

# Norwalk Tank Farm Update

Presented to the Norwalk Tank Farm  
Restoration Advisory Board

On behalf of KMEP

February 9, 2012



# Presentation Overview

- KMEP Update
  - Remediation Operations Update
  - TBA Treatment System Update
  - Additional Assessment Update
  - Five -Year Action Plan Progress Report



# Remediation Operations Update

- Objectives
  - Contaminant Mass Containment
  - Contaminant Mass Removal
- South-Central and Southeast Areas
  - Soil Vapor Extraction (SVE) System
  - Groundwater Extraction (GWE) System
  - Total Fluids Extraction (TFE) System
    - Free product
    - Groundwater
- West Site Barrier
  - Groundwater Extraction
    - Discontinued August 2008
    - Shut-down based on low concentrations of MTBE and 1,2-DCA
    - Currently monitoring TBA and other constituents



# Remediation Systems

- South-Central Area
  - 18 TFE wells (product and groundwater)
  - 24 onsite and 6 off-site SVE wells (most collocated with TFE wells)
  - 2 GWE Wells
- Southeastern Area (24-inch Block Valve Area)
  - 3 TFE wells (GMW-O-15, GMW-O-18, GMW-36)
  - 2 offsite SVE wells (both collocated with TFE wells)
  - 2 GWE Wells
- Treatment and Discharge
  - SVE Vapors
    - Treatment – Thermal catalytic oxidizer (catox)
    - Discharge – Atmosphere under SCAQMD Permit
  - TFE Liquids – Oil/Water Separator
    - Oil/Water Separator – Free product recycled offsite
    - Groundwater Treatment – Liquid-phase GAC
    - Groundwater Discharge – Coyote Creek under NPDES permit



# Remediation Systems

- Operations & Maintenance Activities
  - Weekly Inspection and Maintenance
  - Weekly Data Collection
    - Vapor flow rate, vacuum, groundwater extraction rates, hours of operations, and other system parameters
  - Monthly Pump Inspections
  - Measurement of Individual Well Vapor Concentrations
  - Collection and Analysis of System Influent and Effluent Vapor and Groundwater Samples
  - Gauging of Select Remediation Wells

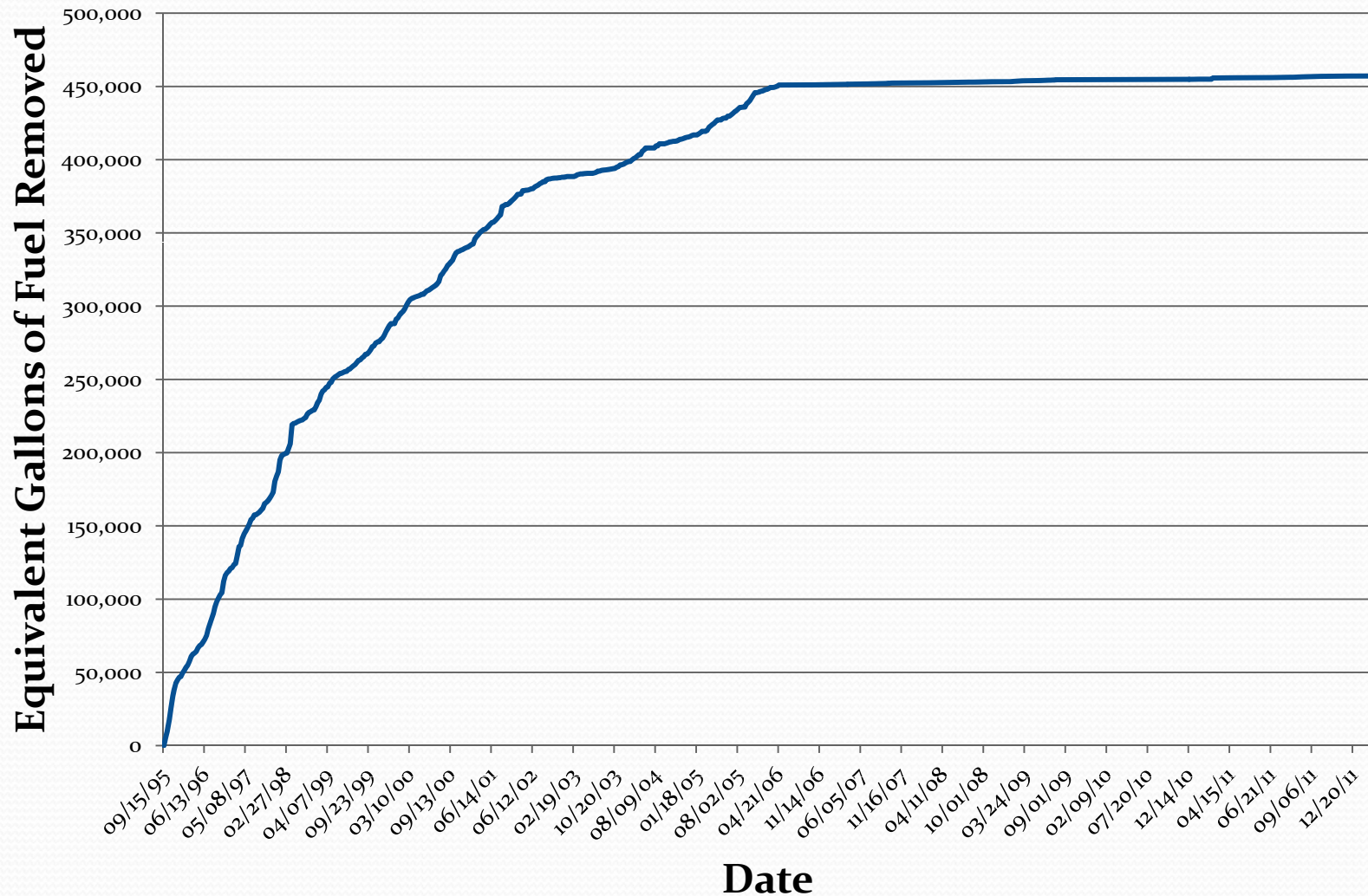
# SVE System Operations Summary

- Equivalent Fuel Treated

- Based on weekly monitoring of influent vapor concentration, vapor extraction flow rate, and hours of operation.
- Pounds / 6.6 lbs/gal = gallons
- 3<sup>rd</sup> Quarter 2011 – 929 gallons (6,132 pounds)
- 4<sup>th</sup> Quarter 2011 – 119 gallons (783 pounds)
- Since Second Addendum – 5,329 gallons (35,172 pounds)
- Since 1995 – Approx. 457,100 gallons (3 million pounds)

# SVE System Operations Summary

## Cumulative Fuel Removed by Vapor Extraction To Date





# TFE/GWE System Operations Summary

- Groundwater Extracted
  - 3<sup>rd</sup> Quarter 2011
    - South-Central and Southeast Areas – 1,965,084 gallons
    - West Side Barrier – none (shutdown in third quarter 2008)
  - 4th Quarter 2011
    - South-Central and Southeast Areas – 1,043,949 gallons
    - West Side Barrier – none (shutdown in third quarter 2008)
  - Since 1995
    - South-Central and Southeast Areas – 64.4 million gallons
    - West Side Barrier – 26.9 million gallons





