A Holistic Approach to Site Remediation:
A Decade of Integrated In Situ Remedies for Multiple AOCs in a Commercial Setting

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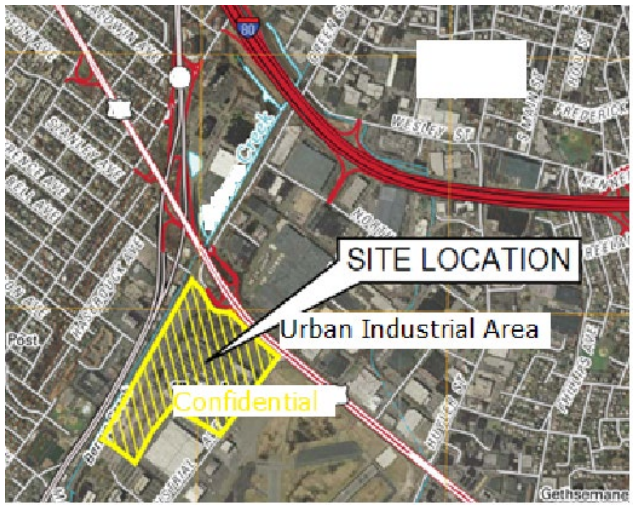
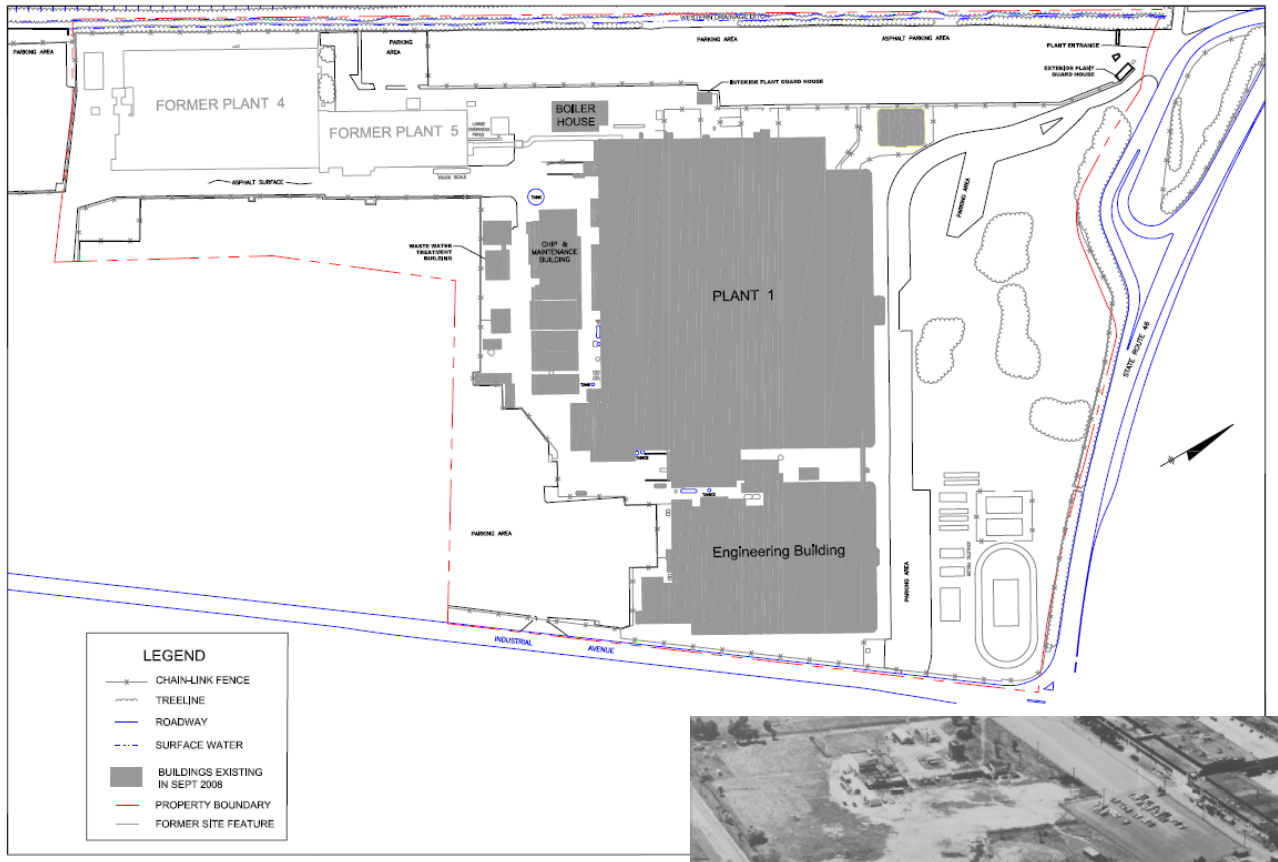
Ramboll USA

