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Regulatory Negotiations: Case Study for the Remedy Development and Selections to Treat Large Complex Groundwater Plumes

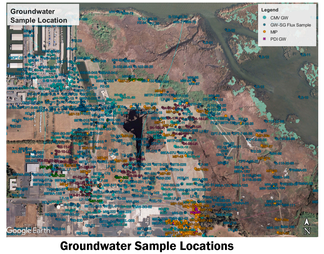
Overview

Background

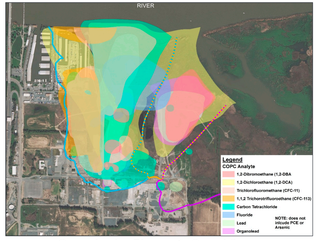
- Former chemical plant operational in California from 1956 to 1999
- Groundwater primary constituents of potential concern (COPCs), including carbon tetrachloride, tetrachloroethene, 1,2-dichloroethane, plus others
- Groundwater plumes up to 2,000 feet–Three aquifer units to 110 feet deep
- Groundwater plumes interface with a river and wetlands
- Site groundwater poor quality and not used for drinking water

Environmental History: 30 years of Site Investigations

- Site investigations since mid-1980's. Since 2003, under a corrective action consent agreement with Department of Toxic Substance Control (DTSC)
- Lots of data: Since 1990, 1,000 groundwater sample locations, over 15,000 groundwater samples, with 413,000 analytical results, in addition to MIP



Groundwater Sample Locations



Groundwater Plumes 1, 2, and 3

Objectives

Site Remedy Selection Under Regulatory Oversight

- Return site to productive use in a cost-effective manner. Likely technically impractical to meet drinking water standards in reasonable timeframes.
- Meet EPA 2020 deadline for remedies to be in place.
- Develop a systematic way to reasonably address regulatory requirements.

Key Questions to Answer

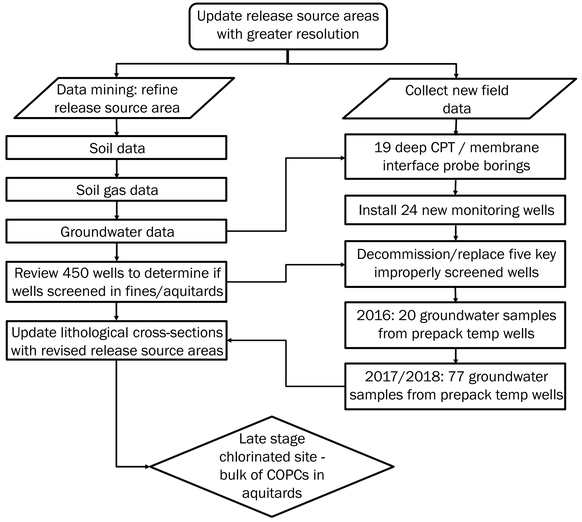
- Update conceptual site model (CSM) – what are COPC primary source areas?
- Can remedies focus on source areas versus dilute groundwater plumes?
- What is a reasonable remedial timeframe?
- Are groundwater plumes discharging to river or wetlands – if so, is there an unacceptable impact?
- Based on work by Tom Sale (ITRC 2011, 2015), can site be evaluated as a "Late Stage" chlorinated solvent site where COPC mass has been flushed out of aquifers, with the bulk of the remaining COPC mass to remedy slowly back-diffusing from fine-grained aquitards into aquifers?

Approach

- Use CSM as basis to refine COPC release source areas, evaluate data gaps, exposure pathways, and the selection of the groundwater plume remedies protective of human health and the environment
- Use EPA RCRA Facilities Investigation Remedy Selection Track (FIRST) principles as guidance to fast-track regulatory negotiations, although the site is not a designated RCRA FIRST facility
- Site owner voluntarily set tone and agenda to fast-track a comprehensive update to CSM as the basis to complete the RCRA Groundwater Corrective Measures Study with regulator buy-in up front
  - Established an aggressive one-year timeline to conduct many data gap investigations, technology demonstration field studies, and advanced data analysis steps
  - Commitment from stakeholders to meet aggressive deadlines. Abbreviated turn-around times to provide comments and responses between meetings.
  - Presentations and extended interactive team meetings versus formal reports to review CSM data gaps, present findings, and establish next steps
  - Meetings attended by all stakeholder decision makers

