NJDEP Technical Guidance Document: Response to Comments

Document: In Situ Remediation: Design Considerations and Performance Monitoring Technical Guidance Document

Comment Period: September 22, 2016 to November 3, 2016
Committee Co - Chairpersons: Joel Fradel, NJDEP, and Maria Van de Zilver, NJDEP

Comment #	Page	Section	Subsection	Comments	Final Response
1				1,4 Dioxane is a contaminant that is frequently found in groundwater at and beyond contaminated sites. The document does not appear to address performance monitoring of advanced oxidation processes for treatment and monitoring of this contaminant in a significant way. A comprehensive subsection for performance monitoring of effective treatment of this contaminant should be provided.	Performance montioring techniques are similar to other advanced oxidation processes. See Chem-Ox Section. This document does not go into great detail on any contaminants.
2				All performance monitoring reports should include inlet and outlet concentrations of contaminants of concern to determine effectiveness of the remediation system.	This document pertains to in-situ treatment.
3				All performance monitoring reports should include inlet and outlet concentrations of contaminants of concern to determine effectiveness of the remediation system.	Performance montioring techniques are similar to other advanced oxidation processes. See Chem-Ox Section. Guidance document does not go into great detail on any contaminants.
4		General		Overall, high-level assessment: This is a very good guidance document, containing useful and practical recommendations that, in general, follow internal recommended practices for the remedial technologies that our members commonly apply at their sites.	Considered, no change.
5		General		It may not be part of the scope of this Technical Guidance, but it seems that there is no discussion about risk prioritization and risk management decisions (i.e. the use of (limited) resources to remediate those sites that present a real human health or ecological risk vs. those that do not pose a risk). We would expect that, for high-risk sites, the approaches mentioned in the Technical Guidance would be applicable (e.g. active remedial technologies followed by MNA); however, what are acceptable approaches to follow for sites that are low-risk and, therefore, may not need aggressive remediation? There needs to be a framework that guides the environmental practitioner on the level of effort of the remediation.	This is beyond the scope of this document.

6		General		One general technology omission: There is no guidance provided for multi-phase extraction technology remediation performance, nor for groundwater extraction (as a plume treatment technology (e.g. for addressing brine plume concentration reduction, rather than hydraulic containment)). MPE, in particular, is one of our most widely used technologies, and has a relatively high potential to be ineffective or inefficient if key performance monitoring aspects are not followed. Though, from our perspective, it is not critical to add MPE to this Technical Guidance as our members have their own guidance; however, including MPE would make the document more complete.	This is beyond the scope of this document. Extraction technologies are not focus of this document.
7	7	2		Recommending the 3rd sentence be restructured to focus on the the in-situ aspect of the document: "This particular technical guidance documant details the performance monitoring associated with in-situ remediations used for treating both contaminated ground water and soil. This document is meant to enhance the performance language found in the GW SI-RI-RA document"	The sentence was restructured.
8	7	2		The document states it addresses both soil and grounwater contamination. A subsection 7.3 is provided on Page 109 for Remedial Action Permit for Groundwater but not Soil. Remidial Action Permit for Soil should also be included.	Not applicable. Soil RAPS apply to remediations consisting of institutional and engineering controls. Soils RAPS are not required for in-situ remedial actions.
9	9	3.1	5th Para	While it is noted that the Department does not approve RAWs (other than in specific circumstances), the implication of this should be made clear; specifically, the investigator should proceed with implementation of the RAW immediately following submittal.	The language commented on was edited to emphasize that while a discharge may be part of a remedial action, the DGW proposal is not part of the RAW, and that the DGW proposal must be approved by the Department.

10	10	3.1	2nd Para	In the remedial context, the primary intent of the monitoring plan in the DGW proposal is to evaluate the effectiveness of the remedy, not evaluate any potential negative impacts. While important, the latter should be considered secondary objectives.	Last paragraph of regulatory basis section was modified to clarify that the primary objective of monitoring under the **RAW** is to evaluate the effectiveness of the remedy but all remedies are to comply with the general RA requirements of N.J.A.C. 7:26E-5.1(d). The purpose of the PBR and DGW proposal is to permit discharges and discharge monitoring under a permit to ensure that any discharge was designed and is carried out in a manner that protects the environment and human health and safety and is consistent with the applicable GWQS & SWQS.
11	11	3.3	1st Para	The use of microbial cultures is specifically referred to as 'bioaugmnentation' and should be referenced as such .	Addressed in section 6.1.1
12	12	4	1	CCNJ/SRIN recommends adding the following key items related to performance monitoring: (1) Potential sensitive receptor analysis (only surface water bodies are currently included); (2) Understanding of whether the pathway between source and receptors is potentially complete; and (3) Current plume stability (i.e. stable, shrinking, expanding, etc.).	Added to bullet list in Section 4.1