# TFE/GWE System Operations Summary

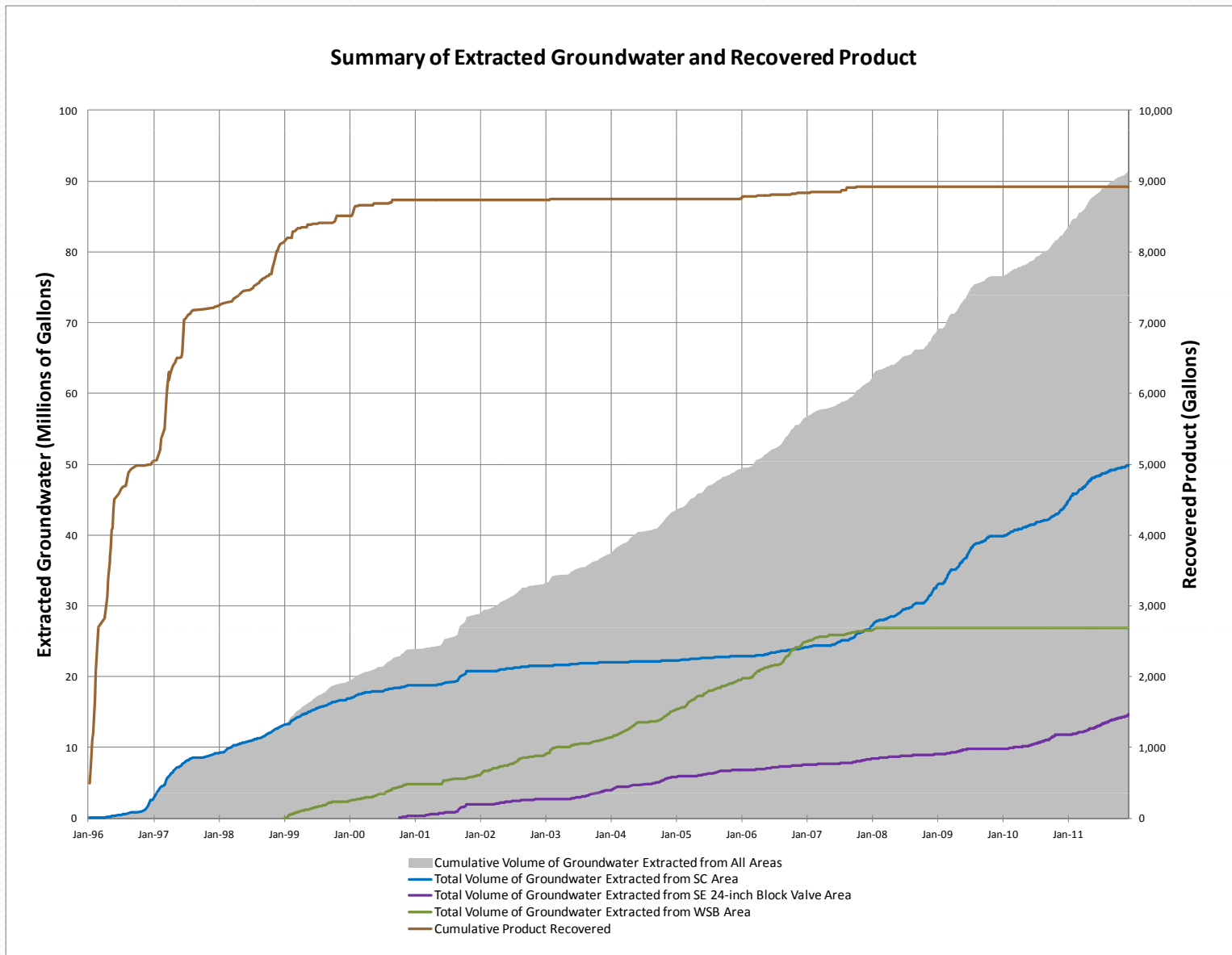
- Mass of TPH removed in Groundwater Extracted
  - 3<sup>rd</sup> Quarter 2011– 21 gallons (136 pounds)
  - 4<sup>th</sup> Quarter 2011– 7 gallons (44 pounds)
  - Since implementing Second Addendum
    - 242 gallons (1,599 pounds)



# TFE System Operations Summary

- Free Product Extracted
  - 3<sup>rd</sup> and 4<sup>th</sup> Quarter 2011
    - Free product has generally decreased since implementing the Second Addendum
    - Volume of free product recovered is small and emulsified
    - Free product not observed to accumulate in the product holding tank.
  - Free product not estimated for 3<sup>rd</sup> and 4<sup>th</sup> Quarter 2011
  - Since 1995 – 8,917 gallons

# TFE System Operations Summary





# Remediation System Operations Summary

- SVE System
  - 3<sup>rd</sup> Quarter 2011
    - Operated 76% of time
  - 4<sup>th</sup> Quarter 2011
    - Operated 20% of time
- TFE/GWE System
  - 3<sup>rd</sup> Quarter 2011
    - Operated 68% of time
  - 4<sup>th</sup> Quarter 2011
    - Operated 58% of time
    - Operated 67% of time (excluding planned shutdowns for groundwater monitoring)

# Remediation System Downtime

- SVE System
  - Groundwater monitoring activities
  - Routine maintenance activities
    - Drain water condensate from manifold
    - Facilitate carbon changeouts for GWTS
  - Recalibration of flow sensor
  - Cleaning of flame arrestor for SVE catalytic oxidizer
  - Replacement of ultraviolet (UV) flame sensor and Veri-flame controller
  - Tracing and repair of underground natural gas line that feeds SVE system
- TFE/GWE System
  - Groundwater monitoring activities
  - Carbon changeouts
  - High level alarms for transfer tank
    - Changed bag filters, cleaned bag filter housing
  - Clean oil water separator (OWS) and replaced OWS media
  - Plugging of polishing LGAC vessels due to formation of precipitates

# Remediation System Upgrades

- SVE System
  - Replacement and re-calibration of flow sensor
  - Replacement of UV flame sensor and Veri-flame controller
  - Provision of independent power source for digital chart recorder
  - Replacement of digital chart recorder hard drive
- TFE/GWE system
  - Installation of an automated notification system (autodialer) to inform technicians of a system shutdown.
  - Installation of a proportional controller at the influent to keep the influent flow similar to the influent flow to the TBA treatment system
  - Replacement of the temporary fluidized bed bioreactor (FBBR) with a new permanent FBBR
  - Replacement of the 8,000-gallon equalization tank with a 3,000-gallon equalization tank
  - Replacement of lead polishing LGAC vessel

# Preventative Maintenance

- Check pump operation – monthly
- Pump inspection/cleaning/maintenance - ongoing
- Bag filter replacements – weekly minimum
- Backwashing of lead carbon vessel
- Pre-catalyst back pressure monitoring – Weekly
  - Monitor for particulate buildup on catalyst cells
- Sampling between GAC vessels – bi-weekly
  - Monitor for breakthrough prior to last vessel
  - Carbon change outs on October 21 and 24; December 13, 2011



# Preventative Maintenance

- System-specific preventative maintenance schedule for each of the other components of the remediation system
  - South-central System
  - Southeastern System
- Example system-specific preventative maintenance activities
  - Check/inspect valves, blowers, chemical pumps, level switches, hoses, and catox flame arrestor
  - Clean filters (various types), flow sensors, valves, transfer pumps, and catox catalyst
  - Change oil and air filters in various equipment
  - Check/replace belts and hoses on various equipment
  - Maintain pneumatic pumps
  - Clean oil/water separator and sumps
  - Drain and/or pressure wash holding tanks