Analysis and Results

Updating the Conceptual Site Model



Show COPCs Don't Unacceptably Impact Adjacent Surface Waters

- Annual surface water sampling over 12 years shows no detections greater than water quality objectives.
- Modeling to show (1) mass flux across plume transects and (2) mass discharge to an adjacent river

Analysis and Results

Reasonable Remedial Timeframes

- Mass attenuation estimates using Measurement of Mass Flux and Mass Discharge (ITRC 2010) and the Mass Flux Tool Kit (GSI 2011)
- Updated monitored natural attenuation timeframes
- REMChlor modeling to estimate timeframes to meet corrective action objectives relative to the level of remedial effort
- Visual presentation of trends graphs
- Mann-Kendall statistics

0%, 25%, 50%, and 75% Source Removal

Plume 1 REMChlor Modeling Results
Cleanup Years from 2017

Plume/ Aquifer/ COPC	Base-Case (years)	Darcy Velocity x 10 Sensitivity (years)	Darcy Velocity x 1/10 Sensitivity (years)	Natural Attenuation Rate x 2 Sensitivity (years)	Natural Attenuation Rate x 1/2 Sensitivity (years)	25% Fraction Source Mass Removed (years)	50% Fraction Source Mass Removed (years)	75% Fraction Source Area Removed (years)	Excluding Salt Zone 75% Source Removal (years)
P1 SA DCA	33	*	383	*	69	33	33	33	21
P1 SA CT	51 **	*	411	41 **	71 **	51 **	51 **	51 **	51 **
P1 SA CFC-11 (1981 release)	80	*	192	45	110	80	80	80	74
P1 SA CFC-113 (1981 release)	56	*	352	34	76	56	56	56	50
P1 UA DCA	53	*	137	53	53	53	51	47	25
P1 UA CT	< 50 **	*	396	< 50 **	< 50 **	< 50 **	< 50 **	< 50 **	< 50 **
P1 UA CFC-11	Complex commingled plumes cannot be modeled with REMChlor ***								
P1 UA CFC-113	Complex commingled plumes cannot be modeled with REMChlor ***								
P1 LA DCA	53	*	137	53	55	53	51	47	47
P1 LA CT	101	45	194	97	107	99	95	87	87
P1 LA CFC-11 (1981 release)	16	*	160	*	42	16	16	16	16
P1 LA CFC-113	Complex commingled plumes cannot be modeled with REMChlor ***								
P1 LA PCE	29	*	245	3	71	29	29	29	29

* Calibration dicteted assumption that source is depleted. With this assumption, CT WQO achieved in Surficial and Upper in 51 years and 19 years, respectively. However, professional judgment indicates timeframe would likely be longer due to back diffusion, etc.
** Even though we couldn't model CFCs in some aquifers given plume architecture and plume nuances, empirical data demonstrates CFC sources and plumes are attenuating (see next slide). Thus, expect timeframes for these CFCs to be ≤ other COPCs.

Conclusions

- Using and iteratively refining the CSM was a key tool to convey exposure pathways and to build objectives for evaluations and remedy selection.
- Strategy includes ongoing stakeholders discussion and negotiations to enhance communication and site progression vs. using formal reports / comments / response to comments process.
- Team negotiations were enhanced by using meetings and presentations attended by all regulator and site owner decision makers to establish common ground and address issues in real time.
- To maintain momentum it was important for the site owner to establish aggressive evaluation and reporting milestones and for stakeholders to commit to quickly review the work and provide comments.

Results

- By engaging in proactive interactive regulatory negotiations, the remedy selection process for complex groundwater plumes was completed in less than a year, with the corrective measures study was deemed technically complete by DTSC.
- The final selected corrective action were remedies protective of human health and the environment, that were cost-effective. Remedies combined excavation and in-situ groundwater treatments in focused COPC source areas in combination with MNA

BATTELLE 2018 CHLORINATED CONFERENCE | Michael H. Schulman | Daniel R. Griffiths, P.G. | James Schuetz, P.G. | Linda McGlochlin, C.H.G.