NAVFAC Hawaii Implements Sustainable Approach to Remediate Contaminated Soil

Constructive Stakeholder Interaction, Flexible Remediation Plan Key To Success

EX-SITU CHEMICAL OXIDATION of soil can be a sustainable and cost effective alternative to dig and haul and in-situ chemical oxidation for the remediation of petroleum contaminated source soil.

Personnel from the Naval Facilities Engineering Command (NAVFAC) Hawaii along with project contractor CH2M HILL Kleinfelder, a Joint Venture successfully executed a project, funded by the Defense Logistics Agency, to remediate petroleum-contaminated soil at Spill Site Stripper Pit No. 43 (SP43) on Joint Base Pearl Harbor-Hickam, Hawaii.

The dynamic and flexible approach used in the execution of this project allowed the team to change and implement a more sustainable and cost-effective remedy than originally planned. This eventually turned into the conservation of invaluable landfill space and saved hundreds of thousands of dollars.

Problem Statement

A reported 2,000 gallons of jet propulsion fuel were accidentally released in 1997 along a subsurface pipeline system that crossed Site SP43. Investigations and a streamlined risk assessment conducted at the site demonstrated that concentrations of petroleum constituents were present in soil and soil gas above the remedial action cleanup goals (RACG) identified in the Final Decision Document. Additionally, up to one foot of light non-aqueous phase liquid (LNAPL) was measured in site monitoring wells. (Note: LNAPL is fuel present in the subsurface as separate (not dissolved) phase.)

A Decision Document signed in 2011 for the remediation of the site required the implementation of land use controls (LUC), in-situ chemical oxidation (ISCO) using calcium peroxide, and monitored natural attenuation (MNA), with the option of conducting limited excavation and offsite disposal of petroleum contaminated soil from the source area. ISCO is a remediation technology that involves the injection of a substance (oxidizing compound) in the ground to destroy contaminants in place.

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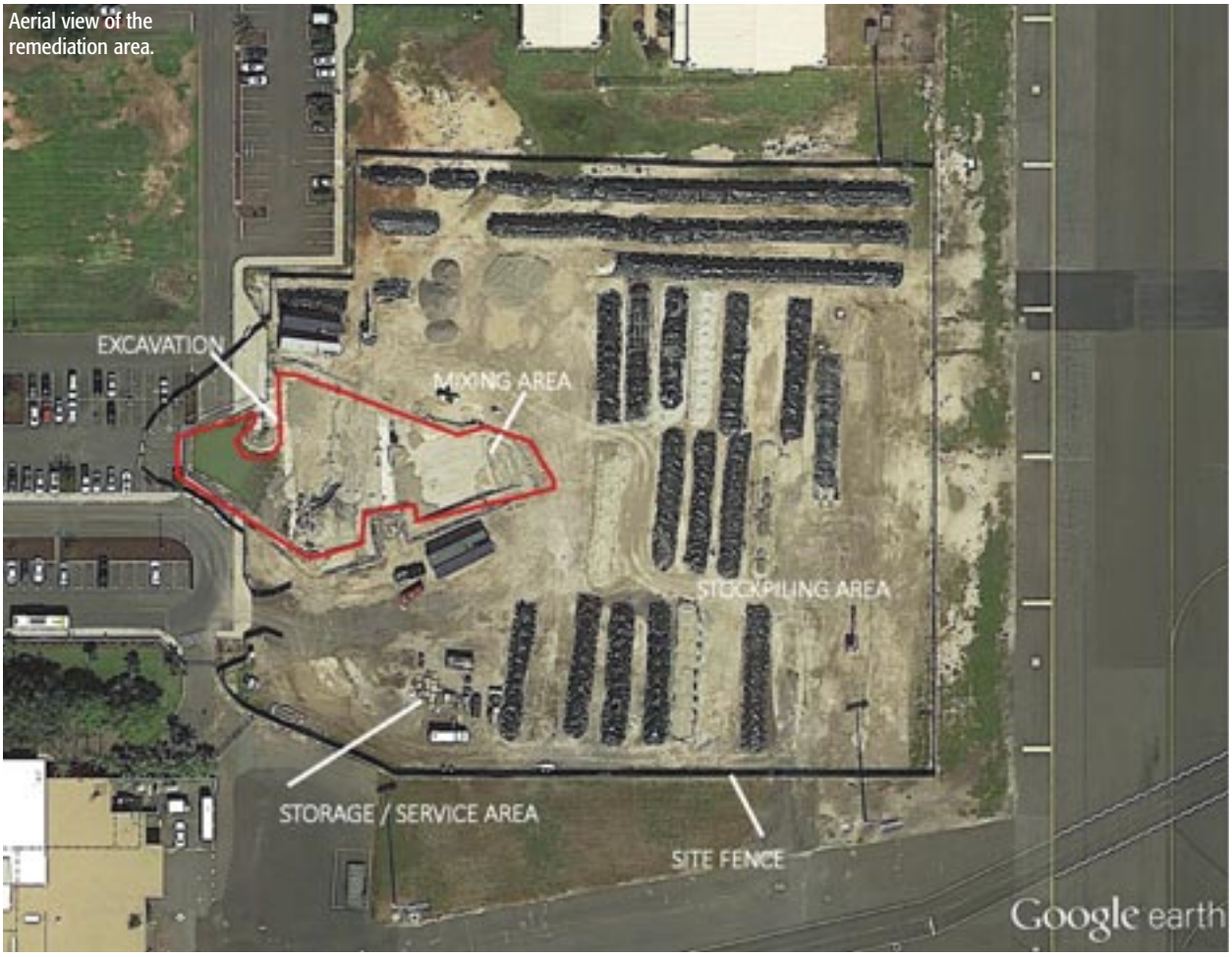
Project Scope & Objectives

