Geo-Cleanse
INTERNATIONAL, INC.

August 7, 2013

Mr. Matt DeVinney
Dvirka & Bartilucci Consulting Engineers
330 Crossways Park Drive
Woodbury, NY 11797

RE: CPC Facility – Sodium Permanganate Injection Summary

Dear Mr. DeVinney:

Geo-Cleanse International, Inc. (Geo-Cleanse), in collaboration with Dvirka and Bartilucci Consulting Engineers (D&B), along with Eastern Environmental Solutions (EES), who provided the subcontracted drilling services, has completed an in-situ chemical oxidation (ISCO) treatment program at the Chemical Pollution Control (CPC) facility located in Bay Shore, New York. The primary goal of the treatment program is to reduce groundwater concentrations to below the Class GA Groundwater Standards for tetrachloroethene (PCE), trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE), which is 5 µg/L for each contaminant. Injection of sodium permanganate through temporary direct-push points was selected as the ISCO technology to treat the residual chlorinated volatile organic compound (CVOCs) impacts observed at the site, which consist primarily of chlorinated ethenes. The post-treatment sampling event has not occurred, thus the post-injection results are not discussed in this summary report. This report summarizes the details of the treatment program including health & safety, treatment area and depth, injection volumes and concentrations, and the results from the process monitoring.

Health & Safety

Health and Safety is paramount during any injection event or field activity. The Site Specific Health and Safety Plan was reviewed and signed by Geo-Cleanse and EES, prior to conducting any work. In order to ensure the safety of the field crew throughout the injection event, a tailgate health and safety briefing was conducted prior to the start of each day. Each tailgate meeting discussed the proper procedures for material handling and spill procedures, drill rig operation and inspection, proper personal protective equipment (PPE), and discussion of the daily activities with focus on any issues or concerns from the previous day's activities. Most of the work was conducted in level D PPE, with the exception of reagent transfer and dilution activities as well as when disengaging the well head from the driller's casing. During these activities, a splash shield and protective coveralls were donned as well. There were no injuries or incidences reported during the seven day injection event.

Equipment Mobilization/Demobilization and Reagent Storage

The equipment utilized for the injection was mobilized to the site on July 8th and staged in a location approved by D&B. The equipment mobilized to the site consisted of the Geo-Cleanse® Mobile Treatment Unit (Exhibit 1), a 75-KW generator, a forklift for drum handling, a track mounted direct push drill rig, and a support vehicle for the drilling activities.

A total of 11,550 lbs of 40% sodium permanganate was delivered to the site on July 8, 2013. The oxidant was delivered in twenty-one 550-lb (net), DOT approved, black poly-drums. Once on site, the drums were secondarily contained in the approved staging area (Exhibit 2). Once each drum was emptied, it was thoroughly rinsed three times and then sprayed with the sodium permanganate neutralizing solution prior to being cut up for disposal. The oxidant was transferred from the secondarily contained drum at 40% concentration to the dilution tanks inside of the Geo-Cleanse® Mobile Treatment Unit using a dip-leg system. This method allows the drums to stay in place and minimizes worker exposure to the reagents. The oxidant was then diluted to approximately 2-3% prior to injection.

Exhibit 1: Geo-Cleanse ® Treatment Vehicle

Re agent injection to the subsurface was conducted via specially designed heads that are attached to the casing of the drilling rod (Exhibit 3). The heads are designed with redundant safety features including check valves, pressure gauges and flow-control ball valves and are constructed of CPVC to withstand the reagent and potential pressure. The mixing head has a duplicate set of ball valves to allow for multiple injection lines to be attached to the same injection head to allow for a faster injection rate if conditions are warranted as with this site.

The injection activities were completed at the end of the day on July 13th. The following day was used as a demobilization day, where the equipment was thoroughly cleaned and removed from the site. The empty drums were removed from the secondary containment. The secondary containment was decommissioned and all of the equipment was removed off of the site. The site was restored back to its pre-injection conditions.

