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FIELD TESTING OF BIMETALLIC NANOSCALE PARTICLE TECHNOLOGY FOR IN-SITU GROUNDWATER TREATMENT OF A FRACTURED ROCK DNAPL ZONE

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This study has been carried out as part of the Corrective Measure Study (CMS) at a property owned by GlaxoSmithKline in Research Triangle Park, North Carolina, USA. The study area is located in the Durham subbasin of the Deep River Triassic Basin and is underlain by interbedded siltstone and sandstone sequences. Groundwater underlying portions of the site has been impacted by historical industrial activities conducted by previous owners; groundwater contaminants consist mainly of chlorinated volatile organic compounds. Golder conducted an initial review of potentially applicable remediation technologies and retained the Bimetallic Nanoscale Particle (BNP) technology for further evaluation. BNP consists of nanoscale particles (˜ 60 nm) of zero valent iron (Fe0) with a trace coating of noble metal catalyst (palladium). The rapid destruction of a wide range of recalcitrant contaminants is based on a surface-catalyzed redox process where the contaminant serves as an electron acceptor and BNP as the electron donor and can be accomplished either in situ or ex situ (Wei-xian Zhang, 1997, 1999, 2000). This study presents the field demonstration of the BNP effectiveness to treat in-situ chlorinated VOCs in a complex fractured bedrock aquifer setting. During the field pilot test 11 kilograms of BNP mixed in water-based slurry were injected into the shallow bedrock groundwater suspected to contain dense non-aqueous phase liquids (DNAPLs). The results of the test indicated rapid treatment of chlorinated VOCs 7 m to 14 m around the injection well. In addition, the oxidation-reduction potential (ORP)

and dissolved oxygen (DO) values have decreased and persisted at very low levels of -450 millivolts and less than 0.001 milligrams per liter, respectively, indicating favorable conditions for reductive dechlorination. Interpretation of pre- and post-test data on the in-situ microbiological community in the test area indicate that the changes in ORP and DO have resulted in inhibition of aerobic bacteria and likely stimulation of anaerobic bacteria known to degrade chlorinated solvents. Redox-induced mobilization of naturally occurring inorganics from the aquifer solids was not detected. Treatment efficiencies closely correlate with predictions from bench scale tests, suggesting that very little reagent interacted with non target constituents within the aquifer matrix. BNP in-situ treatment technology has the potential to reduce significantly the remedial costs in comparison to the conventional treatment systems.