Complementary to WWTP processes

- Promotes carbon (VFA) production for Biological Nutrient Removal processes
- Enables in-plant PRI-TECH® applications
- Enhances plant-wide solids separation and odour/ corrosion control
- Improves P-removal (and struvite control)
- Improves dewatering efficiency and reduces disposal costs



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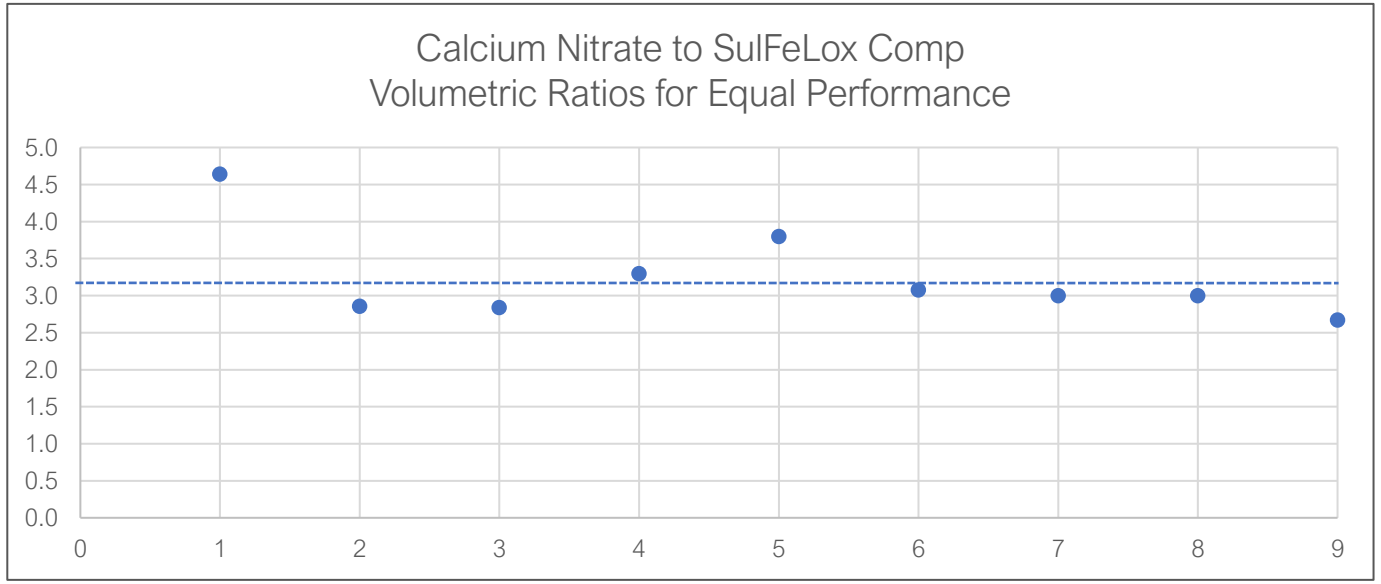
Best Fit Applications – Collection Systems

- Why collection systems?
  - Low hazard – Suitable for residential communities and commercial districts
  - Good replacement for CaN – use less chemical and require less frequent deliveries

SulFeLox® to Calcium Nitrate Replacement Ratios



Avg ratio: 3.2

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Best Fit Application – Eastern Municipal

Background:

- Project site in Southern Cal is treated with 50 gpd of Calcium Nitrate.
- Line is small and customer is looking for savings preferably with a low hazard class product (though allowed testing of standard $FeCl_2$).
- All options provide good control, but FeCl2 and SulFeLox® require <50% of dose rate.

	Avg	Peak	Est Gal/yr
Calcium Nitrate – 50 gpd	0.9 ppm	22 ppm	18,250
SulFeLox^{tm} – 23 gpd	1.3 ppm	9 ppm	8,400
Ferrous Chloride – 23 gpd	1.6 ppm	32 ppm	8,400

- 1.5 miles from Dose Pt

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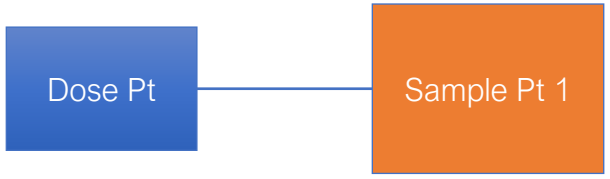
Best Fit Application – Henry County

