UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
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OFFICE OF
RESEARCH AND DEVELOPMENT

Rodene Lamkin
Massachusetts Department of Environmental Protection
Northeast Regional Office
205B Lowell Street
Wilmington, MA 01887

Re: Draft Phase III Remedial Action Plan, General Chemical Corporation, 133-135 Leland Street, Framingham, Massachusetts (MassDEP RTN 3-19174 EPA ID No. MAD019371079 Tier I Permit No. W052893, February 15, 2016 (16-RC01-001)

Dear Rodene Lamkin,

A technical review was conducted on the report entitled, "Draft Phase III Remedial Action Plan, General Chemical Corporation, 133-135 Leland Street, Framingham, Massachusetts (February 15, 2016). Prepared by: Groundwater & Environmental Services, Inc." Several comments and recommendations are provided regarding the proposed remedial action plan that may help scope and/or improve the project. The organization of this technical review follows the same format of the report. Contact me at your convenience to further discuss these matters (580-436-8610; huling.scott@epa.gov).

Sincerely,

Scott G. Huling, Ph.D., P.E.
Applied Research and Technical Support Branch

cc: Mike Fitzpatrick (5303P)
Bill Brandon, Region 1
Yoon-Jean Choi, Region 1
Jan Szaro, Region 1

Technical Review Comments and Recommendations

General Comments

1. The use of persulfate was proposed for in-situ chemical oxidation applications. Treatability studies will be needed, if not already conducted, to better assess the overall feasibility of this technology.

2. The impact of the residual from using sodium persulfate (i.e., sulfate), should be evaluated prior to the use of this oxidant at each of the areas of concern. Specifically, the sulfate residual will elute from the injection zone in the ground water and may impact downgradient areas.

3. The use of permanganate ISCO, in conjunction with bioremediation should be considered further. For example, under some contaminant conditions, some CVOCs could be oxidized by MnO_4^-, and subsequently followed by biodegradation to target compounds such as 1,4-dioxane. A similar approach was proposed using persulfate. A potential advantage of this approach is that the MnO_4^- residuals (i.e., $MnO_2(s)$), are generally immobile and are projected to have less impact than SO_4^{2-} residuals on downgradient areas.

Specific Comments

7.2.1 - AOC#1: Shallow Soil – GCC Facility and Section 7.3 - Selected Remedial Action Alternative(s). It was reported in Section 7.3 that air sparging (AS) and soil vacuum extraction (SVE) would be used for AOC#1. Tentatively, AS/SVE appears appropriate and may successfully remove a large mass of contamination from the unsaturated zone. However, at some point in the future, if it is determined that AS/SVE exhibits treatment performance limitations (discussed below), one alternative involving remediation in AOC#1 is to treat the contaminated soil on-site and in-situ through the use of chemical oxidation. The proposed treatment interval in AOC#1 is 5-10 ft deep, which is amenable to soil mixing. Conceptually, an oxidant could be mixed into the soil using a track hoe, rotating head, or large diameter auger. Site specific conditions would impact which mixing method would be feasible and most effective. Further, there may be hot spot areas that persist using AS/SVE where either in-situ or ex-situ treatment could be useful. Excavated soil could be treated on-site using chemical oxidation in piles, in conjunction with an engineered covered and lined system to limit volatilization and leaching.

Section 7.2.1 AOC#1: Detailed Evaluation of Mechanical Controls. In this section, it was proposed to use SVE with AS. Air sparging involves gas transport through saturated media. Unfortunately, this technology is vulnerable to preferential pathways, and consequently, greatly hampered by heterogeneous and random distribution of air channels. Based on published studies, this condition significantly restricts contact between the air and water phase and limits mass transfer of contaminants from the water to the air. It was unclear whether this limitation was fully recognized in the technology review.

Section 7.2.2 AOC#2: Shallow Groundwater – GCC Facility and AOC#3: Deep Groundwater - Downgradient of GCC Facility, and Section 7.3 - Selected Remedial Action

Alternative(s). In the section entitled, AOC#2: Detailed Evaluation of In Situ Chemical Oxidation, the use of persulfate was proposed, and later selected in Section 7.3.