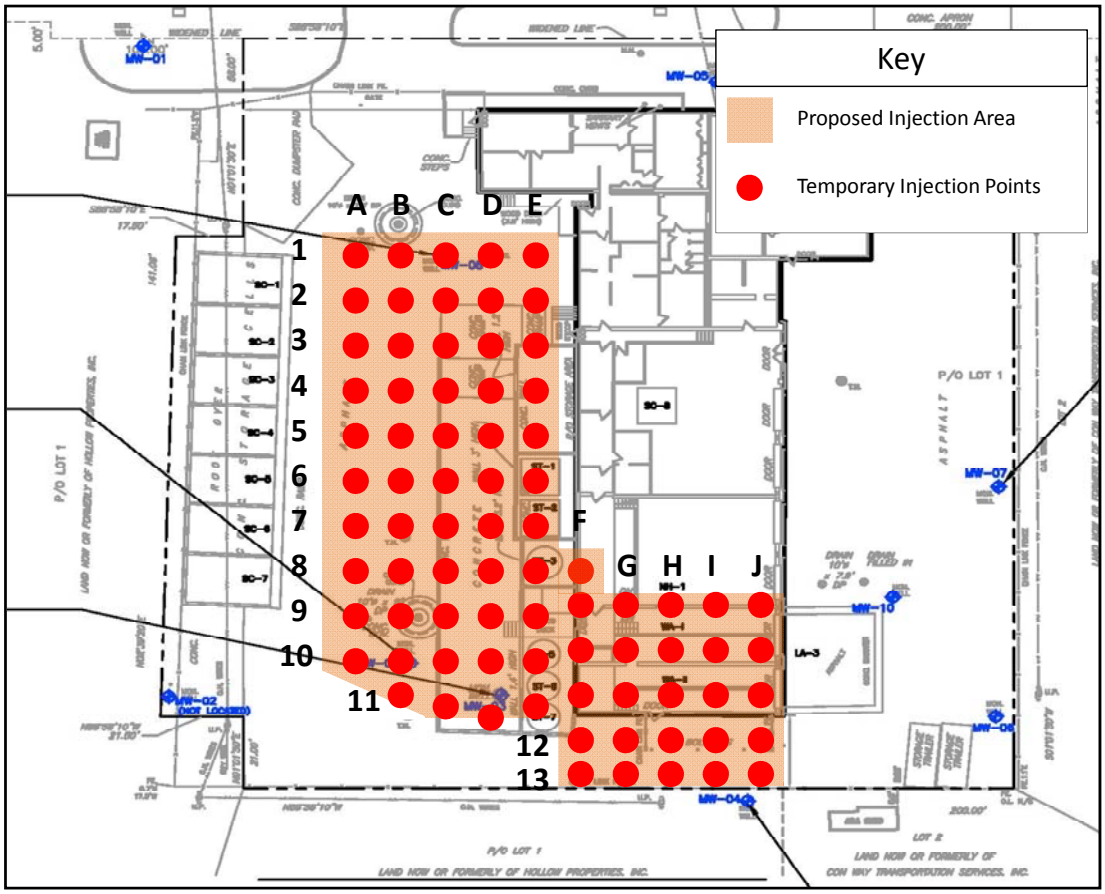
Exhibit 2: Sodium Permanganate Storage

Exhibit 3: Geo-Cleanse ® Mixing Heads

Treatment Area

The injection program targeted a 10,100 sq ft area with a vertical treatment interval extending from approximately 10 to 20 feet below ground surface (ft-bgs). Two 4-ft vertical intervals (e.g., 10 to 14 ft bgs and 16 to 20 ft bgs) were targeted to inject the reagent. Final treatment injection depth and intervals were adjusted based upon the surface elevation variability of the site. The specific depths of the injection intervals for each injection point are discussed in more detail in the next section. A total of 80 temporary injection points were emplaced using a track mounted direct push drill rig. The temporary points were installed in a grid-like pattern and were spaced approximately 12 ft on center. The primary goal of the treatment program is to address the CVOC contamination that is present in MW-03, MW-04, MW-08, and MW-09. However, during demolition and excavation activities these monitoring wells were decommissioned.. Monitoring wells MW-3R and MW-4R were installed as replacement wells along the periphery of the site on the down gradient end of the treatment area. A site map outlining the treatment area and injection points has been included as Exhibit 4**.**