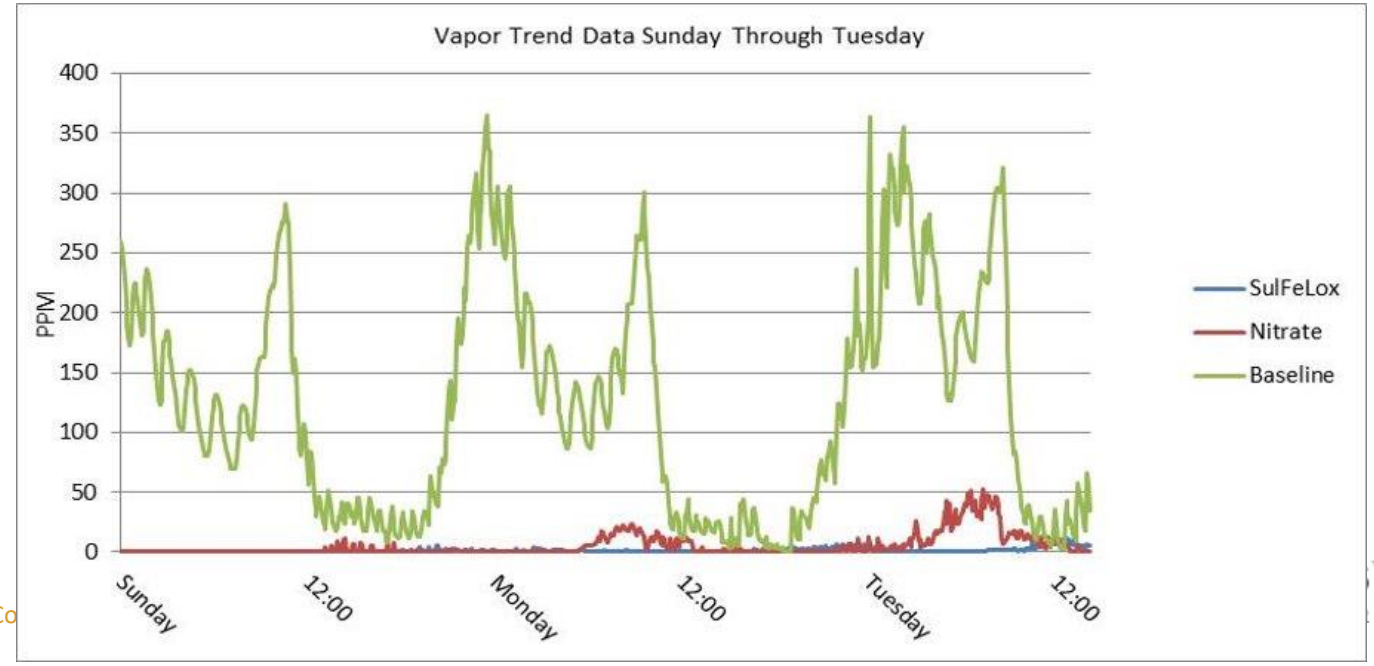
Background:

- Project site south of Atlanta, GA was untreated and USP tested SulFeLox® and Calcium Nitrate.
- Site experienced very high H2S at FM discharge resulting in dangerous H2S levels (>590 ppm), odour complaints and severe corrosion.
- SulFeLox® provided better performance at 1/3 dose of nitrate.

	Avg	Peak	Est Gal/yr
Baseline (no treatment)	93 ppm	590 ppm	n/a
SulFeLox® – 10 gpd	1 ppm	12 ppm	3,600
Calcium Nitrate – 30 gpd	5 ppm	52 ppm	10,800
Re-baseline (post testing)	112 ppm	365 ppm	n/a



