**Pre-Demonstration ISGS Injection Testing – Additional Information**
**December 22, 2011**

Prior to performing the full-scale demonstration ISGS injection, Tetra Tech plans to test and evaluate the geoprobe and temporary injection point approaches. They plan to select two pre-injection test locations in areas with known DNAPL impacts. The selection of locations will follow the Phase I subsurface characterization effort.

Tetra Tech states that the goals of this pre-demonstration injection testing are to:

1) Develop information on achievable injection rates and volumes at multiple injection pressures;
2) Establish the affected radius (radius of influence) and optimal mode of permanganate injection; and
3) Evaluate whether changes in depth of injection affect the injection method and distribution of permanganate.

Following injection, continuous core will be collected from land surface to the top of the middle clay at six locations at various distances from the injection point. The cores will be photographed, and logged for presence of non-reacted reagent solution, precipitate, and DNAPL.

While this information for both the geoprobe and temporary injection point approach is helpful to establish operational procedures for scale-up, there is an opportunity to gather additional information that may lead to an improvement in system performance.

A) The use of temporary injection points or wells will be used for locations where it is deemed that a considerable mass of DNAPL is present and hence either a larger reagent volume or repeated injections will be required for treatment. Prior to soil core collection, but after some time has passed for reactions to occur (say 7 days), reinjection should be attempted. Initial pathways that become "plugged" may allow for the development of alternative pathways (increase the zone if influence), or rejection may not be possible. Note: If possible it would be preferable to core in between the first and second injections, provided that these core holes could be adequately grouted shut to prevent short-circuiting.

B) The temporary injection points also provide an opportunity to gain some information on alterations to mass transfer processes - which is a key element of ISGS. Consider using the temporary injection points much like a push-pull test. We suggest a push-pull of only a "tracer" solution to gather baseline behaviour. This can be followed by the planned reagent injection and then a pull phase. During the pull phases groundwater samples can be analysed for a suite of analytes (such as but not limited to Mn, dissolved phase COCs, permanganate, pH, Eh, TDS, conductivity). The data can be used (with some interpretation) to provide insight into "post-treatment conditions", and to improve treatment performance. To a limited extent, a pull phase following reagent injection (without the initial "tracer only" push-pull test) might be helpful.

C) The connection between the testing of cores as outlined Section 3.1.3 for "pSOD" data and scale-up to in situ conditions is not well established. The cores collected post ISGS injection testing can be used to help make this connection. Depending on the "intact" nature of the collected cores, a host of relatively simple laboratory tests can be conducted to support and augment the data collected as outlined in Section 3.1.3. This information will also be useful to improve system performance. The integrity and overall characteristics of the cores will

affect what tests can be done. We would like to revisit this issue after the Phase I characterization is completed.

D) As part of the Phase I characterization temperatures of the cores should be measured. We are concerned about the effects of elevated temperatures that might result from the core collection. Elevated core temperatures will reduce DNAPL viscosity and can cause DNAPL to drain from the cores.