Site History

- 55-acre property used for industrial operations from 1938-2008
- Manufactured aircraft technology that supplied World War II and the nation's fledgling space race
- Operations included machining of metal parts, degreasing/cleaning, plating, painting, etc.
- Decades of industrial use had left the site's soil and groundwater with extensive and complex contamination, including TCE, PCE and Freon, in a varied clay formation





Program Overview

Site Purchased for Mixed Use Commercial Redevelopment in 2007, Industrial Operations Ceased in 2008

Cleanup Required under NJDEP's Industrial Site Recovery Act (ISRA) Program using a Licensed Site Remediation Professional (LSRP)

Multiple Areas of Concern, Including Chlorinated Solvent Source Zone (Soils and Groundwater Impacts), PCB Soils, and a 3,600 LF Drainage Ditch

Client goal: Remediate all Site Soils within 4-5 Year Period (Longer-Term Groundwater Mgmt.)

Redevelopment Aspects

- Industrial Buildings Demolition – roughly 1M square feet
- Import of over 400,000 CY of fill (floodplain mgmt.) across the site
- Site grading/drainage work and new subsurface utilities
- All orchestrated/sequenced with site remediation work

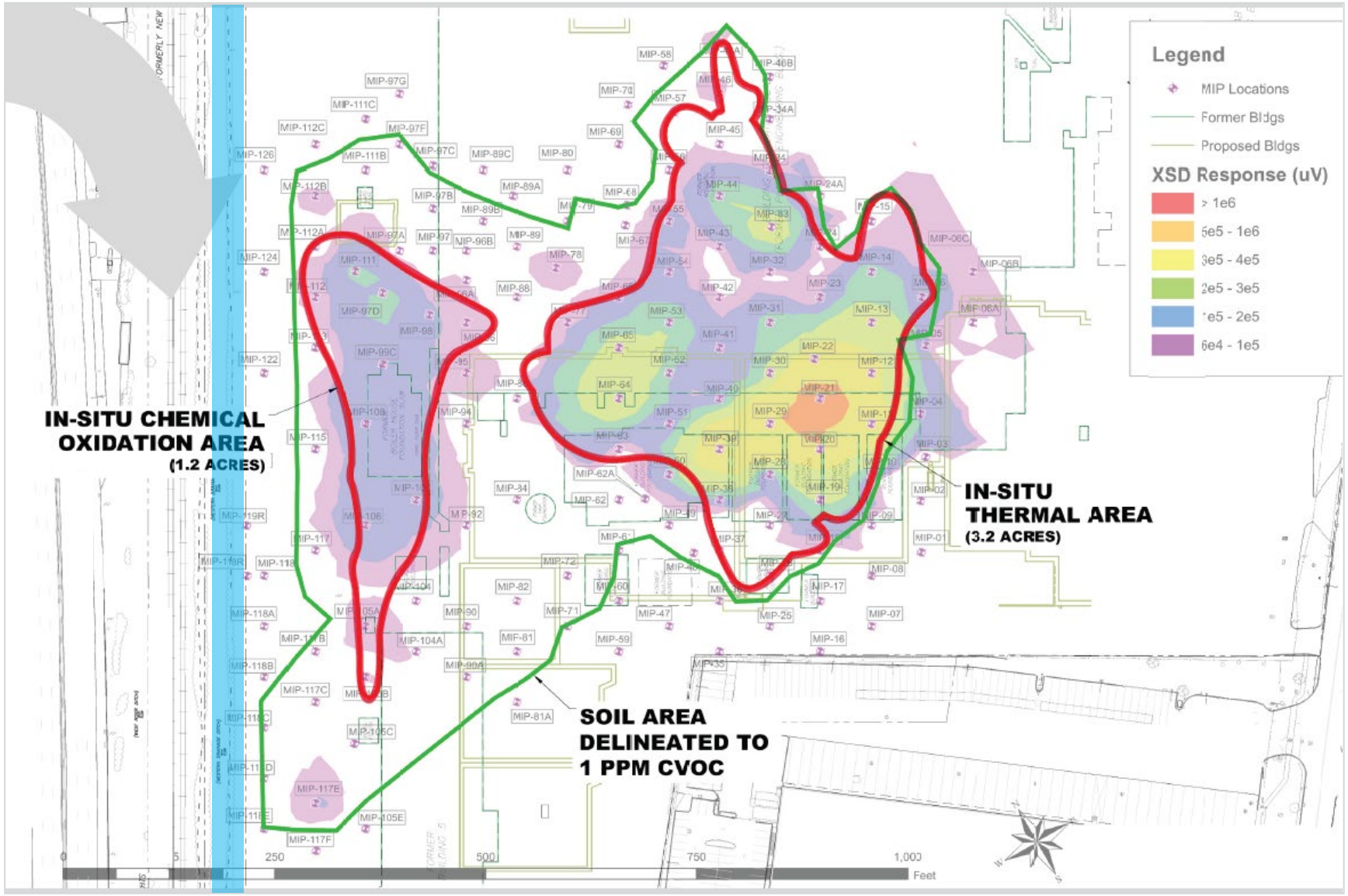
Remedial Investigation

Delineation completed in 3 months

10-acre area of soil impacts

“Primary” source area: 3.2 acres, 50,000 lb VOC mass (5-40 ft bgs)

“Secondary” source area: 1.2 acres, 1,000 lb VOCs (25-40 ft bgs)



Remedial Alternatives

Primary source area

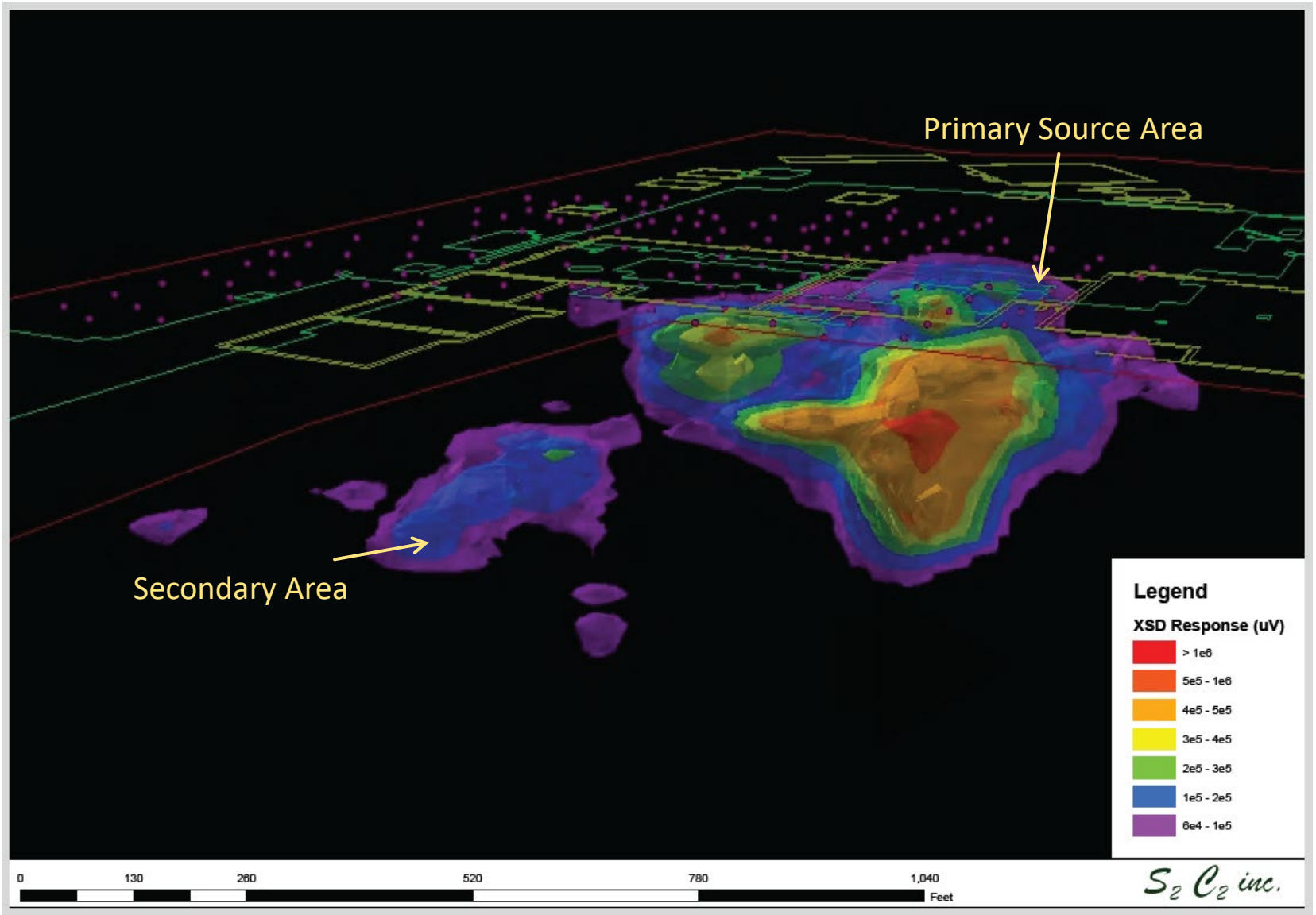
In-situ thermal remediation (ISTR) chosen, based on