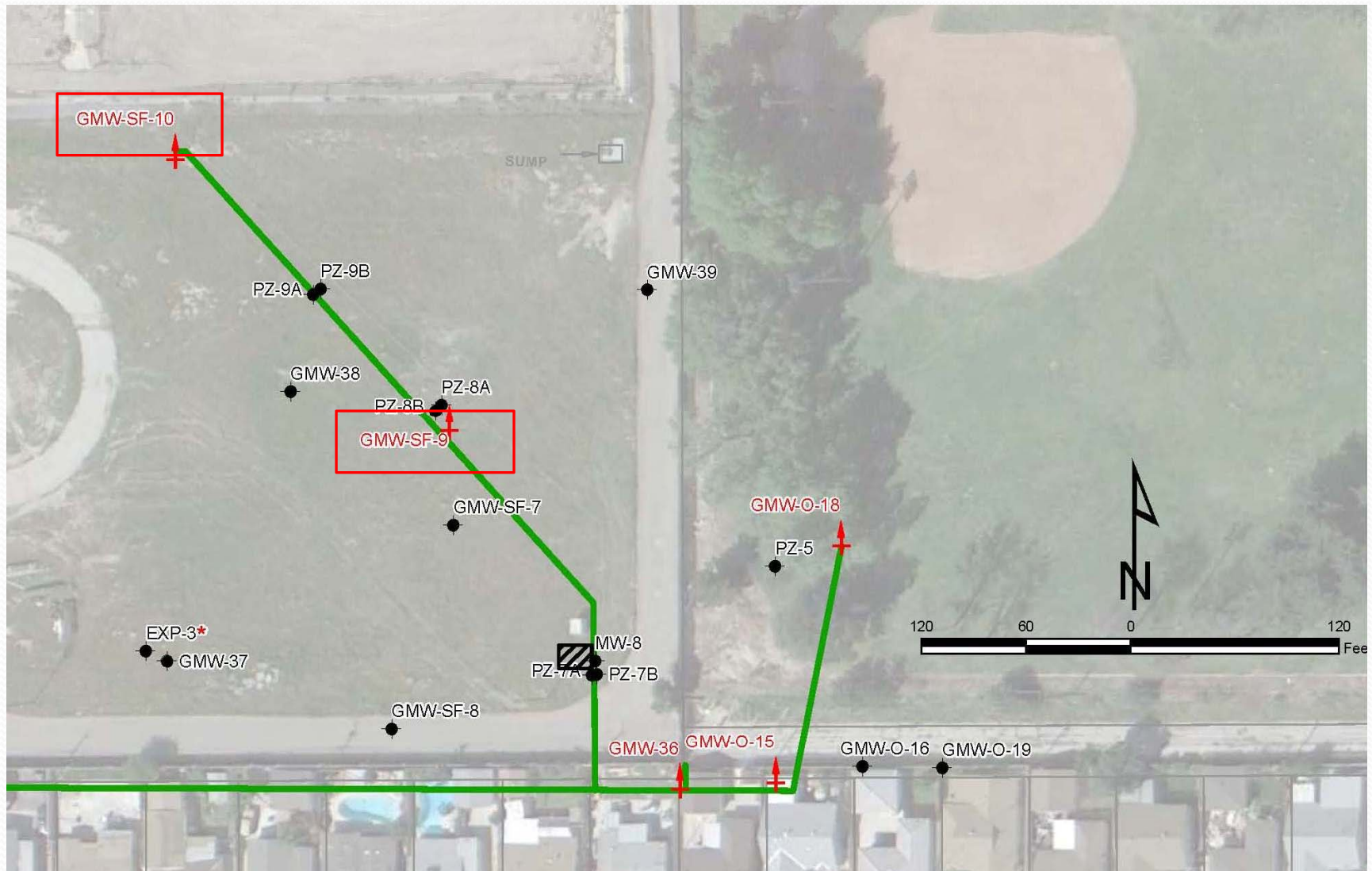




# Planned Remediation Activities

- Continue focusing remedial efforts on South-central and Southeastern areas
  - Continue operating TFE, GWE, and SVE systems
  - Continue system maintenance, inspections, and data collection on weekly basis
  - TBA treatment
- Monitor concentrations of 1,2-DCA, MTBE, and TBA in western area and restart WSB if necessary
- Complete repairs to southeastern area onsite conveyance piping and initiate extraction from wells GMW-SF-9 and GMW-SF-10

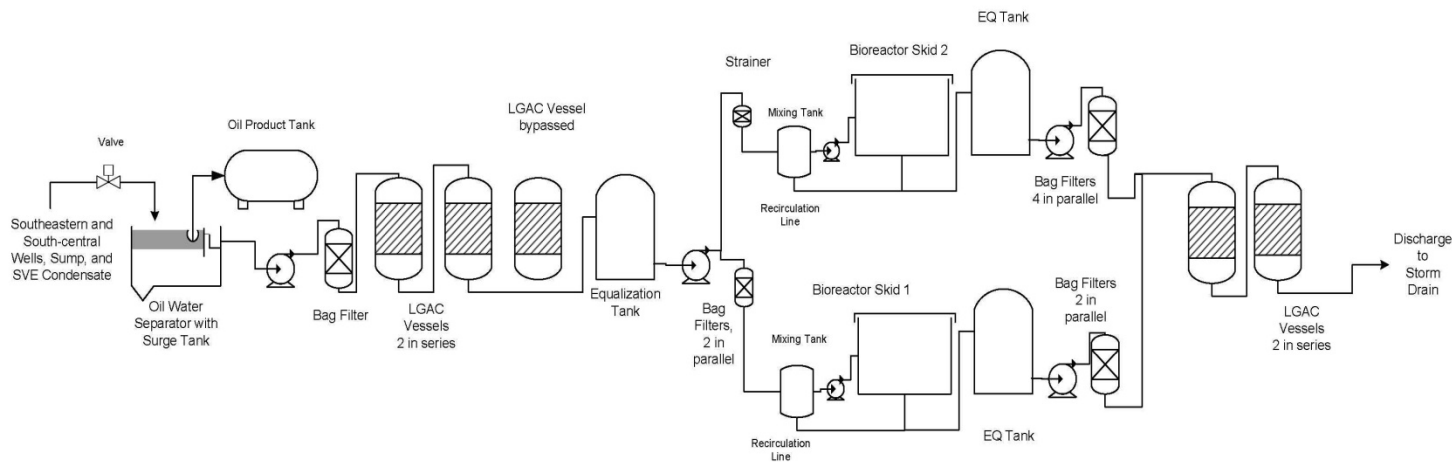
# GMW-SF-9 and GMW-SF-10



# TBA Treatment System

- Installed in 2011 to address TBA added to new NPDES permit that was finalized in June 2011
- Working as planned
  - TBA not above NPDES discharge limit (12 ug/L)
  - Reducing carbon usage in upstream (main) LGAC vessels
  - Formation of carbonate precipitates has been plugging polishing LGAC vessels
    - Adjusting pH in bioreactors and effluent stream has reduced formation of precipitates and extends life of carbon

**Figure 3**  
**Process Flow Diagram**  
SFPP Groundwater and Product Extration System for the  
South-central and Southeastern Wells  
SFPP Norwalk Pump Station – Norwalk, California