13	13	4	2	One of the factors to be considered during the remedial technology screening is sustainability of the remedial action, and CCNJ/SRIN fully supports this inclusion; however, there is no mention of the sustainability (e.g. energy requirements, carbon footprint) of the different technologies throughout the document. CCNJ/SRIN recommends incorporating a general discussion about the sustainability of each remedial technology. CCNJ/SRIN also recommends that references on the subject be included in the document, such as SURF White Paper (http://www.sustainableremediation.org/library/issue-papers/), EPA's work (https://www.epa.gov/remedytech/green-remediation-incorporating-sustainable-environmental-practices-remediation, https://semspub.epa.gov/work/HQ/100000160.pdf, etc.), and ASTM standards E2876-13 and E2893-16. Since one of the main tenets of these sustainable remediation documents is that there is not a remediation technology that is more sustainable than another (it depends on the site and the application), the following should be included with these references: "It is important to conduct a sustainability evaluation of multiple technologies to help guide decision-making and remedy selection. A sustainability evaluation can also be done to help optimize an existing remedy, and it is even worthwhile to include sustainability when developing a strategy for a site."	This comment has been incorporated, as modified, into Section 4.2. Alternate and/or elimination of some references were incorporated into the document.
14	13	4	2.1	The determination of the presence or absence of residual/free product is important to the success of any insitu remediation approach, as the full contaminant mass must be accounted for in design calculations. CCNJ/SRIN recommends that the second paragraph of this subsection expand on this, as it currently only introduces this concept; examples of the use of the contaminant mass equations presented in Appendix A should be provided here. Also, an example where residual LNAPL is properly considered vs. not properly considered would be very helpful in showing the difference in contaminant mass demand, which ultimately will determine the success of the insitu approach.	Additional language and example calculation added to section

15	14	4	2.1	The 3rd and 4th paragraphs of this subsection discuss the regulatory requirements to manage LNAPL and common exsitu remedial approaches, respectively. CCNJ/SRIN recommends that this discussion be reduced to simply point investigators to the regulations and other guidance documents that address this topic (e.g. LNAPL Technical Guidance). As currently written, these 2 paragraphs, followed by the bulleted listed of free/residual product "indicators", emphasize the regulatory reporting aspects of free/residual product & LNAPL when, in practice, the investigator has already completed its site/remedial investigations and has already made the decisions/determinations. The goal of this Technical Guidance is to assist in the design and monitoring of successful insitu remediation programs. In addition, the free/residual product "indicators" is an example of the NJDEP's overly complex and contradictory regulation and policy on LNAPL Science and Management. The first bullet comes directly from regulation, and is a definition from other guidance. The second bullet comes from a Protocol that was not subject to any external stakeholder process (but remains part of the NJDEP policy), and from generally accepted industry practices. CCNJ/SRIN recommends that the NJDEP update its approach to managing free/residual product and LNAPL by adopting those developed by recognized organizations such as ITRC, ASTM, and API.	References added, but the listing of indicators of free and residual product remain. Commenter indicates goal of technical guidance is to assist in design and monitoring of a succesful in situ remedy. The committee agrees, but as part of that the investigator should know what the Department considers as indicators of product. The Department prohibits monitored natural attenuation as a remedy for free and residual product. If an investigator does not adequately address something that the Department considers to be product, the case may be delayed, the final remedy may be delayed, costs may go up, etc. Updating the approach that the Department uses for free and residual product is beyond the scope of this technical guidance.
16	20	4.2.3	4th Para	Regarding the issue identified in this paragraph, suggest also referencing (or summarizing) the attached tech notice from Regenesis ("Potential Liability from High-Presure Injection of Powdered Activated Carbon")	Change made.
17	22	4.3.1	General	In most cases, injection well screens should consist of wire wrapped stainless steel to insure for reagent delivery; PVC slotted screens are generally not acceptable.	Done, text added to 1st paragraph
18	30	5	4.1	CCNJ/SRIN recommends that the source monitoring wells be depicted as a transect to allow mass flux consideration.	Change made.
19	29	5.4.1	General	This section should also reference the Department's MNA guidance relative to issues associated with design of an appropriate monitoring well array.	Change made.
20		5	4.3	Sections 5.4.1 and 5.4.2 deal with monitoring the performance of in situ remedial tecchnologies in ground water and soil. Sections 5.4.3, 5.4.4, and 5.4.5 involve monitoring the impacts of in-situ remdial technologies (implemented in GW and Soil) on receptors. These are different things. The headers should be more clear. Currently it seems the sections involve performance monitoring of vapor, surface water and potable wells. Alternatively, you could create a new section on "Monitoring the impact of remedial technologies on receptors" and include info presented in sections 5.4.3, 5.4.4, and 5.4.5.	Change made.