- Large VOC mass (est. 50,000 lbs.)
- Tight clay matrix
- Implementation speed (2 years)

Secondary source area

In-situ chemical oxidation (ISCO) chosen, based on

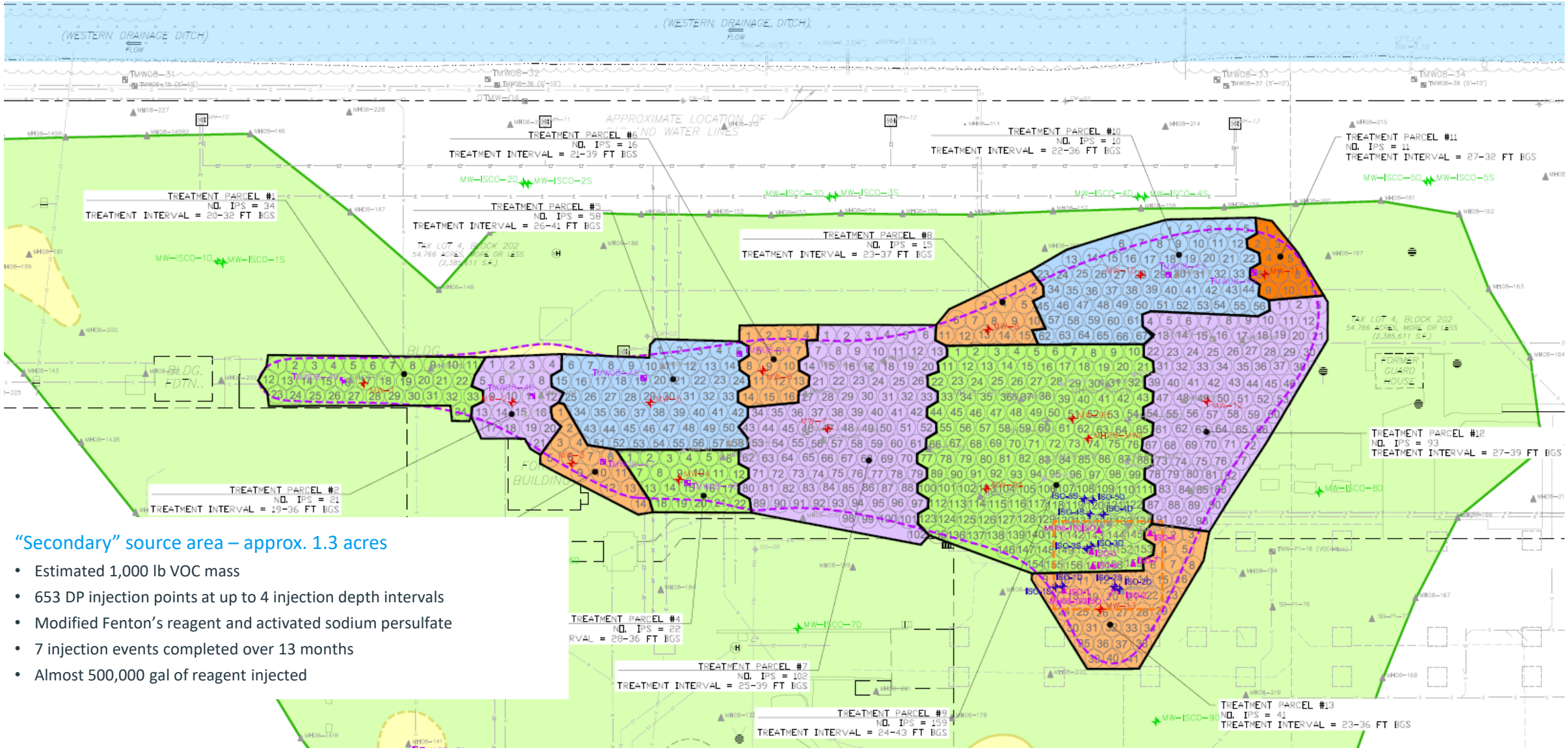
- Smaller VOC mass (est. 1,000 lbs.)
- Deeper location
- Implementation speed (12-18 months)



In-Situ Thermal Remediation

- 100,000 CY treatment zone (Approx. 3.5-acre Light-Weight Concrete Thermal Insulating Cap)
- 907 Heater Wells Ranging from 20-40 Feet in Depth
- 80 Temperature Monitoring Points, 25 Pressure Monitoring Points, 35 Multi-Phase Extraction Wells
- Over 35,000 pounds of VOC mass removal