TBA Treatment System was described during the August 2011 RAB Meeting



# Additional Assessments

- Southeastern 24-Inch Block Valve Area
  - Field investigation complete in January 2011
  - Results presented in August 11, 2011 RAB and document in report prepared by CH<sub>2</sub>M HILL (CH<sub>2</sub>M HILL, August 2011)
- South-Central Residential Area Vapor Study (pending access)
  - Access agreement being finalized with one property owner
  - Field investigation expected to be complete next quarter
- Vertical Assessment of LNAPL in Soil
  - Field investigation complete in October 2011
  - Results documented in report prepared by CH<sub>2</sub>M HILL (CH<sub>2</sub>M HILL, February 2012)



# Vertical Assessment of LNAPL in Soil

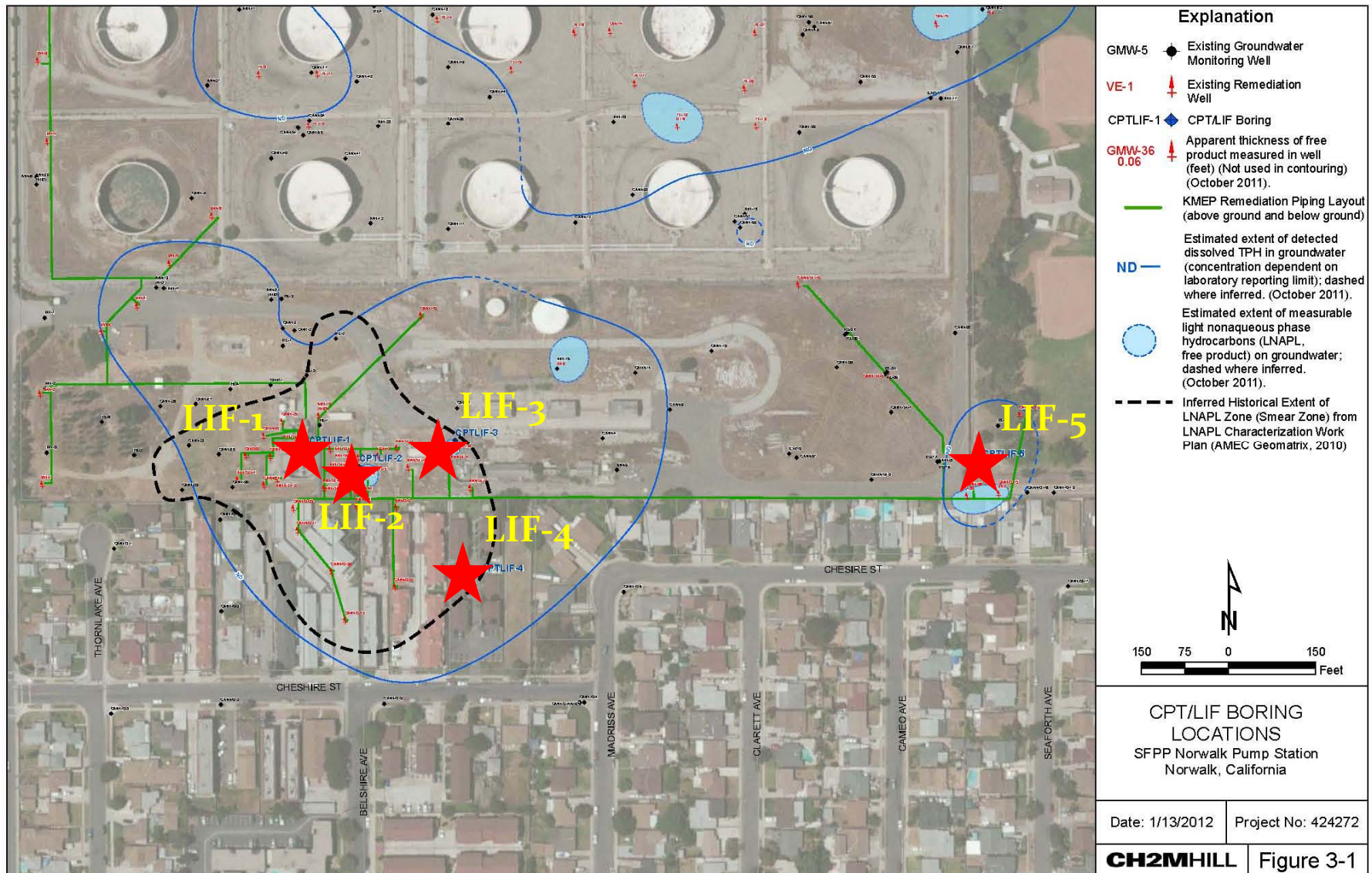
- Objectives

- Further evaluate the vertical distribution of LNAPL in the uppermost groundwater zone in the south-central and southeastern areas
- Evaluate the lithology of the uppermost groundwater zone where LNAPL occurs, and confirm the presence of the underlying Bellflower aquitard
- Obtain additional information on the chemical composition of LNAPL and adsorbed-phase residual hydrocarbons and fuel constituents present at the assessment locations
- Evaluate LNAPL distribution and mobility

# Vertical Assessment of LNAPL in Soil

- Approach
  - Collect LNAPL samples from two wells
    - South-central area and southeastern area
  - Apply samples to LIF tool to assess responsiveness
    - Laser-induced fluorescence (LIF), Ultraviolet Optical Screening Tool (UVOST by Dakota Technologies, Inc.)
  - Advance a paired cone penetrometer testing/laser-induced fluorescence (CPT/LIF) tool via direct-push
    - Five locations into the top of the Bellflower aquitard
    - CPT – Assess lithology
    - LIF – Assess vertical LNAPL distribution

# Vertical Assessment of LNAPL in Soil



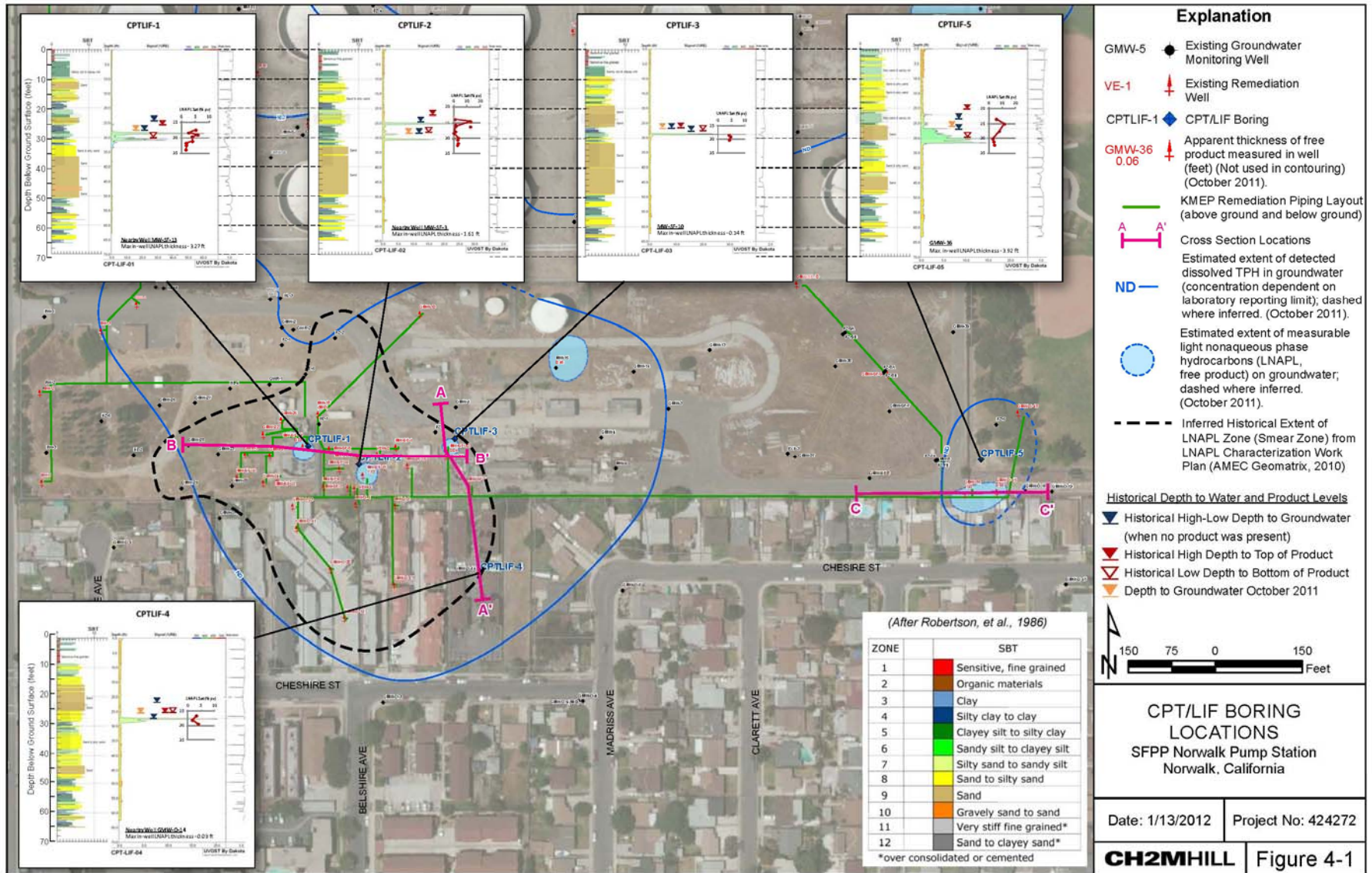
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# Vertical Assessment of LNAPL in Soil