21	36	6		While Section 6.0 provides a good review of the details behind the various methods, it also creates an expectation for a more expansive and detailed monitoring program. Although many areas are characterized as "suggested", the fact that they are part of this Technical Guidance may well necessitate that they be followed and, if not, that an explanation be provided for deviating.	This guidance document is intended to be flexible and allow investigator to use professional judgement. Pursant to 1.5(b) of the Tech. Rules however, an investigator is supposed to justify why they deviate from Technical Guidance but the rigorousness of the justification can be consistent with the context and meaning of the guidance text.
22	37	6		CCNJ/SRIN recommends including a clear definition of "source" in this Technical Guidance. "Source" could mean the ongoing leak, and sometimes the definition includes the presence of LNAPL in the subsurface. Looking at page 37, it is especially important to define "source" since it states that MNA is an appropriate remedy "when no source is present"; however, MNA can be an acceptable approach for source masses that are stable and attenuating over time and do not pose a human health or ecological risk.	The reference to source in Section 6 is from Section 4.1 (page 4 of 46 of Version 1, March 1, 2012) of the MNA tech guidance.
23	38	6.2	General	Suggest referencing the ESTCP BioPIC tool for evaluation of bioremediation approaches; it provdes the results of extensive field data compilation to evaluate site conditions relative to the optimal pathway for chlorinated solvent degradation: https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-201129/ER-201129	Change made.
24	41	6	2.1.1.2	CCNJ/SRIN recommends adding hydrogen sulfide to the 3rd bullet, as it has significant inhibitory effects on Dehalococcoides.	Change made.
25	41	6	2.1.1.2	CCNJ/SRIN recommends removing the 6th bullet. There is going to be methanogenesis since there has to be to provide hydrogen. Based on our experience, excess sulfate reduction would be of more concern.	Change made.

26	42	6	2.1.2	CCNJ/SRIN recommends revising the second paragraph as follows: "With respect to chlorinated **ethene** remediation, the most accepted form of bioaugmentation involves the use of anaerobic cultures belonging to different DHC **strains**. **Complete sequential dechlorination of PCE to ethene was demonstrated in 1997 (Maymo-Gatell, et al.). Metabolically and phylogenetically distinct subgroups include *D. ethenogenes*** , ...Different strains of DHC species...In general, microorganisms capable of degrading PCE and TCE to cis-DCE are ubiquitous and bioaugmentation may be most beneficial when **there is a low density of *D. ethenogenes*** ..." For your reference, a summary of the proposed revisions is below: (1) Change "ethenes" to "ethene", and "species" to "strains" in the first sentence. (2) Move the fifth sentence to be the second sentence and delete "by a single DHC species" and "for the species *Dehalococcoides ethenogens"* , and place the year in the sentence vs. the reference; the different strains were not known then so this sentence, as it reads currently, is implying something that had yet to be discovered. (3) Combine the current second and third sentences. (4) Simplify the current sixth sentence. Also, the species is spelled "ethenogenes", not "ethenogens"; this misspelling needs to be corrected throughout document. In addition, CCNJ/SRIN recommends that, after first usage, "*Dehalococcoides ethenogenes* " be abbreviated "*D. ethenogenes* ".	Change made.
27	43	6	2.1.2	CCNJ/SRIN recommends revising/clarifying the first sentence of the last paragraph. There is no bioaugmentation of petroleum hydrocarbons; it appears this section is intended to show that bioaugmentation can be used for other contaminants, such as BTEX and PCBs.	Done
28	44	6	2.1.2.2	CCNJ/SRIN recommends removing the third bullet. It does not seem useful to have such general information when you can get much more specific information about activity with molecular analyses.	Done
29	44	6	2.1.3.1	Re: the second paragraph, performance monitoring wells should not be very far downgradient of the PRB or else you will be measuring existing, back diffused contaminants in the dissolved phase. Instead, they should be immediately after the PRB, and also in a transect formation.	Agreed; text modified