In Situ Chemical Oxidation



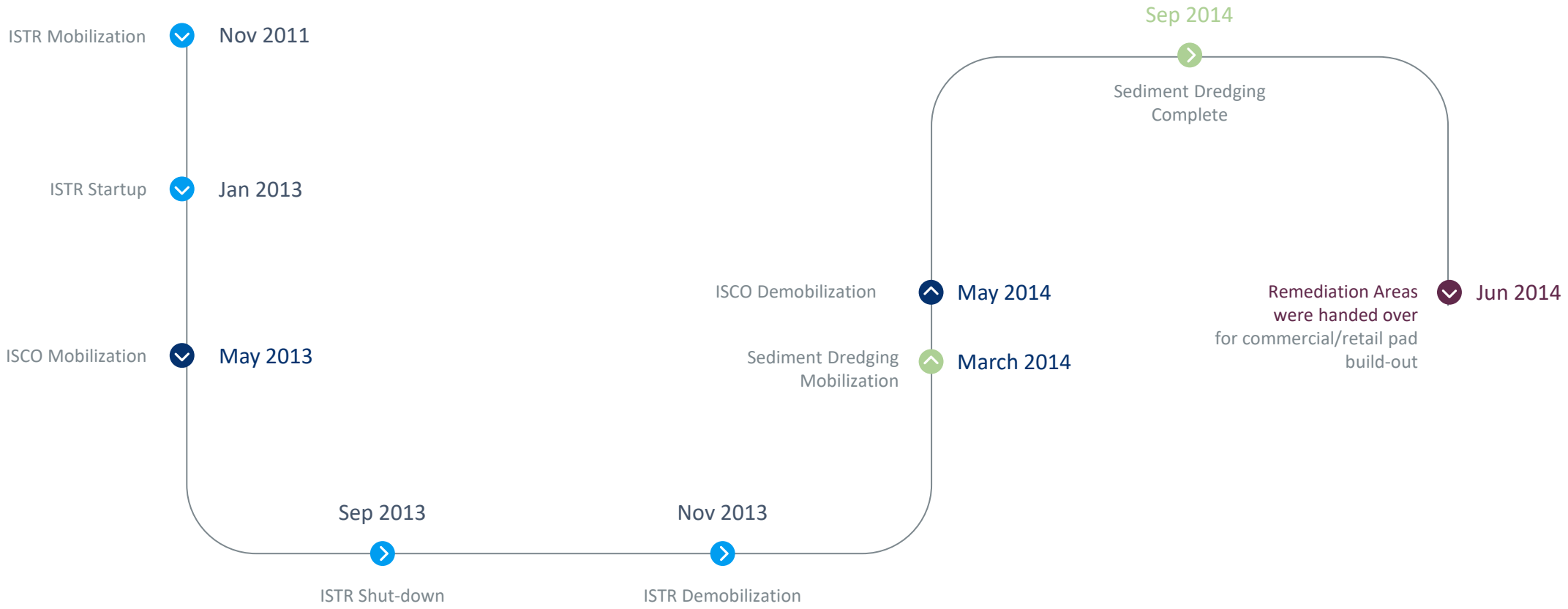
"Secondary" source area – approx. 1.3 acres

- Estimated 1,000 lb VOC mass
- 653 DP injection points at up to 4 injection depth intervals
- Modified Fenton's reagent and activated sodium persulfate
- 7 injection events completed over 13 months
- Almost 500,000 gal of reagent injected