- Approach (Cont'd)
  - Collect soil samples at two depths within the LNAPL smear zone at the five CPT/LIF locations based on LIF responses
  - Collect soil samples at two locations at the top of the Bellflower aquitard (south-central area and southeastern area)
  - Analyze the 2 LNAPL samples and 12 soil samples at offsite lab
    - TPH and VOCs
  - Photograph intact soil cores collected across the LNAPL smear zone
    - White and ultraviolet (UV) light.
  - Analyze 26 soil core subsamples at offsite lab
    - Pore fluid (water and LNAPL) saturation (PFS)
  - Analyze 3 additional soil core subsamples for free product mobility
    - Based on LIF and PFS data
    - Centrifuge at three different pressures
      - 1psi, 5 psi, and 1,000 x gravity



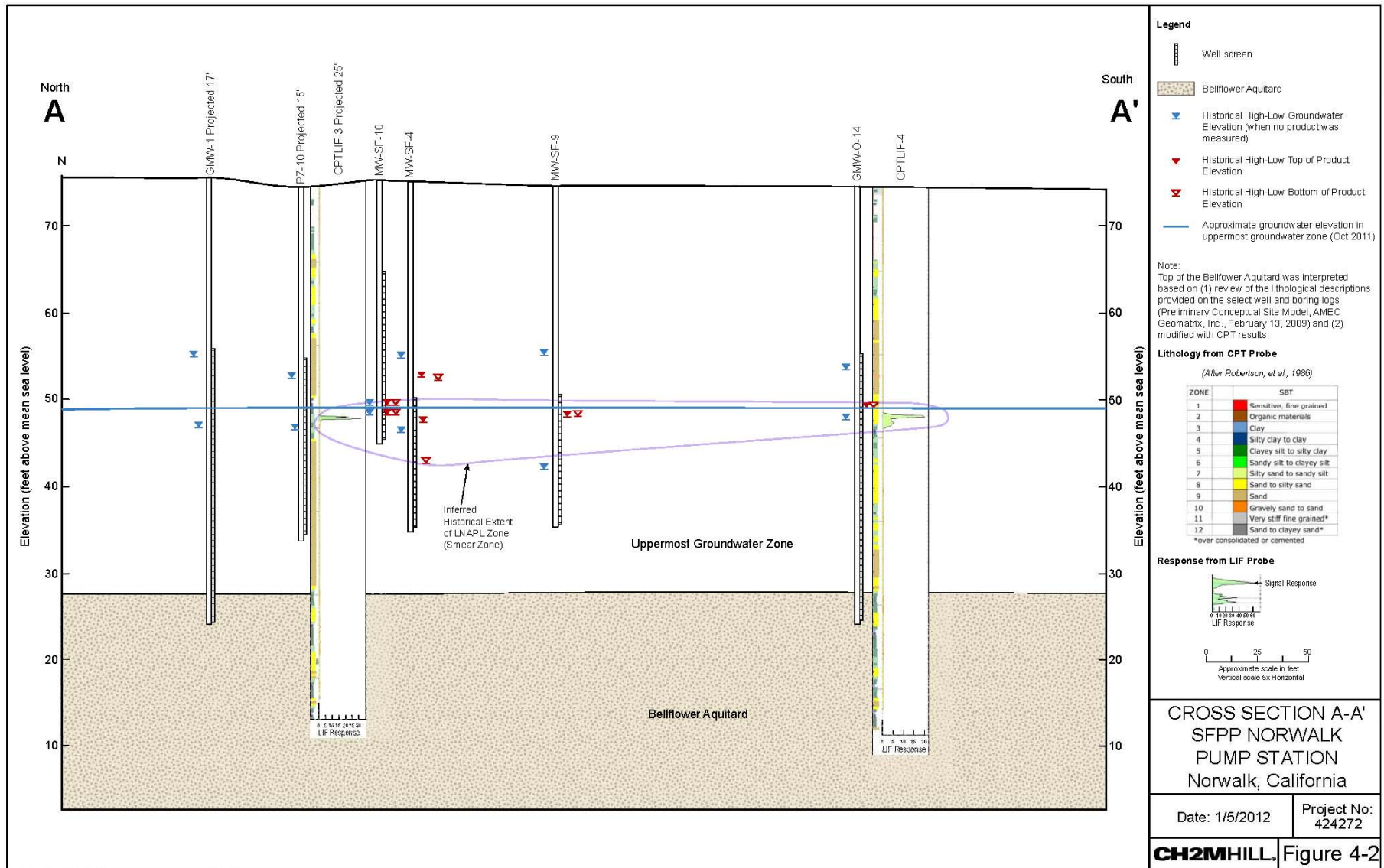
# Vertical Assessment of LNAPL in Soil



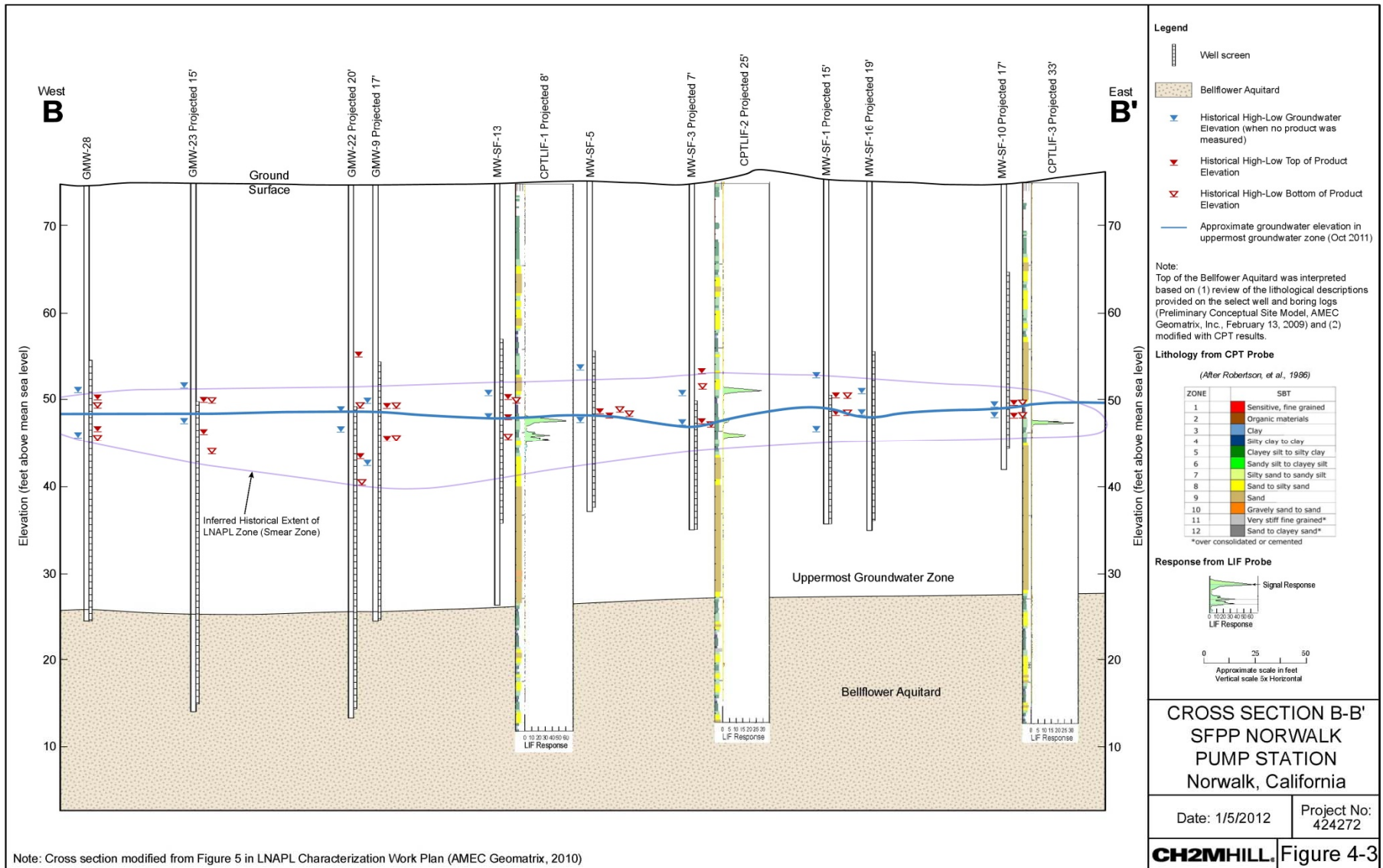
# Vertical Assessment of LNAPL in Soil

- Lithology
  - Uppermost groundwater zone is ~50 feet thick
    - Upper 30 feet more interbedded fine-grained and coarse-grained materials
    - Bottom 20 feet more uniformly coarse-grained
  - Bellflower aquitard was encountered at all five CPT/LIF locations
    - Fine-grained units (clays/silts) interbedded with coarser-grained materials (silty sand/clayey sand)
- Vertical Distribution of LNAPL
  - LNAPL smear zone
    - Occurs near recent October 2011 water table and capillary fringe
      - Depth to groundwater was approximately 25 to 28 feet bgs at the five locations
    - Does not occur in deeper part of the uppermost groundwater zone
    - Base corresponds roughly to the depth of the minimum groundwater and product levels observed at the site
  - Maximum smear zone thickness based on LIF data
    - 6.5 feet in the south-central area (CPTLIF-2 near well MW-SF-3)
    - 2 feet in the southern offsite area (CPT-LIF-4 near well GMW-O-14)
    - 10 feet in the southeastern area (CPTLIF-5 near GMW-36).
  - LIF waveforms from the two LNAPL samples
    - Gasoline and diesel ranges, consistent with LNAPL and soil sample analytical chemistry results