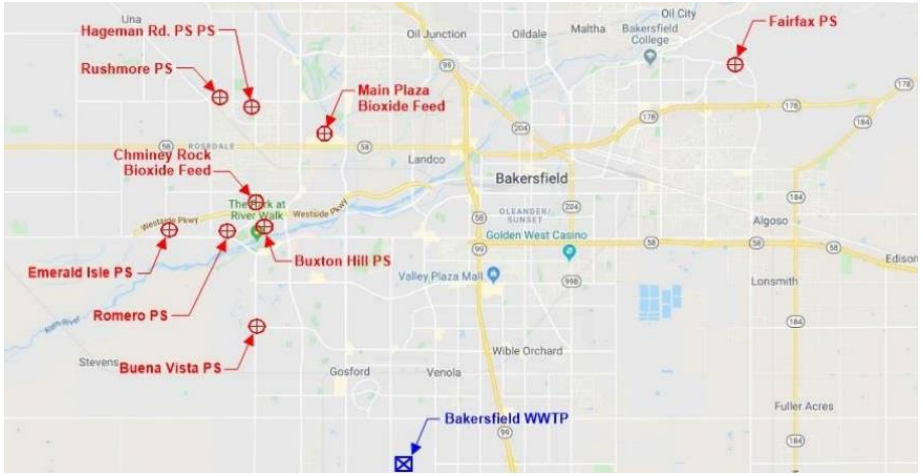
- <100k gpd
- 8 – 18 hrs retention time



Case Study 3: City of Bakersfield

Background: Nitrate Program & Odour Control Study

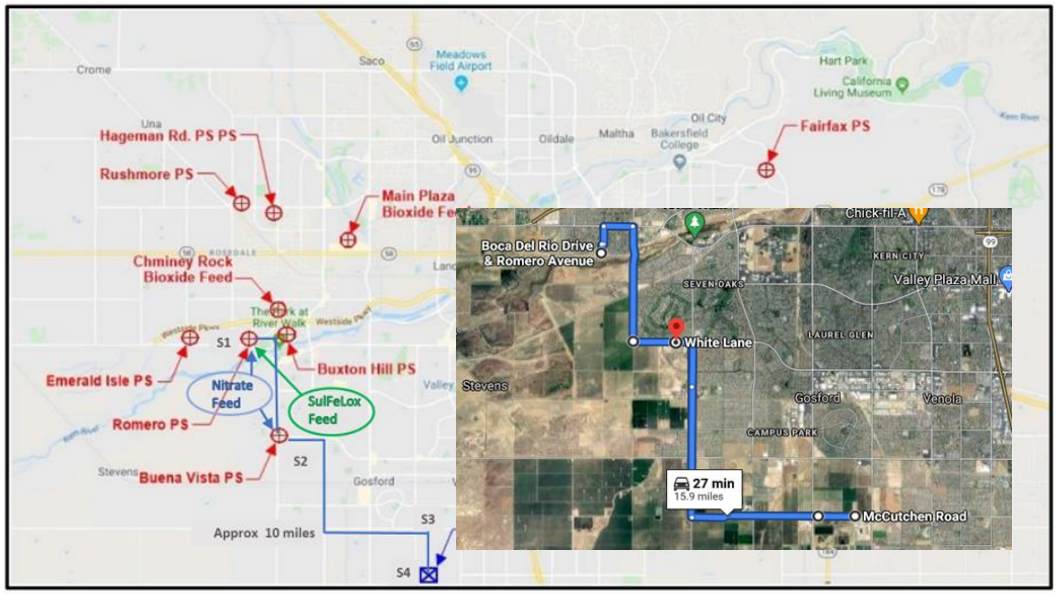
- Existing program with 9 CN sites
- Buxton Hill Line controlled to 50 ppm H2S peaks
- Buena Vista line not well controlled with 140 ppm average, peaks to 500 ppm
- Significant odour complaints from Buena Vista PS and surrounding areas



Carollo Study:

- City currently spends $1M/yr on Calcium Nitrate ($600K/yr Buxton Hill Line, $400K/yr BV)
- Recommended $FeCl_2$ 340 GPD between two sites on Buxton Hill Line in lieu of 554 GPD of CN
- No recommendation on BV line due to lack of available data on flows
- Projected overall savings of $355k/yr by switching program to iron (based on 2019 pricing)

Bakersfield Cont.



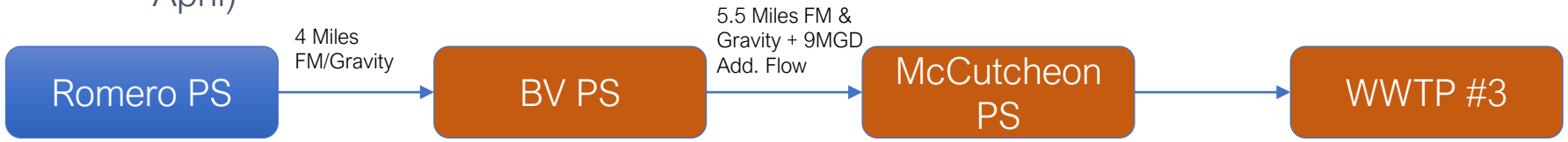
- City decided that resolving odour complaints at BV was priority
- Attempted to control with calcium nitrate but were unable.
- Highest attempted CN dose was 336 GPD total at three sites (Rushmore, Romero, Buena Vista) achieved 80 ppm avg H2S with peaks to 300 ppm H2S at BV
- Estimated CN demand for to adequately control at BV PS was >500 GPD
- Significant nitrate volume to Romero PS to prioritize BV odours proved ineffective, and City reverted to 140 GPD dose while seeking alternative solution
- Decided to trial SulFeLox® at Romero PS, to begin spring 2021
- Study goal was target of <25 ppm H2S avg, peaks <50 ppm