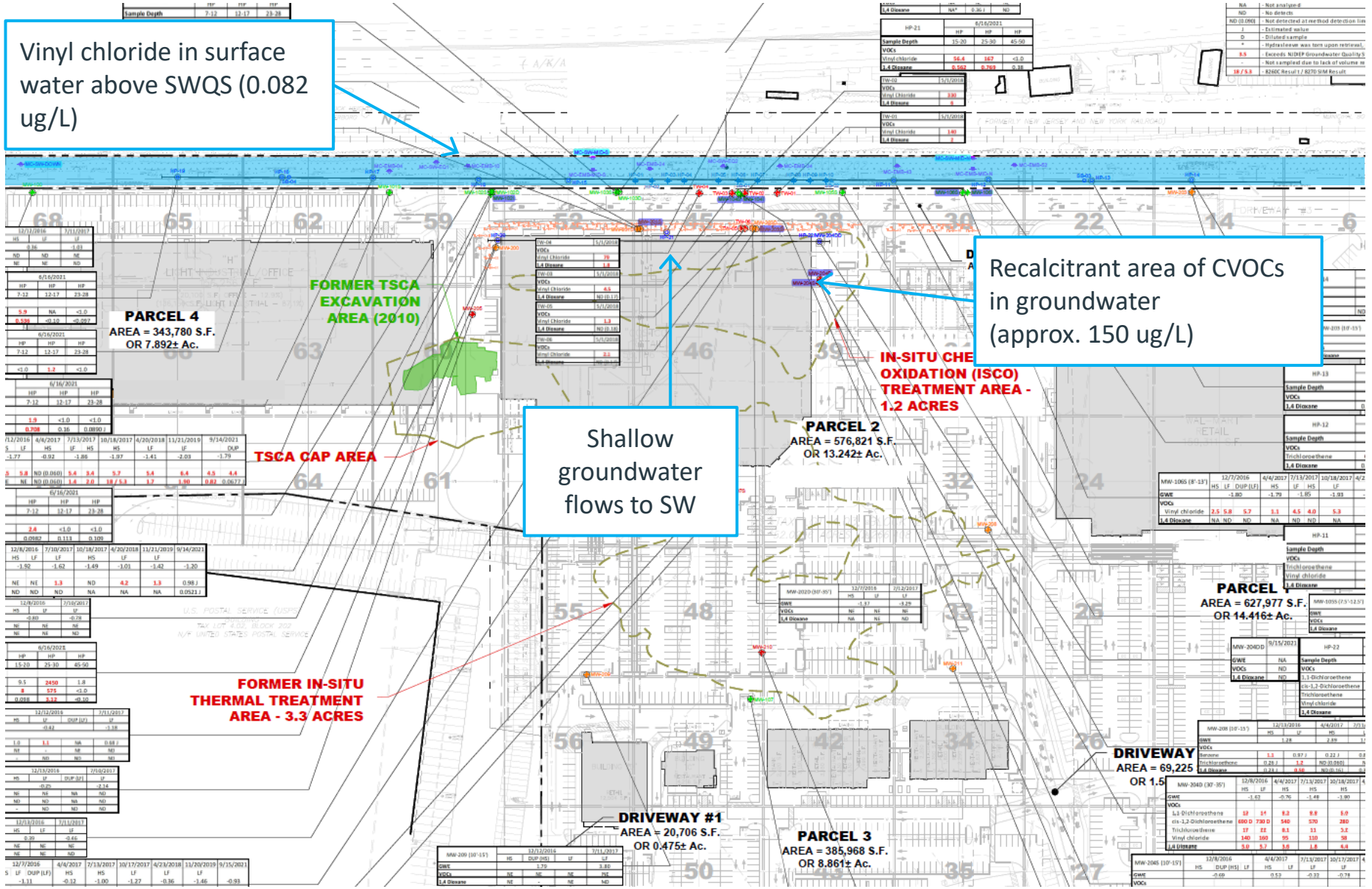
Drainage Ditch Remediation

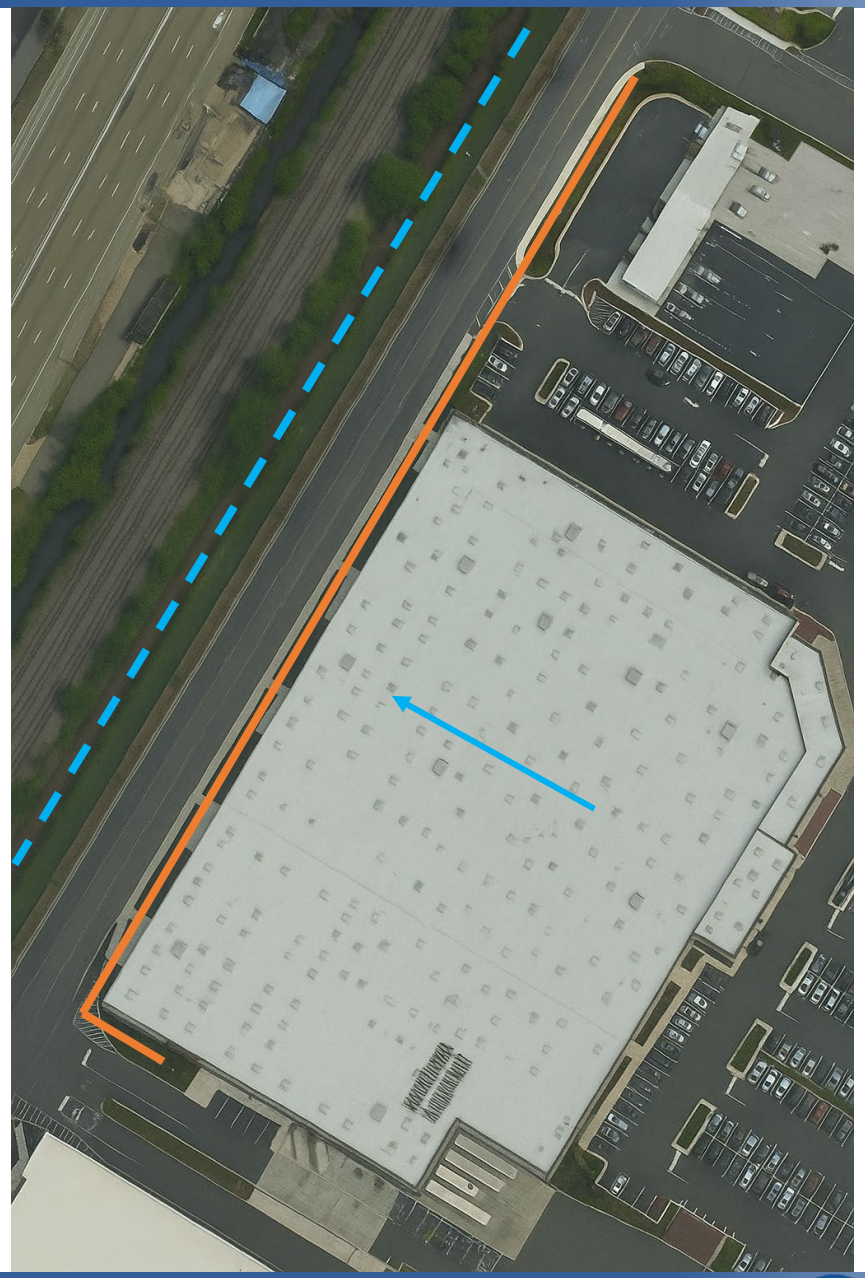
- 3,600 LF Drainage Ditch – Metals and PCB Impacts
- Dredging Work Commenced in March 2014 - Commercial Re-development Already Underway
- Sediment Stockpile/ Dewatering Areas had to be Relocated During the Work in Concert with Re-development Site Activities