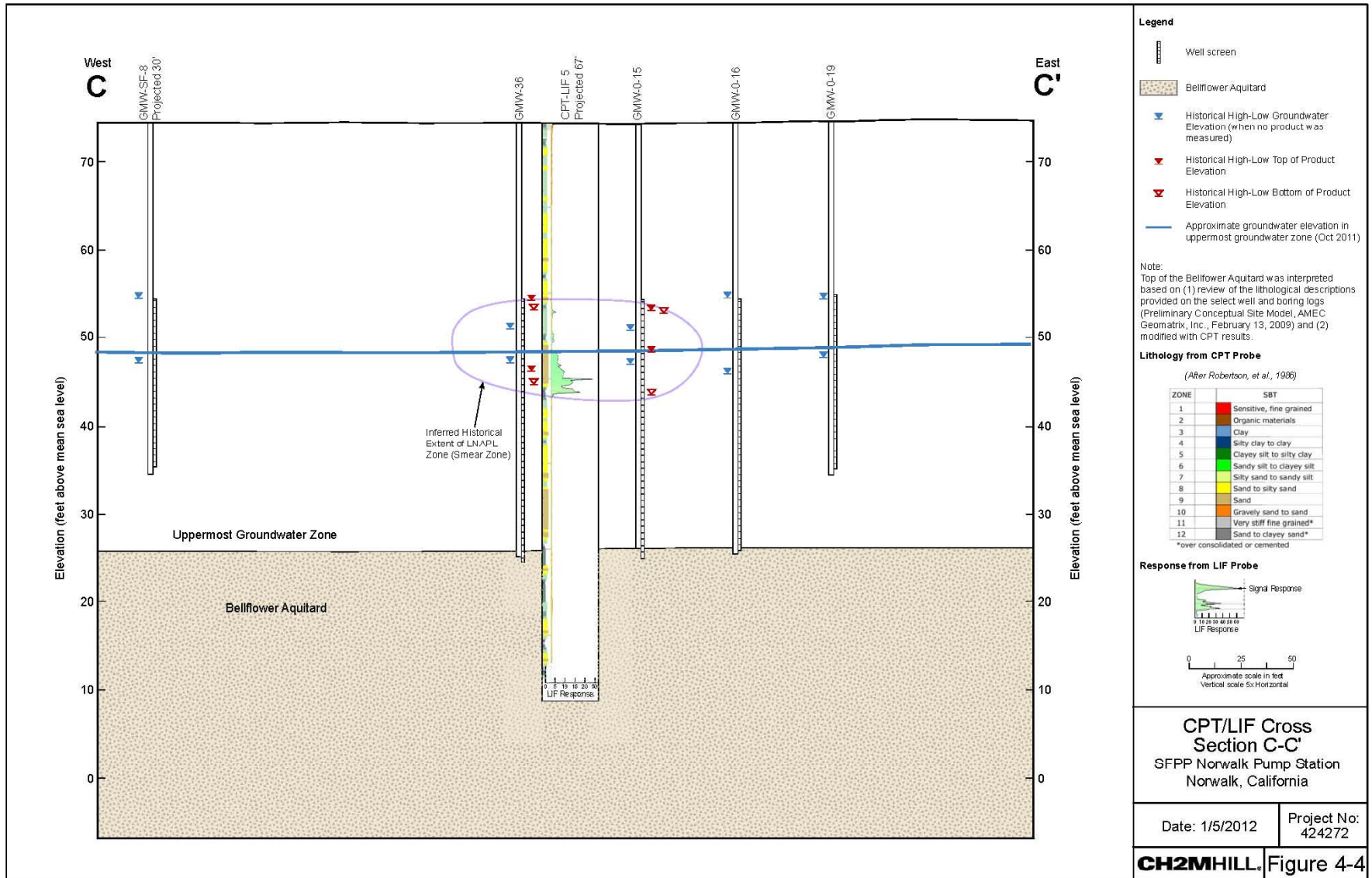
# Vertical Assessment of LNAPL in Soil



# Vertical Assessment of LNAPL in Soil



# Vertical Assessment of LNAPL in Soil



# Vertical Assessment of LNAPL in Soil

- LNAPL Chemistry
  - Included C<sub>4</sub> to C<sub>27</sub> hydrocarbons (gasoline/diesel range)
  - Hydrocarbons greater than C<sub>27</sub> were not detected (oil range)
  - TPH-g and TPH-fp detected at over 100,000 mg/kg in both LNAPL samples
  - BTEX concentrations were detected in both LNAPL samples at high concentrations
  - MTBE, TBA, DIPE, TAME, and ETBE were not detected above laboratory reporting limits in either LNAPL sample (may be due to the elevated laboratory detection limits)
- Soil Chemistry – Uppermost Groundwater Zone (LNAPL Smear Zone)
  - Included primarily C<sub>4</sub> to C<sub>23</sub> hydrocarbons (gasoline/diesel range)
  - Oil range hydrocarbons were not detected at CPTLIF-5
  - TPH-g, TPH-fp, and BTEX detected in most samples
  - MTBE detected in approximately half the samples at both areas
  - TBA and ETBE not detected in any samples
  - DIPE and TAME detected in one or two samples
- Soil Chemistry – Top of Bellflower Aquitard