Specifically, a total liquid volume of 59,072 gallons of a 20% sodium persulfate solution was proposed to remediate the impacted soil. The sulfate (SO_4^{2-}) residual concentration from this initial chemical oxidant concentration would be approximately 200 g/L. The residual sulfate is projected to be mobile in the ground water and could potentially migrate downgradient and eventually discharge into the wetlands and other downgradient water bodies. The very high concentration of SO_4^{2-} could have a significant negative impact on the wetlands, and any other downstream water body receiving the SO_4^{2-} loading. It is recommended that this issue be taken into consideration. This comment and recommendation applies to both AOC#2 and AOC#3 where ISCO has been selected. Basically, the impact of the oxidant-sulfate residuals should be considered for any application of sodium persulfate at the site.

7.3 Selected Remedial Action Alternative(s). ISCO was selected for AOC's 2 and 3. Currently, given the design conditions, the projected oxidant loading (i.e. 60,000 gal; 20% sodium persulfate; 20,000 ft^3 soil) seems high. It is recommended that this issue be clarified.

7.3 Selected Remedial Action Alternative(s). In section AOC#2: Shallow Groundwater – GCC Facility, it was proposed to inject 60,000 gal, 20% sodium persulfate, into 20,000 ft^3 soil. Assuming a porosity of 0.3, 1 pore volume is roughly estimated to be 6000 ft^3 (44,880 gal). Therefore, the volume of oxidant injected is 134% of the pore volume. However, in AOC#3: Deep Groundwater - Downgradient of GCC Facility, it was proposed to inject 100,000 gallons of a 20% sodium persulfate into 810,000 cubic feet of soil. Assuming a porosity of 0.3, 1 pore volume is roughly estimated to be 243,000 ft^3 (1.82×10^6 gal). Therefore, the volume of oxidant injected is 5.5% of the pore volume. There seems to be a significant difference in the design of these two ISCO systems which may also impact the projected cost. It is recommended to clarify the discrepancy between these designs.

7.4 Feasibility of a Temporary or Permanent Solution (310 CMR 40.0861 (2)(d)). It was reported that, "There is no evidence that mobile DNAPL is currently present at the GCC site." This statement is somewhat misleading. It is recognized that the presence of DNAPL may be difficult to find and confirm. This was accurately described as the "heterogeneously distributed ribbons of DNAPL" at the site described in the report. However, there are numerous indicators that DNAPL is present and therefore the overall strategy at the site should be to fully recognize the implications of the GCC site as a DNAPL site. For example, accumulation of DNAPL on low permeable lithologic units, back diffusion of DNAPL components, limited mass transfer from DNAPL, grouting exploratory and aquifer sampling boreholes to prevent downward migration and cross-contamination, etc.

7.4 Feasibility of a Temporary or Permanent Solution (310 CMR 40.0861 (2)(d)). The feasibility of a achieving a temporary versus a permanent solution is discussed in detail. Several important mechanisms and others causes of remedial challenges and long term contamination are cited including DNAPLs, heterogeneous distribution of DNAPL, recalcitrant CVOCs, contrasting permeability and interbedded zones, and matrix- and back-diffusion. The Phase III

RAP report also reports that "Following implementation, the effectiveness of the remedial alternative(s) can be judged empirically, and thereafter, remediation may enter a more iterative process to determine the direction of the clean-up."

The general approach implied by this text is appropriate in that contaminant mass reduction be the initial focus and that subsequent evaluation will be needed to assess the effectiveness of cleanup after the Phase III RAP. This logical path forward should recognize the impact of Phase III RAP, regulatory requirements, exposure pathways and risks, and treatment options. Given the projected limitations of remediation cited above, there is a probability that at some point in the future, implementation of a permanent, long term treatment strategy will involve ground water treatment. In recent years, sustainable ground water pump and treat systems have been developed, designed, and deployed to lower treatment cost, to limit the use of natural resources, and to limit the carbon footprint (i.e., the Resolve Superfund site, North Dartmouth, MA). It is recommended that similar systems be considered for the Framingham, MA site. A short overview of the system is included below.

> EPA and the Re- Solve Site Group have collaboratively explored sustainable treatment enhancements to the traditional groundwater "Pump & Treatment" system on the Site. Two "Anaerobic Bio-Reactor" systems have been developed. These are underground, contained, biological treatment beds where the native microbes consume chlorinated volatile organic compounds. This is a natural treatment process that minimizes the use of process chemicals and waste disposal. A further enhancement is that 644 solar panels provide 100 percent of the power needed to run the groundwater treatment system.