30	48	6	2.1.4.2 Table 1	CCNJ/SRIN suggests that "recommended" (vs. "required") analysis for total iron, manganese, and chloride be listed instead; in our experience, analysis of total iron, manganese, or chloride is not very useful. CCNJ/SRIN also recommends changing the following "recommended" analyses to "required": dissolved ethene, ethane, and methane; TOC; all field parameters, especially pH since it is so critical to Dehalococcoides. A discussion on this critical parameter needs to be included in the text.	Scope of this document is to provide guidance for sample analysis; Required parameters shown in the Tables are for DGW Permit sampling not for the overall remedial action monitoring; text added to explain the importance of pH to bullets in Section 6.2.1.1.2
31	49	6	2.2.1	CCNJ/SRIN recommends that the Air Force protocol be referenced.	Change made.
32	54	6	2.2.3.2 Table 2	CCNJ/SRIN recommends changing "recommended" analyses to "required" for all field parameters; these are inexpensive and easy, and provide valuable information.	Change made.
33	57	6	3.2	This subsection lacks references, and discusses application of surfactants in a manner that seems unfamiliar; they are not left in the ground for a period of time, but rather injected/added and then pulled through the formation in a line drive or 5-spot. Also, a well designed application is a one-time event; there are not multiple applications.	References added, text modified; however the comment on one-time events is not consistent with the committee's experience.
34	59	6	3.2.2.2	NAPL thickness in the remediation wells is typically the primary line of evidence to determine the success of the remedial program; however, NAPL thickness can be inconsistent under varying hydrostatic conditions (i.e. perched, fluctuating, and confined). In such cases, the same NAPL mass would exhibit different thicknesses in different soil types and hydrostatic conditions. CCNJ/SRIN recommends that NAPL transmissivity, which is a parameter that describes the potential for NAPL to move through the porous media, be added as a metric to measure NAPL recoverability or the performance of a recovery program. When calculated and used appropriately, a decreasing transmissivity indicates that the NAPL mass is decreasing or has reached asymptotic recovery levels.	Change made.
35	77	6	3.5	The last sentence of the first paragraph on this page is incomplete.	Sentence revised
36	79	6	3.5.7	CCNJ/SRIN recommends revising/clarifying the first sentence, as it seems to imply that peroxide (vs. calcium peroxide) is a mild oxidant.	Sentence revised

37	83	6	3.5.8.2 Table 4	CCNJ/SRIN recommends changing "recommended" analyses to "required" for all field parameters, especially DO, and moving oxidant to the Lab Parameters section. CCNJ/SRIN also recommends changing "required" analysis to "NA" for oxidant under the Fenton's/Hydrogen Peroxide and Ozone columns; oxidant is too short lived to be adequately measured.	The language has been modified to indicate that these are standard field parameters. Committee considered but felt it should stay in the field monitoring section based on process monitoring and the availablity of field kits. Oxidants are required under the DGW Permit and recommended for effectiveness monitoring.
38	85	6	3.6.1	There are many other reagents that can be used for insitu treatment of Cr6+, such as ascorbic acid, dithinoate, ferro-black, and MRC, just to name a few. CCNJ/SRIN recommends that this Technical Guidance at least state this fact, and suggest that appropriate monitoring programs should be proposed. While the discussion of the individual technologies in Section 6.0 may not be necessary, if this subsection is to remain, all other technologies should be included and discussed. It is also important to note that this methodology can be applied to other multivalent metals, such as uranium, selenium, vanadium, etc.	Change made.
39	86	6	3.6.1.2	The recommendation for multiple post-injection sampling events is overly conservative. Typically, one does not see such great variability at sites to warrant 8, or even 4, sampling events; therefore, the recommended number of events would not yield more useful information.	The number of post-remediation sampling events is designed to provide a suitable data set to demonstrate that down-gradient constituent concentrations are attenuating as predicted. However, to provide for flexibility, we have changed 8 quarters of monitoring from a minimum requirement to a recommendation
40	87	6	3.6.1.2	Re: the statement below, testing for individual parameters, such as Fe and Mn, is redundant and may be counterproductive. CCNJ/SRIN recommends accounting for such things in ambient demand testing, as one cannot accurately model the effects of individual metals and ions. “Groundwater field parameters measured during each round should include water level, temperature, specific conductance, pH, ORP, and DO. Groundwater laboratory analytical parameters should include total Cr, Cr^{VI+}, Mn, Fe, Hardness, TDS, sulfide, and sulfate. In formations consisting of glauconitic sands, silts and/or clays or where anthropogenic sources of arsenic may be present, arsenic should be monitored in order to determine if it is remobilized due to the CaSx injection. Increased sulfate concentrations can result in degradation of local concrete structures, including building foundations and monitoring well grout.”	Monitoring for indivicual parameters is necessary, as ambient concentrations of these parameters, such as Fe and Mn may be significantly affecty by the remedy. These parameters should be included in the monitoring program to ensure that concentrations of these parameters do not exeed the NJDEP GWQS, and if they do, to ensure that these parameters are included in the CEA.

