Field Pilot Studies for In Situ Stabilization/Solidification (ISS) of Hydrocarbon-Contaminated Sediments in Kendall Bay, Sydney, New South Wales (NSW), Australia

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Background/Objectives. Hydrocarbon contamination (polycyclic aromatic hydrocarbons [PAHs], total recoverable hydrocarbons [TRH], benzene, toluene, ethylbenzene and xylenes [BTEX]) within the sediments of Sydney Harbour has resulted from operation of a former gasworks. The gasworks itself was remediated and developed for high density residential land use two decades ago. NSW Environmental Protection Agency (EPA) has now issued a clean-up notice for remediation of the sediments within the adjacent bay. This presents a challenge to develop a remediation methodology for the contaminated sediments that minimizes impact to the adjacent residents. For this reason, ISS has been selected as the preferred remediation technology. In situ treatment will significantly reduce the number of truck movements required to transport contaminated material off-site compared to traditional dredging approaches and odour will be managed by maintaining water cover above the sediments.

Approach/Activities. A Phase 1 ISS laboratory treatability study for the project was recently completed and identified the optimal mix designs required to meet the project performance criteria (unconfined compressive strength [UCS], contaminant leachability and hydraulic conductivity). Following on from the laboratory treatability study, Phase 2 and 3 field pilot studies will be undertaken in the coming months, utilizing the optimal mix designs identified during the laboratory study.

The laboratory study successfully identified the required ratios of Portland cement and ground granular blast furnace slag required to meet the project performance criteria. Other treatment enhancers/additives were tested, and are likely to be required to overcome the placement challenges associated with underwater ISS. A superplasticizer may be required to ensure grout viscosity is maintained between the batch plant and the mixing head at field-scale. An accelerant and/or anti-washout agent will be required to minimize both seawater ingress and washout of cement, and the field studies will be used to determine the most effective product(s) and their final application rates. The field studies will also assess the effect of seawater ingress at the ISS interface and importantly its impact on the ability to achieve the project performance criteria.

Phase 2 of the pilot study works will take place at a location within the greater Kendall Bay sediments area that lies outside the remediation extent. The location has been selected based on the similar physical sediment conditions and lower levels of contamination compared to the remediation areas, with the rationale that this location will ensure the success or failure of this Phase does not directly impact upon the contamination status within the remediation areas. During Phase 2 the mix injection will be undertaken with the equipment and procedures intended to be utilized during the full-scale remediation works to best simulate their performance under conditions anticipated during the project.

Following the Phase 2 works, the planned approach will be reviewed, and where required refined, followed by the final phase of the pilot study. Phase 3 works will involve construction of an ~5 feet thick ISS raft (for remediation) and up to 16 deeper ISS columns (for structural support and constructability) in one of the remediation areas. Final results will be validated through wet grab sample collection of the final mix, using similar methods to the intended sample collection during full-scale remediation works.

Results/Lessons Learned. The Phase 2 and 3 field pilot study results and lessons learned will be available by the conference and will be presented in this paper. Results will include the required ratios of Portland cement and ground granular blast furnace slag required to meet the project performance criteria, the required superplasticizer application rate to ensure grout viscosity is maintained between the batch plant and the mixing head and the required accelerant and/or anti-washout product and additive rates required to overcome seawater ingress and cement washout challenges associated with the application of ISS underwater. Application techniques to mitigate the effect of seawater ingress at the ISS interface will also be discussed.