Bakersfield Results

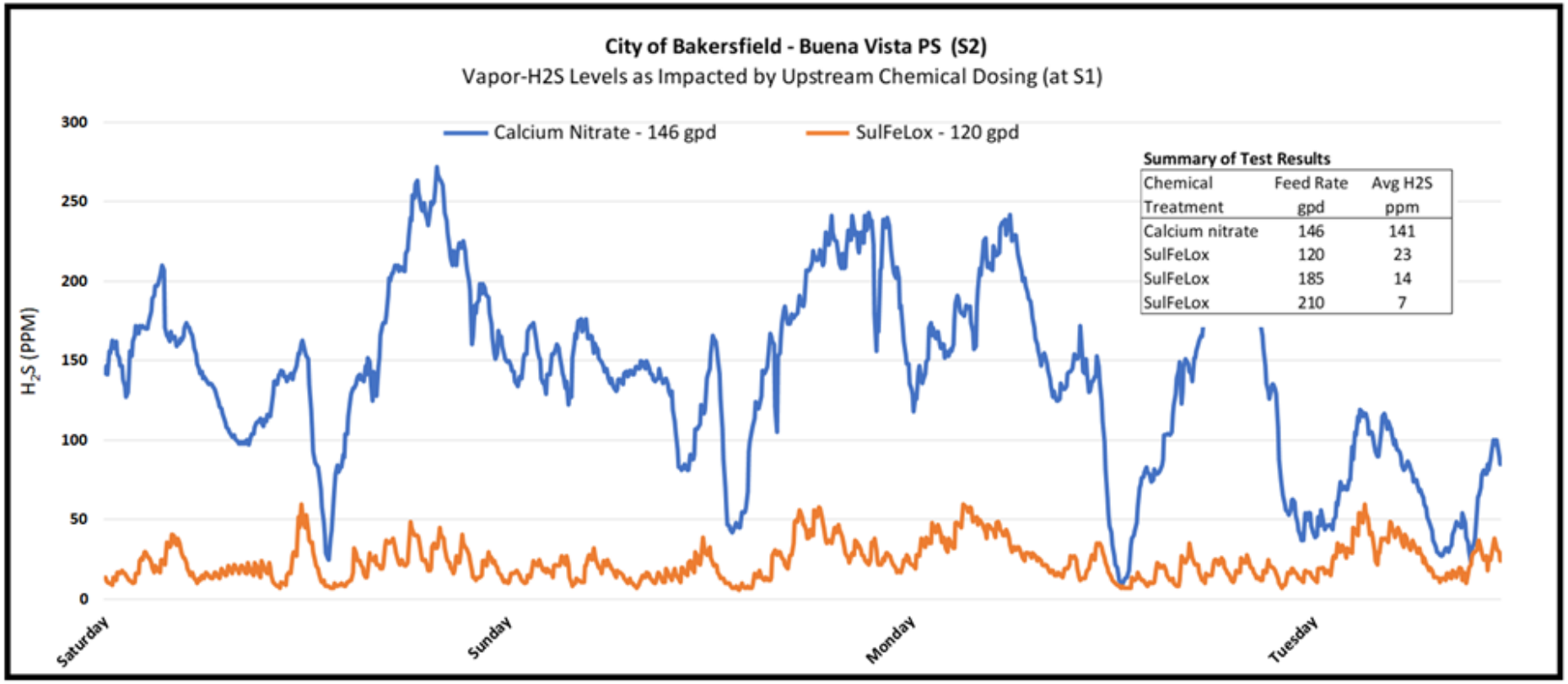
Romero PS to Buena Vista PS

	Daily Feed GPD	Water Temp. Deg. F	Peak Vapor H_2S PPM	Daily Average Vapor H_2S PPM	Daily Average Vapor H_2S % Reduction
Calcium Nitrate (April 8 - 20 , 2021)	146	77	457	146	0%
SulFeLox™ (April 20 - May 16 , 2021)	130	79	74	25	83%
SulFeLox™ (May 18 - 21, 2021)	195	79	65	17	88%
SulFeLox™ (May 22 - June 8, 2021)	210	82	31	7.3	95%
SulFeLox™ (June 9 - June 15, 2021)	130	92	52	14	90%
SulFeLox™ (June 15 - June 21 , 2021)	100	92	72	25	83%
No Chemical (June 21 - June 28, 2021)	0	92	307	136	
No Chemical (June 29 - July 7, 2021)	0	92	645	195	