  - Very low concentrations of hydrocarbons that is either adsorbed or dissolved in groundwater occurs in the top of the Bellflower aquitard
  - TPH-g, TPH-fp, ethylbenzene, total xylenes, TBA, DIPE, ETBE, and TAME were nondetect
  - Benzene (0.01 mg/kg) and toluene (0.02 mg/kg) were detected in the CPTLIF-5 aquitard sample, but not in the CPTLIF-2 aquitard sample
  - MTBE was detected in both Bellflower aquitard samples at concentrations ranging from 0.016 to 0.018 mg/kg

# Vertical Assessment of LNAPL in Soil

- LNAPL Saturation

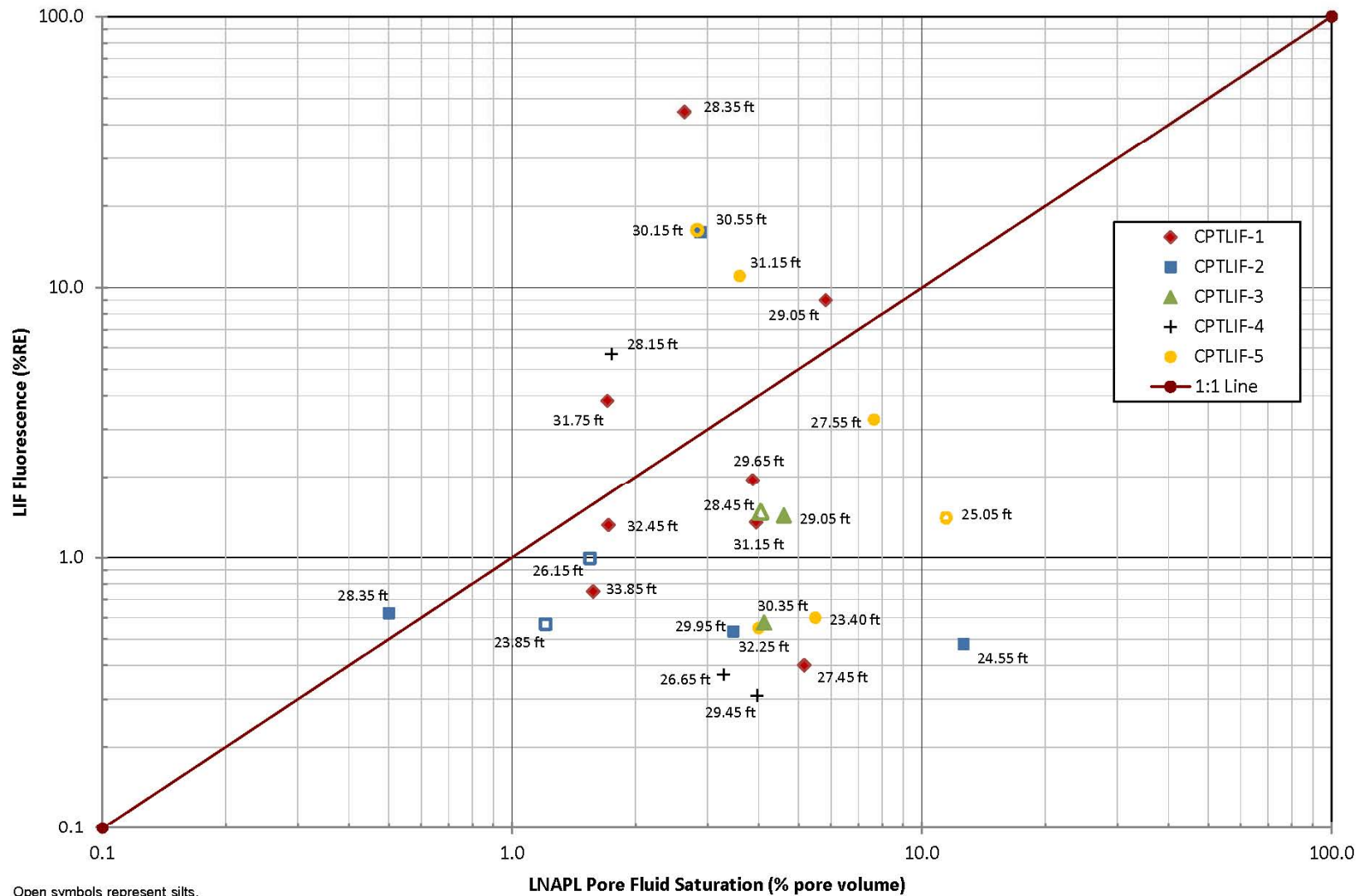
- Maximum LNAPL saturation

- South-central area = 12.6 %PV (CPTLIF-2\* at 24.55 feet bgs, fine sand)
- Southeastern area was = 11.4 %PV (CPTLIF-5 at 25.05 feet bgs, silt)

- Correlation between LIF UV fluorescence and LNAPL saturations

- General trend where higher LNAPL saturation (%PV) correlate with higher UV fluorescence (%RE)
- Not a clear arithmetic correlation between the two sets of data.

# Vertical Assessment of LNAPL in Soil



Open symbols represent silts.  
 Solid symbols represent fine sand or soil that did not undergo sieve analysis.