Exhibit 4: Treatment Area Map



Injection Volume & Depth

Injection activities began on July 9th and continued through July 13, 2013, for a total of five days of active injection (seven days total including mob/demob). A total of 11,550 lbs of 40% sodium permanganate was delivered to the site. The reagent was diluted to approximately 19,974 gallons of 2% sodium permanganate prior to injection. Each

injection location received approximately 247 gallons of 2% sodium permanganate injected. Each 4-ft injection interval within an injection point received on average 123-124 gallons of 2% sodium permanganate. Injection location I-12 (10-14 ft-bgs) received the most volume at 176 gallons of 2% and location I-13 (10.5 to 14.5) received the least volume at 74 gallons of 2% sodium permanganate. Injection location I-13 (10.5 to 14.5) received less volume due to surfacing issues that occurred while injecting at this location. Injection location I-12, which is immediately upgradient from this location, received the excess volume that I-13 would have received at the same depth. Other injection points such as F-12, G-12, H-12, and J-12 each received 149 gallons in the shallow interval and 150 gallons in the deep interval. Specific volumes and injection depths are shown in Exhibit 5.

Exhibit 5: Injection Volume and Depth

Injection Location	Injection Interval (ft-bgs)	2-3% Sodium Permanganate Solution (gal)
A-01	9 to 13	124
	15 to 19	123
A-02	9 to 13	123
	15 to 19	124
A-03	9 to 13	124
	15 to 19	123
A-04	9 to 13	123
	15 to 19	124
A-05	9 to 13	123
	15 to 19	124
A-06	9 to 13	123
	15 to 19	124
A-07	9 to 13	123
	15 to 19	124
A-08	9 to 13	123
	15 to 19	124
A-09	9 to 13	123
	15 to 19	124
A-10	9 to 13	123
	15 to 19	124
B-01	9 to 13	124
	15 to 19	123
B-02	9 to 13	124
	15 to 19	123
B-03	9 to 13	124
	15 to 19	123
B-04	9 to 13	123
	15 to 19	124
B-05	8.5 to 12.5	123
	14.5 to 18.5	124
B-06	8.5 to 12.5	123
	14.5 to 18.5	124
B-07	8.5 to 12.5	123
	14.5 to 18.5	124
B-08	8.5-13.5	124
	14.5 to 18.5	123
B-09	8.5 to 13.5	123
	14.5 to 18.5	124
B-10	8.5 to 13.5	123
	14.5 to 19.5	124
B-11	9.5 to 13.5	123
	15.5 to 19.5	124
C-01	9 to 13	124
	15 to 19	123
C-02	9 to 13	123
	15 to 19	124
C-03	9 to 13	124
	15 to 19	123
C-04	8 to 12	124
	14 to 18	123
C-05	8 to 12	123
	14 to 18	124
C-06	8 to 12	123
	14 to 18	124
C-07	8 to 12	123
	14 to 18	124
C-08	8 to 12	123
	14 to 18	124
C-09	8 to 12	123
	14 to 18	124
C-10	8 to 12	123
	14 to 18	124
C-11	9.5 to 13.5	123
	15.5 to 19.5	124
D-01	9 to 13	124
	15 to 19	123
D-02	9 to 13	123
	15 to 19	124
D-03	9 to 13	124
	15 to 19	123
D-04	8 to 12	124
	14 to 18	123
D-05	8 to 12	123
	14 to 18	124
D-06	8 to 12	123
	14 to 18	124
D-07	8 to 12	123
	14 to 18	124
D-08	8 to 12	123
	14 to 18	124
D-09	8 to 12	123
	14 to 18	124
D-10	9 to 13	123
	15 to 19	124

Exhibit 5: Injection Volume and Depth (Cont'd)

