Application of Alkaline Activated Persulfate to treat Petroleum Hydrocarbon Contamination beneath the Active Construction of a 32-Story High-rise Residential Tower

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By

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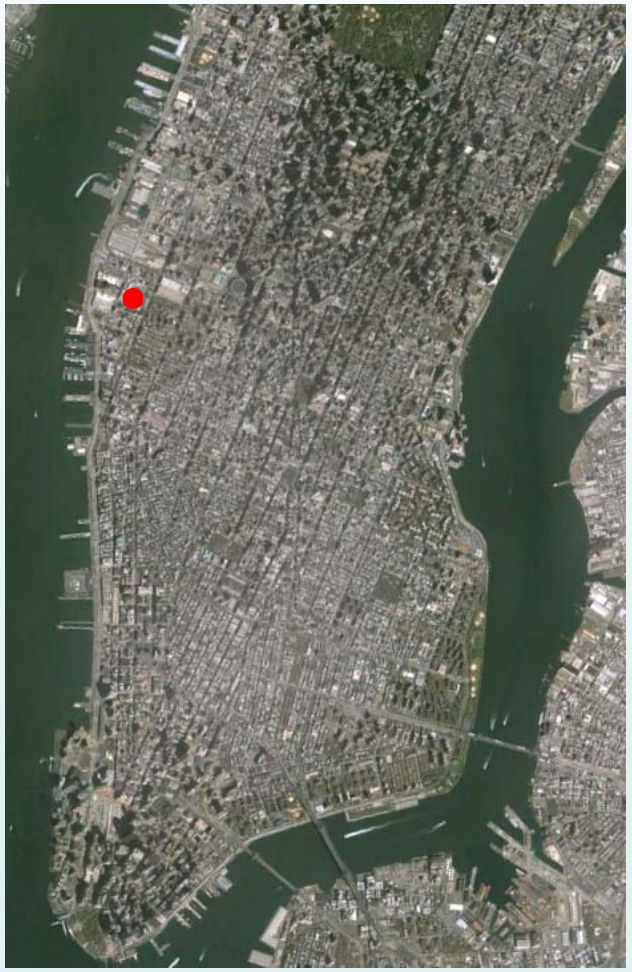
Background

- Located in the Chelsea neighborhood of New York City.
- Site uses included lumber yard, metal works facility, auto-repair facility, coal yard, piano manufacture, livery car service, and gasoline station.
- Leaking underground storage tanks observed at site.



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Target Area

- Approximately 6,500 ft^2 (185 ft x 35 ft).
- Treatment Interval of 9 to 14 ft bgs.
- Sandy and silty-sandy material.

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Contaminants of Concern

- Average Concentration of Petroleum Hydrocarbons:
  - 3,000 μg/L BTEX
  - 140 μg/L Naphthalene
  - 1,400 mg/kg GRO + DRO
- DRO and GRO up to 3,760 and 4,180 mg/kg, respectively.
- Variable GRO to DRO distribution indicated possible multiple releases.

Bench-Scale Tests

- Evaluated catalyzed hydrogen peroxide (CHP) and alkaline activated persulfate (AAP).
- CHP eliminated as peroxide decomposed rapidly even with stabilizing reagents, likely limiting subsurface distribution and resulting in rapid release of gas.
- Alkaline activated persulfate selected for effectiveness and chemical compatibility.
  - Reduced BTEX by 64-77%.
  - Reduced total TPH by 50%, with 50% percent of persulfate mass remaining.

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Field Application Design

- Designed based on multiple applications with emphasis on achieving remedial goals in single application.
- Injection wells installed to be accessible upon completion.
- Design called for 100,000 to 108,000 lbs of persulfate.
  - 72,700 lbs in first application
  - 60,300 lbs of 50% sodium hydroxide
  - Approximately 35,000 gallons of reagent solution (250 g/L persulfate)
- Design incorporated the RemMetrik process utilizing Wavefront technology.