# Vertical Assessment of LNAPL in Soil

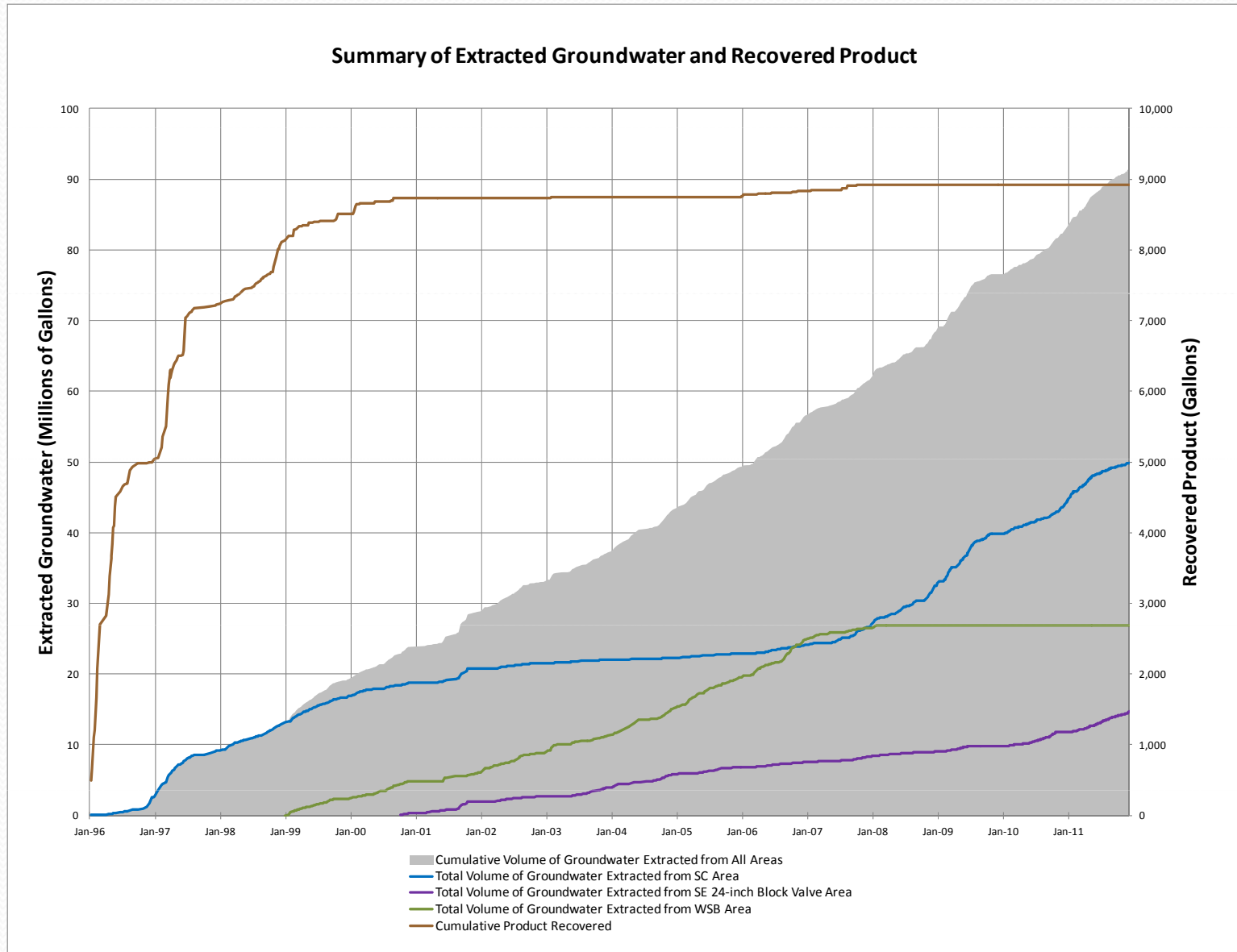
- LNAPL Mobility

- LNAPL saturations measured before and after centrifuging the three samples evaluated for LNAPL mobility at 1 psi, 5 psi, and 1,000xG were identical or nearly identical, indicating that the LNAPL is not mobile or relatively immobile.
  - CPTLIF-2 at 24.40 feet bgs (fine sand) – LNAPL saturations were the same (3.2 %PV) before and after each of the three centrifuge tests.
  - CPTLIF-5 at 25.20 feet bgs (silt) – LNAPL saturations were the same (5.5 %PV) before and after each of the three centrifuge tests.
  - CPTLIF-5 at 27.70 feet bgs (fine sand) – LNAPL saturations were the same (4.2 %PV) before and after the 1 psi and 5 psi centrifuge tests, and decreased slightly after the 1,000xG test (from 4.3 to 4.1 %PV).

# Vertical Assessment of LNAPL in Soil

- LNAPL Mobility (Cont'd)
  - The lack of LNAPL mobility indicates that the remaining LNAPL is primarily at residual saturation and not recoverable using the TFE technology that is currently implemented at the south-central and southeastern areas. This is supported by the lack of measurable LNAPL recovered since 2007.
  - The volume of LNAPL recovered since 1995 from the south-central and southeastern areas is 8,917 gallons; and most of this free product was recovered prior to 2000 when several feet of LNAPL was present in groundwater monitoring and remediation wells

# Vertical Assessment of LNAPL in Soil



# Vertical Assessment of LNAPL in Soil

- LNAPL Mobility (Cont'd)
  - Although LNAPL mobility at the site is low as indicated by the PFS testing, there may be additional free product that can be recovered given the ongoing presence of LNAPL in well MW-SF-15 in the south-central area and wells GMW-36 and GMW-O-15 in the southeastern area.
  - In 2011, LNAPL thicknesses ranged from:
    - 1.1 to 1.4 feet in well MW-SF-15
    - 1.4 to 1.9 feet in well GMW-36
    - 0.02 to 0.57 feet in well GMW-O-15.



# Five-Year Action Plan Progress Report

- Second Addendum to Remedial Action Plan
  - Submitted – November 2006
  - Approved – April 2007
  - Remediation system enhancements
    - Expanded the SVE and TFE system into onsite areas where residual LNAPL appeared to remain
  - 5-Year Schedule to Submitting Closure Request
  - August 2012
- Update provided in February 19, 2010 Letter to RAB
  - Revised Schedule to Submitting Closure Request
  - September 2013
- Remediation System Effectiveness Evaluation provided in Report by AMEC (May 14, 2010)

# Five-Year Action Plan Progress Report

Status	Task	Date Completed or Projected	Second RAP Addendum
Completed	Receive Approval from RWQCB	April 2007	December 2006
	Begin Remediation System Expansion	May 2007	--
	Begin Upgrades to Groundwater Treatment System	August 2007	--
	Complete Remediation System Improvements	December 2007	February 2007
	Full-Scale Remediation Startup	January 2008	--
	Begin SVE Rebound Testing	December 2008	August 2008
	Submit First Annual Remediation Progress Report	January 2009	February 2008
	Submit Second Annual Remediation Progress Report	January 2010	--
	Complete SVE Rebound Testing	As conditions allow	February 2009
	Submit Third Annual Remediation Progress Report	January 2011	--
	Submit Fourth Annual Remediation Progress Report	January 2012	--
	Future	Begin Bioventing Operation	After free product removal
Begin Bioventing Rebound Testing		TBD	December 2009
Begin Verification Groundwater Monitoring		January 2010 (ongoing)	June 2010
Complete Bioventing Testing		TBD	June 2010
Submit Fifth Annual Remediation Progress Report		January 2013	--
Complete Verification Groundwater Monitoring		When cleanup objectives are met	June 2010
Submit Closure Request to RWQCB		When cleanup objectives are met	August 2012



Questions?