Remediation and Management Strategies for redevelopment of a Former MGP Site

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Background. The City of Stockholm has undertaken the major redevelopment of a former manufactured gas plant (MGP) in the Kolkajen area of the Stockholm Royal Seaport (Norra Djurgårdsstaden). This redevelopment is occurring in several stages and will result in a redeveloped harbor, realigned road system, and business and services to support the 2,000 new residential units that will be built on the site following remediation. The work to be presented involves the active remediation of three stages with remediation and management strategies for the site that is located near the subway transportation node of Ropsten. Given the intended uses of the site following remediation, treatment of soil, groundwater and the resulting impacts to the potential for vapor intrusion have been carefully considered. The contamination can be found in two intervals including an approximately 5 to 10 meter (m) thick clay unit (over 50,000 cubic meters) that overlays a more conductive moraine layer requires treatment of approximately over 90,000 cubic meters of soil in the first stage that will be completed early 2023. A second and larger stage of 160 000 cubic meters consisting of fill over clay and moraine have been started and will continue for another 2+ years.

Activities. Bench-scale and pilot tests of various technologies were initiated in 2017 and have concluded in 2020. Full-scale remediation started in the Fall of 2020 and will continue into 2024. Pilot tests in the moraine layer evaluated enhanced biodegradation by injecting oxygen releasing compounds with good result at locations where benzene was predominant. ISCO with hydrogen peroxide, alkaline and iron-organic chelate activated persulfate using both direct push technology (DPT) and fixed injection locations where tested. Remedial goals focused on treatment of groundwater to reach targets based on vapor intrusion risks. The clay layer in the first stage utilized soil mixing with persulfate solution and Portland cement, in the ratio of 2% and 4% by weight (minimum). The post application geotechnical characteristics of the soils as well as contaminant in soil determined the recipe. To limit the amount of persulfate to locations where it is most needed, since cement was also used for geotechnical stabilization, it was used Optical Imaging Probe (OIP) to determine where persulfate could be omitted. A district heating facility that utilizes the nearby seawater (heat pump technology) had to stay in place, so barriers with injectable active carbon with electron acceptors will be installed around it to stop benzene under that building from reaching future residential buildings in the area for as long as the heating facility is planned to stay in place.

Results. The pilot tests demonstrated one to two order of magnitude reduction of the moraine layer using several of the ISCO technologies. ISCO-ISS pilot tests in the clay layer achieved the remedial objectives set forth including having sufficient geotechnical strength to support post application roadways and structures, significant decreases in contamination on soils, and significant reduction of contamination transferred to the vapor phase. The ongoing full-scale work has shown results in that same order. The presentation will include an overview of the complex management issues with a large and complicated site and a tight timetable to have remediation completed in time for building infrastructure and the residential buildings. Lessons learned and remediation results up to the time of the symposium will be reported at as well as interim update of the ongoing remediation stages.