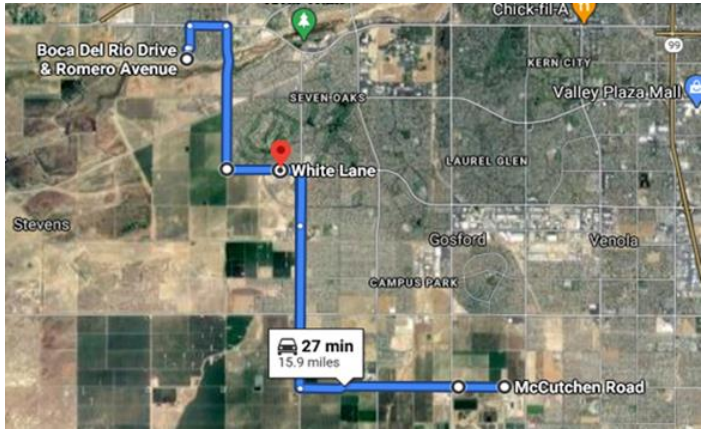
- H_2S reduced by 83% as compared to nitrate at budget-managed dose rates
- Estimated nitrate to achieve <10 ppm H_2S 550 – 600 gpd vs 210 gpd SulFeLox™
- Downstream H_2S reduced from average 750 ppm to 250 ppm
- Line conditioning played significant role in reducing overall SFL demand
- Lasting conditioning effect (untreated June performance > nitrate performance in April)



Bakersfield: Buena Vista PS



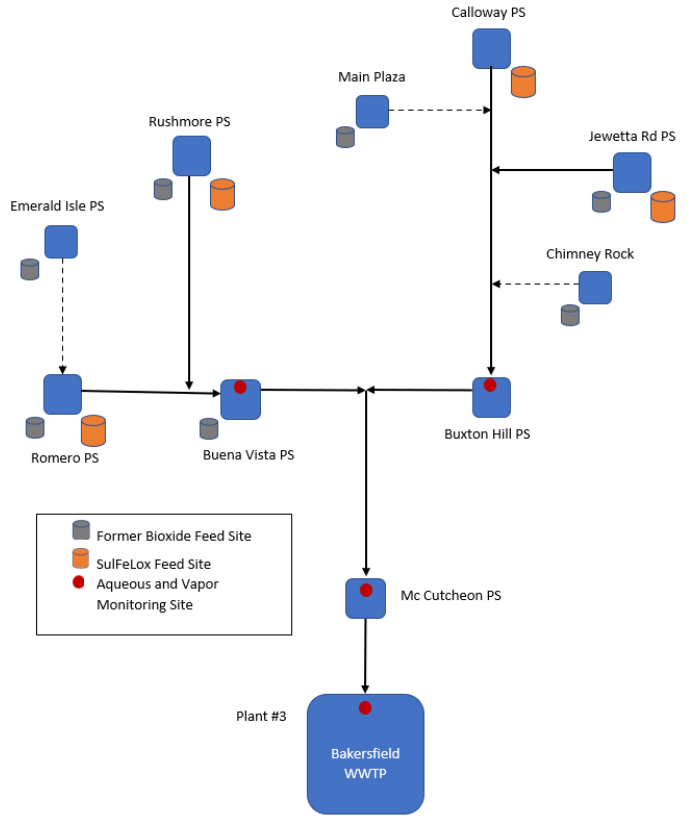
Bakersfield: Downstream Impact



- McCutcheon PS downstream with 12.5 MGD additional flow (4X BV Flow)
- Steady downtrend in H2S at McCutcheon due to biofilm imbedded Fe and Fe solids inventory building
- Gradual trend reversal with cessation of Fe feed

Conclusion

- Demonstration completed June 21, 2021
- Calcium Nitrate program at Romero PS restarted July 2021
  could not meet 25 ppm performance target
- City requested a full system survey and proposal for SulFeLox®
- Full-scale SulFeLox® program delivered March 2022 with implementation at 4 sites
  - Romero PS (120 GPD)
  - Rushmore PS (50 GPD)
  - Jewetta PS (120 GPD)
  - Calloway/Main Plaza (180 GPD)
- **Final implementation eliminated 5 nitrate feed sites**
- Overall program savings of >$300K/yr vs Calcium Nitrate (33%)



What else can be done with SulFeLox®?

Supercharge SulFeLox® through different technologies

- Regenerate with PRI-TECH® in collections for headworks benefits
- Natural aeration to extend beneficial use
- Forced aeration to prevent magnetite fouling
- Use with alkaline to improve efficiency

Thank You

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