Remedial Action – Schedule



Current Groundwater Plume

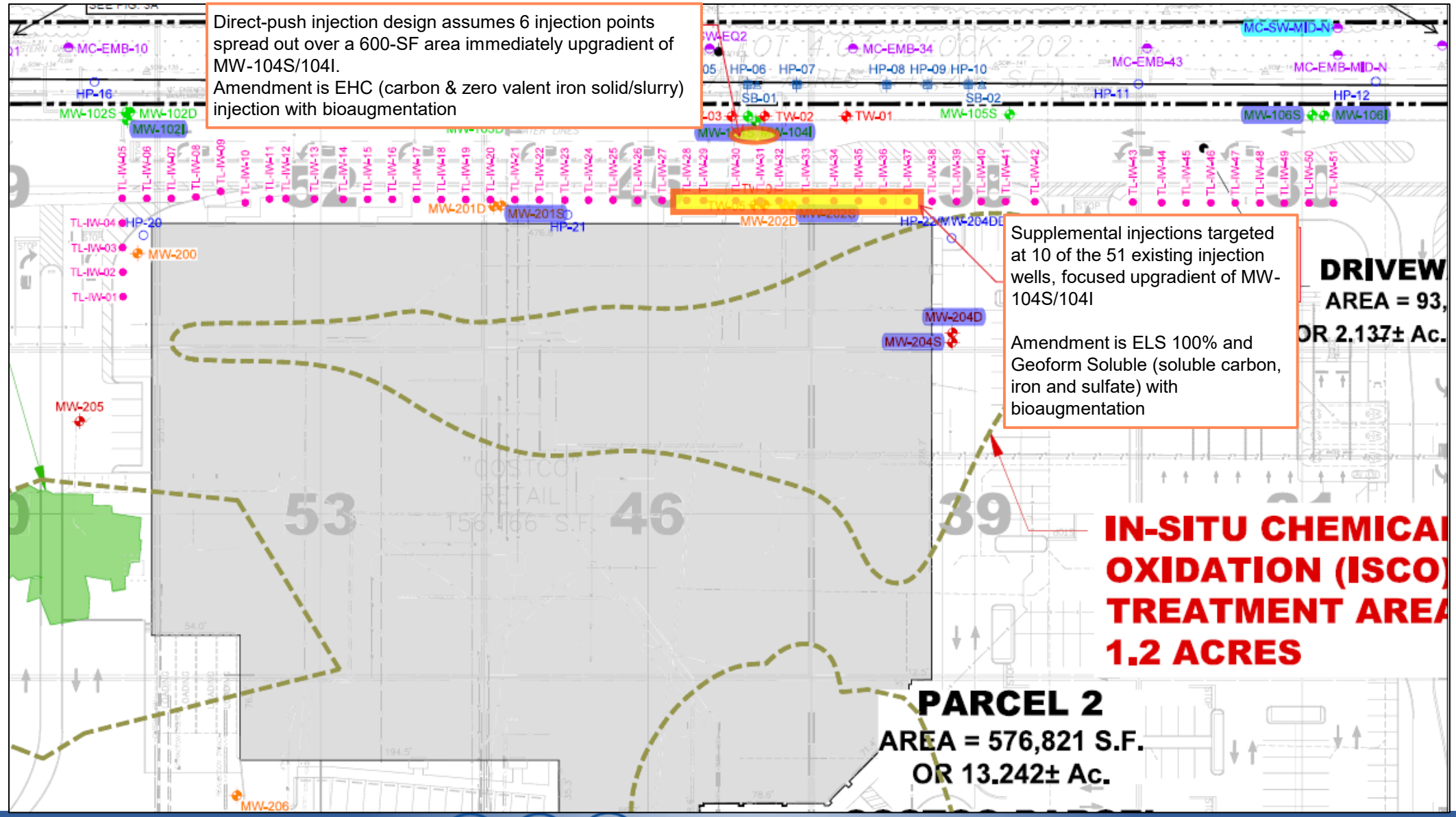




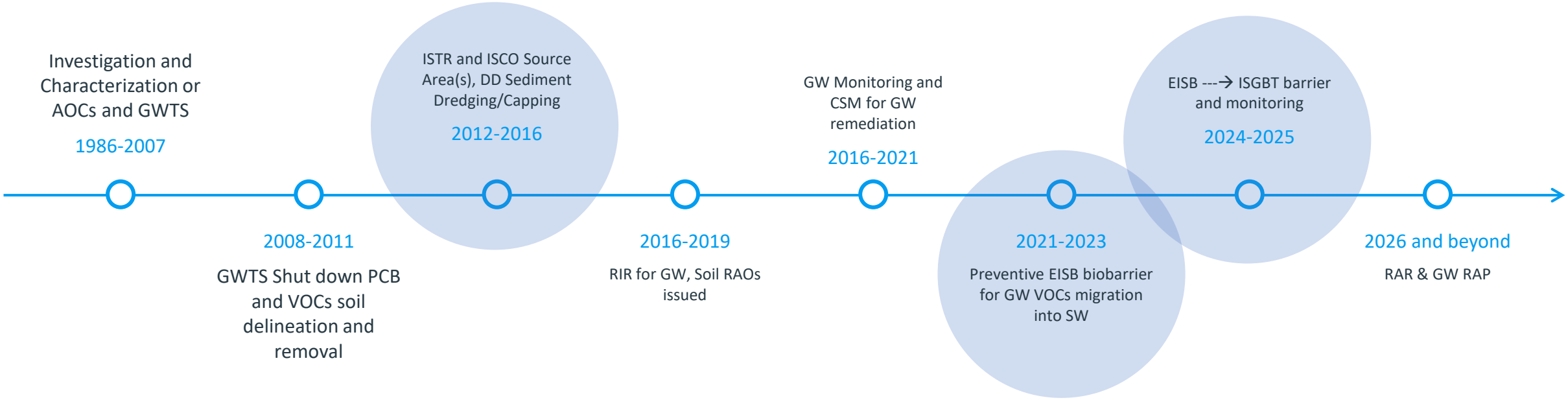
Enhanced In Situ Bioremediation (EISB) Biobarrier

- Groundwater geochemistry reverted back to naturally reducing (anaerobic) after the 2013 ISCO treatment
- 51 permanent injection wells for EISB biobarrier (825 LF)
- Designed to intercept/treat vinyl chloride to reduce mass flux and enhance natural attenuation of vinyl chloride in surface water
- Emulsified vegetable oil (EVO) was used; design life expectancy of 2-3 years. Dechlorinating bacteria already present
- Initial injections completed in July 2022

Focused injections in 2024 – In situ Biogeochemical Transformation (ISBGT)



Remediation Timeline



Total of 56 AOCs identified through investigations dating back to 1985, 7 AOCs remain open (most awaiting administrative closure)

Path Forward

Remedial Action Permit (RAP) designed to maintain flexibility for future injections

Manage long-term monitoring of groundwater and surface water under the RAP

Seek to convert to an MNA remedy once conditions are stabilized

Takeaways


Combined remedial approaches are essential for cost-effective management of DNAPL impacted sites
Long-term sustainability is achieved through integrated remediation
Monitoring and adaptive management are key to effectiveness