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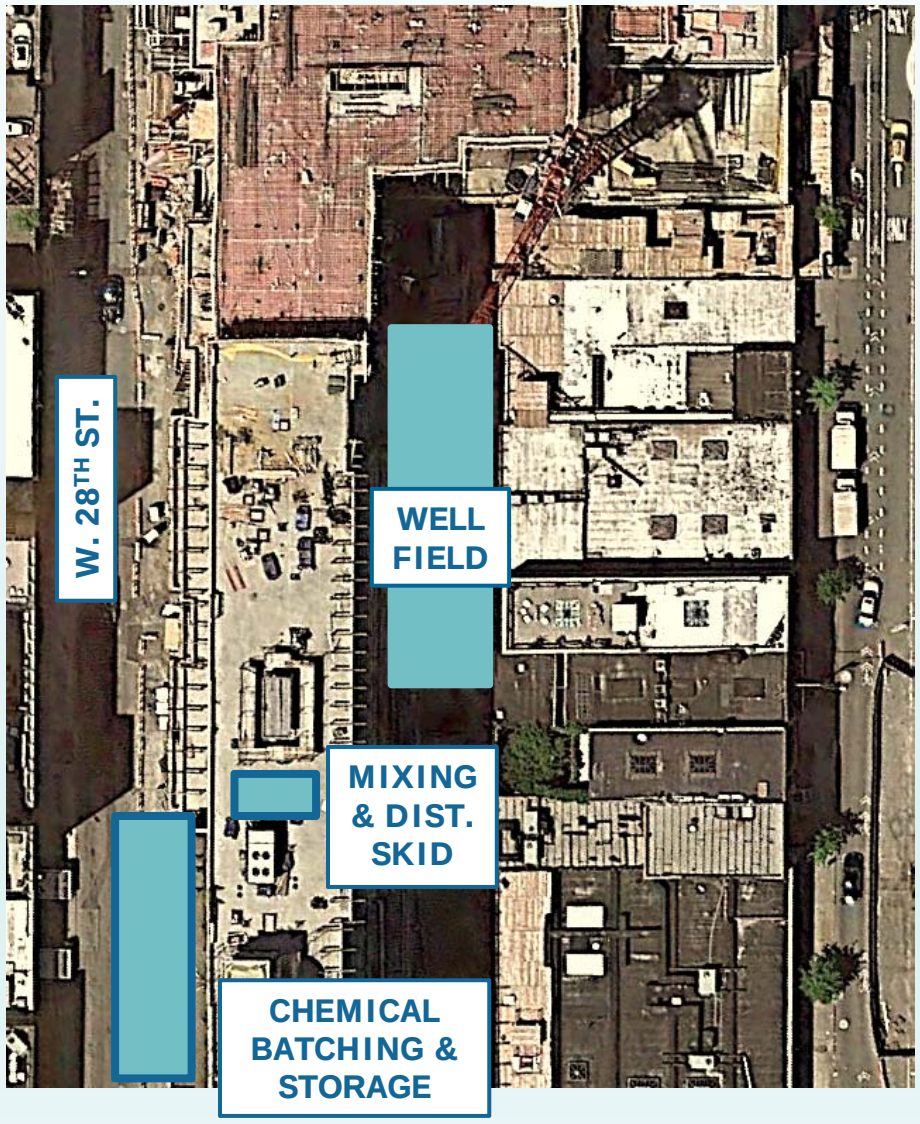
Field Application Logistics

- Difficult spatial constraints from construction activities
- Temporarily closed lane of W. 28th St. each day for batching. Road was open during injection.
- Over 400 daily construction personnel
- Total access window of 9 days.