Injection Location	Injection Interval (ft-bgs)	2-3% Sodium Permanganate Solution (gal)
D-11	9.5 to 13.5	123
	15.5 to 19.5	124
E-01	9 to 13	124
	15 to 19	123
E-02	9 to 13	123
	15 to 19	124
E-03	9 to 13	124
	15 to 19	123
E-04	8 to 12	123
	14 to 18	124
E-05	8 to 12	123
	14 to 18	124
E-06	8 to 12	123
	14 to 18	124
E-07	8 to 12	123
	14 to 18	124
E-08	8 to 12	123
	14 to 18	124
E-09	8 to 12	123
	14 to 18	124
E-10	9 to 13	123
	15 to 19	124
E-11	9.5 to 13.5	123
	15.5 to 19.5	124
F-08	8 to 12	124
	14 to 18	123
F-09	9 to 13	123
	15 to 19	124
F-10	9 to 13	123
	15 to 19	124
F-11	9.5 to 13.5	124
	15.5 to 19.5	124
F-12	10 to 14	149
	16 to 20	150
F-13	10.5 to 14.5	123
	16.5 to 20.5	124
G-09	8.5 to 12.5	123
	14.5 to 18.5	124
G-10	9 to 13	123
	15 to 19	124
G-11	9.5 to 13.5	123
	15.5 to 19.5	124
G-12	10 to 14	149
	16 to 20	150
G-13	10.5 to 14.5	123
	16.5 to 20.5	124
H-09	8.5 to 13.5	123
	14.5 to 18.5	124
H-10	9 to 13	123
	15 to 19	124
H-11	9.5 to 13.5	123
	15.5 to 19.5	124
H-12	10 to 14	149
	16 to 20	150
H-13	10.5 to 14.5	123
	16.5 to 20.5	124
I-09	8.5 to 13.5	123
	14.5 to 18.5	124
I-10	9 to 13	123
	15 to 19	124
I-11	9.5 to 13.5	123
	15.5 to 19.5	124
I-12	10 to 14	176
	16 to 20	124
I-13	10.5 to 14.5	75
	16.5 to 20.5	124
J-09	8.5 to 13.5	123
	14.5 to 18.5	124
J-10	9 to 13	123
	15 to 19	124
J-11	9.5 to 13.5	123
	15.5 to 19.5	123
J-12	10 to 14	149
	16 to 20	150
J-13	10.5 to 14.5	125
	16.5 to 20.5	123

Total Volume Injected = **19,974 gal of 2% $NaMnO_4$**

Groundwater Sampling

The treatment program was designed with the intention of collecting groundwater samples daily and monitoring for a color change to purple to ensure proper distribution of the reagents. However, when Geo-Cleanse arrived at the site, the target monitoring wells (MW-3, MW-4, MW-8, and MW-9) were had been decommissioned as part of previous site activities, which limited the amount of sampling we could perform. Two replacement wells (MW-3R and MW4R) were installed on the outside of the treatment area along the down gradient side of the site piror to Geo-Cleanse mobilizing to the site. As such samples were only collected two times from both MW-3R and MW-4R. Samples were collected on July 13th, after the start of active injection. These locations were several feet away and

would not be effected by what was injected in the ground during the previous injection days. The two locations were sampled again on July 14th, which was one day after the last day of injections. A significant color change was noted in MW-4R, however no change was observed in MW-3, which is located slightly further away from the treatment area.

Conclusions

The following conclusions can be drawn from this injection program:

- Reagents were injected in a safe and efficient manner.
- Injection occurred at the target depths (approximately 10-20ft-bgs).
- Target injection volumes were delivered to each injection point, with the exception of one (I-13).
- A noticeable color change was observed from MW-4R, indicating proper distribution of the oxidant.
- A noticeable color change was not observed in MW-3R. The results are as anticipated because this monitoring well is located further down gradient from the treatment area than MW-4R.

Thank you for considering Geo-Cleanse International, Inc. to assist you in your remedial needs.

Sincerely Yours,

Geo-Cleanse International, Inc.

Robert Connell
Project Manager