41	88	6	3.6.2.1	CCNJ/SRIN recommends that pH be emphasized more in the first paragraph, as it is a critical and an inexpensive indicator. The reaction between chlorinated solvents and ZVI produces OH-, so the pH should increase; this is an easy performance indicator. CCNJ/SRIN also recommends that monitoring of biological indicators be optional; the purpose of adding ZVI is to bring about the chemical reduction process, although biological reductive dechlorination may also be happening since we are in the subsurface, and not in a laboratory. In addition, there is no mention of acetylene, which is the "gold standard" for abiotic chlorinated solvent degradation.	Section amended to address comments.
42	89	6	3.6.3	Again, this subsection lacks references, and discusses application of surfactants in a manner that seems unfamiliar; they are not left in the ground for a period of time, but rather injected/added and then pulled through the formation in a line drive or 5-spot.	References added, text modified; however the comment on one-time events is not consistent with the committee's experience.
43	90	6	3.6.3.2 Table 5	CCNJ/SRIN recommends changing "recommended" analyses to "required" for all field parameters. CCNJ/SRIN also recommends deleting the "Emulsified Vegetable Oil" column from Table 5 and moving it to Table 1 since the addition of EVO is well known as an enhanced anaerobic biodegradation substrate.	Done
44	92	6	4	The implication is that boiling of various COCs is a key mechanism; however, it should be noted that simple thermally enhanced volatilization at temperatures below the boiling point of the COCs or various azeotropes is frequently a significant mechanism which can occur at temperatures far below the boiling point.	Language amended
45	93	6	4.1	Again, the implication is that boiling is required for this process to work, where boiling is a condition where the vapor pressure of the compound or compounds is equal to the atmospheric pressure; however, it should be noted that thermally enhanced remediation is also possible at temperatures which do not reach the boiling point of the COCs or water. Due to increases in vapor pressure due to the temperature increase, water and COCs will make up a larger percentage of the recovered vapor.	See amended text and bullet list in 6.4
46	93	6	4	The bulk of parameters that are listed as "monitoring" considerations appear to be more properly described as "design" considerations.	Language amended
47	94	6	4.1	CCNJ/SRIN recommends expanding the discussion of lower temperature ERH in the past paragraph to include thermal enhancement of volatility at temperatures below the boiling point of the COCs, which is particularly applicable where generation of secondary permeability (e.g. desiccation cracks) is not required to facilitate vapor flow.	Comment addressed above.

48	96	6	4.4.1	CCNJ/SRIN recommends including language in the discussion on vapor monitoring that indicates "vapor sampling procedures need to account for the presence of a hot condensing vapor".	Text modified
49	96	6	4.4.2	CCNJ/SRIN recommends adding language that indicates "mass recovery rate vs. energy input is a key performance parameter for evaluating system efficiency". Also, the fourth sentence of the first paragraph is incomplete.	Done
50	97	6	4.4.2	Where thermal enhancement of biodegradation is desired, monitoring changes in key parameters (e.g. electron acceptors, vadose zone carbon dioxide concentration, microorganisms) can help determine if the thermal enhancement is effective.	While there could be a benefit to determining the mechanizm for biodegredation it is not necessary to evaluate the effectivness of biodegradation.
51	130	Appendix C		CCNJ/SRIN recommends adding the following non-ionic food-grade, biodegradable surfactant products to the list in Appendix C, as they have been successfully applied by our members. Product: Gold Crew Accelerate + (REM-E002) Manufacturer and distributor: Environmental Chemical Solutions, Washington, USA (877) 253-2665 www.ecschem.com Product: IveySol Available from EnviroSupply: http://www.envirosupply.net/cgi-bin/page.cgi?product=Ivey-Sol, or directly from the manufacturer (Ivey international): http://www.iveyinternational.com/technical_support.php Information about IveySol: http://www.iveyinternational.com/pdfs/Ivey-sol_Remediation_Information.pdf Product: EnviroClean (EC-165) Manufacturer: EnviroClean Products, LLC, Oklahoma, USA Distributor: Bio-Protect, Hidalgo, TX, USA; (956) 843-5221 www.bioprotect.net	Done