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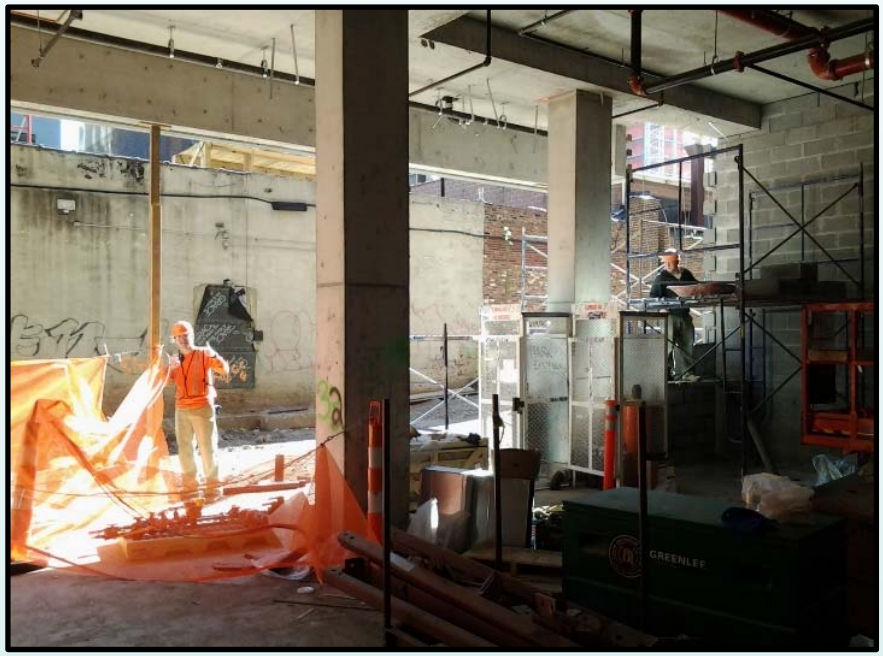
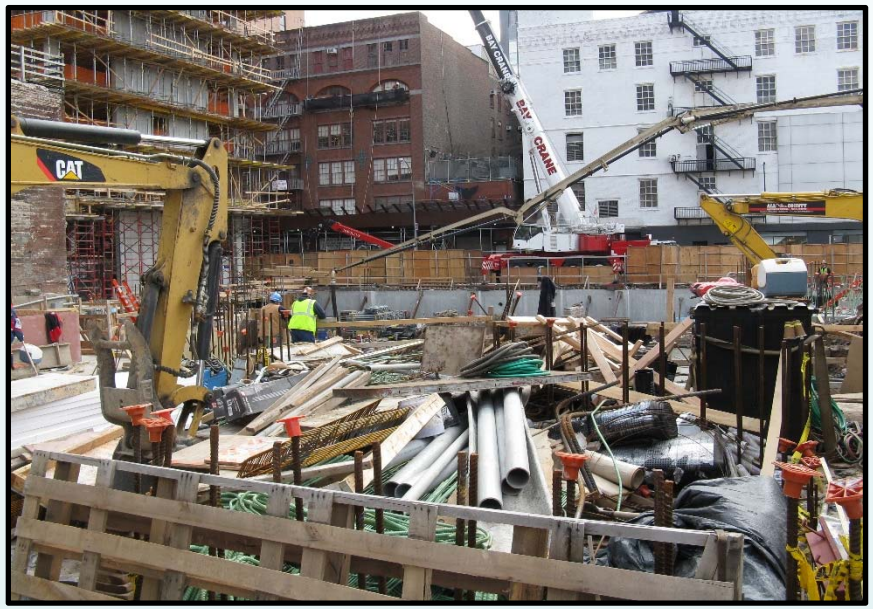
Batching

Mixing and Distribution Areas



Well Field



Field Application

- Occurred May 7 to 17, 2013
- Performed by XDD in cooperation with ZEBRA Environmental and Fleming-Lee Shue.
- 72,372 lbs of alkaline activated Klozur persulfate injected in 35,432 gallons of solution.
- Completed on schedule and within budget, with no impact to construction activities.