The overall objectives of this project were to prevent human exposure and implement source treatment/removal to reduce petroleum constituent concentrations below the site-specific RACGs.

After evaluating offsite disposal options, the project team recognized the necessity to identify a more cost-effective and sustainable remedial option. Landfill space in Hawaii is



Aerial view of the remediation area.

rapidly decreasing. As an island state, available land is limited and highly valuable, making landfill disposal a less desirable and more expensive option than in other states. In addition, the State of Hawaii recently enacted legislation requiring that counties develop policies aimed at reducing waste sent to landfills.

Through significant collaboration with Hawaii regulatory authorities, the project team re-evaluated the remedy selected in the Decision Document to identify options that would allow the implementation of a more sustainable and cost-effective remedial action.

In an agreement with the State of Hawaii Department of Health, a revised remedy was developed which included LUCs, excavation and ex-situ chemical oxidation (ESCO) with reuse/disposal of petroleum contaminated soil, ISCO of subsurface soil/soil gas outside of the source area, and MNA. ESCO is a remediation technology that involves mixing the oxidizing compound with the contaminated medium (in this case soil) after removing it from the ground. This remedy was potentially more sustainable and cost effective, but success was highly dependent on treatment (chemical oxidation) efficiency.

Local small businesses were subcontracted to conduct soil remediation activities using equipment and resources available on island, in an effort to successfully implement a sustainable approach while supporting the local economy.

Methods & Results

Extensive laboratory bench scale testing to evaluate several formulations and activation methods was conducted using representative site soil samples and resulted in the selection of activated sodium persulfate as the most effective oxidant to treat contaminated soil at the site. A treatment efficiency between 70 and greater than 99.9 percent was achieved in the laboratory. Effective activation methods were identified including alkaline activation that uses base (e.g., lime or sodium hydroxide) to achieve a pH of 11 or

Soil mixing with lime-activated sodium persulfate and water.

higher—a condition necessary to activate the persulfate oxidative reaction.

Soil within the source area was excavated, treated onsite with lime and sodium persulfate to achieve alkaline-activated persulfate oxidation of petroleum contaminants, and stockpiled for 14 days for the reaction to occur. Treated soil was then sampled to evaluate if concentrations were reduced below the RACGs.

Approximately 3,200 cubic yards of petroleum contaminated soil were excavated and treated within a mixing pit setup in the excavation area. The petroleum contaminated soil was mixed with 50,000 pounds of solid sodium persulfate activated with 24,000 pounds of hydrated lime and water. An excavator was used to mix the soil. Thirty-two stockpiles of 100 cubic yards each were generated and covered with polyethylene plastic sheeting for 14 days. Approximately 1,300 cubic yards (13 stockpiles) of soil were remixed to further reduce petroleum constituent concentrations.

After the oxidative reaction was complete, one incremental sample composed from 30 increment locations was collected at each stockpile for laboratory analyses. Stockpiled soil analytical results indicated concentrations below the RACGs, with up to 85 percent destruction of petroleum constituents. No LNAPL was observed at the site after remedial actions were completed, except for 0.02 foot of LNAPL measured in one well immediately outside the source area.

Treated source soil was reused on site as backfill, resulting in a more sustainable and cost-effective remedy than originally planned (i.e., excava-

Soil mixing pit within excavation area.

Soil stockpiling area.

Based on post-ESCO soil concentration results within the petroleum contaminated area, Site SP43 is now suitable for future construction.

tion and disposal of source soil). This option also resulted in significant cost savings for the field implementation of source removal. If compared to the excavation and disposal option, ESCO resulted in cost savings (including subcontractor, materials, and disposal costs) of approximately $300,000.

Conclusions & Lessons Learned

Source reduction using ESCO was successfully completed at Site SP43 reusing all excavated soil, which resulted in significant cost savings and the implementation of a more sustainable option than originally planned in the Decision Document.

Approximately 3,200 cubic yards of petroleum-contaminated soil originally planned for landfill disposal were treated and replaced on site. ESCO was demonstrated to be a more sustainable and cost-effective solution compared to dig and haul or ISCO for the source area soil. Site soil was remediated and specific objectives were achieved. Critical for the project success was a very constructive interaction among key stakeholders and a flexible remediation plan. Based on post-ESCO soil concentration results within the petroleum contaminated area, Site SP43 is now suitable for future construction. ⚓

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