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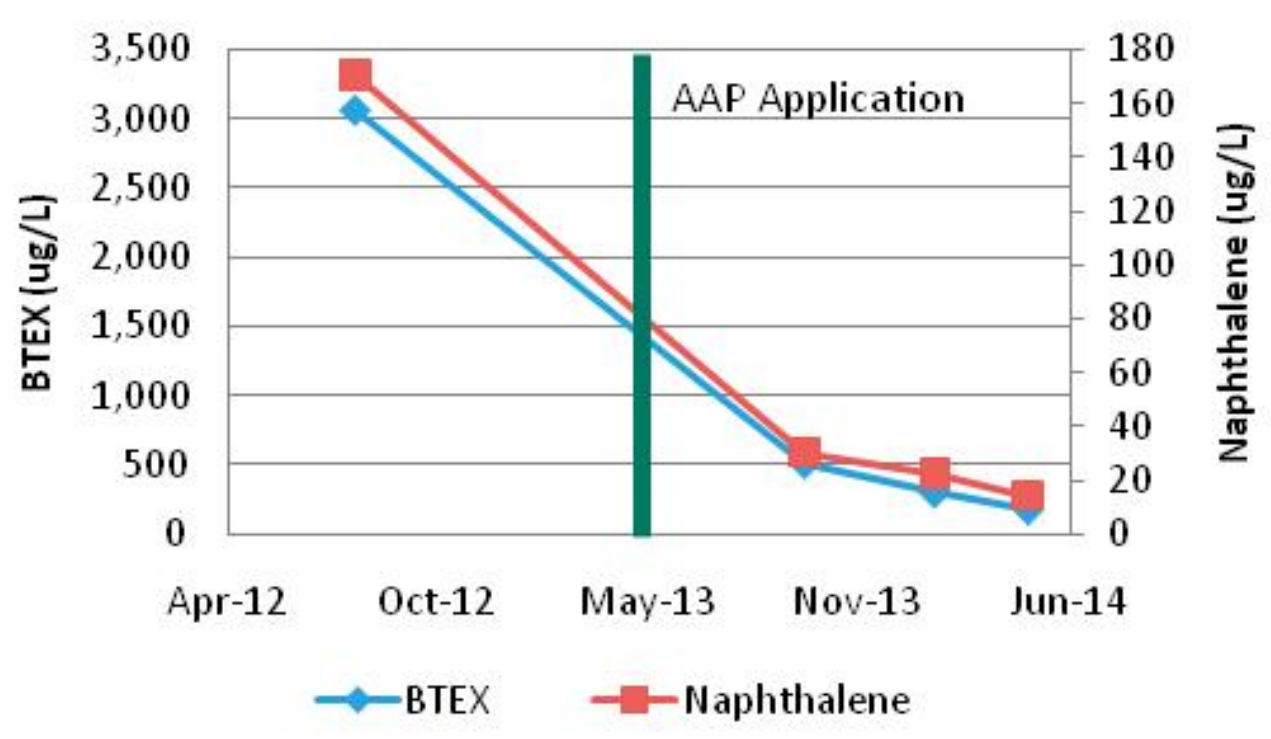
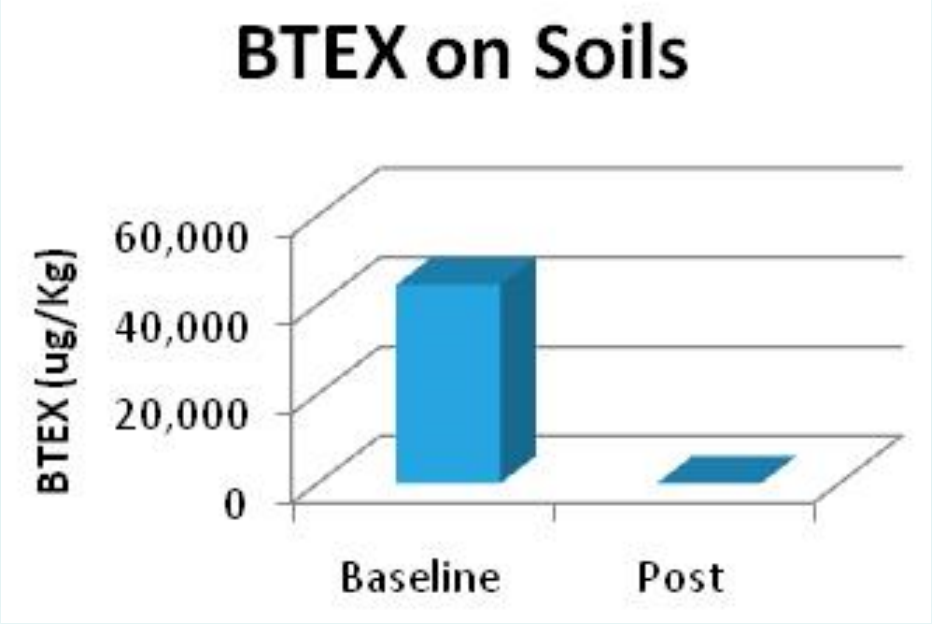
Groundwater Results

- Monitoring conducted approximately 5 months after the application in three quarterly events.
- BTEX and naphthalene GW concentrations decreased by 92 to 95%.
- No rebound observed.



Soil Results

- Soil sampled approximately 5 months after the application.
- BTEX concentrations reduced by 99.9%.
- Average DRO/GRO concentrations reduced by 99.2%.



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Site Closure

- Based upon the monitoring data, NY-DEC issued a letter closing the site on June 19, 2014, approximately one year after the application.

Fleming Lee Shue
Environmental Management & Consulting

RemMetrik, LLC

PeroxyChem

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