Attachment to LSPA Cover Letter: Compilation of Comments from the LSPA

Second Public Review Draft

LIGHT NONAQUEOUS PHASE LIQUIDS (LNAPL) AND THE MCP:
GUIDANCE for SITE ASSESSMENT AND CLOSURE
Policy #WSC-14-450

The following are collective comments from the LSPA. Page numbers refer to the Public Review Draft made available electronically in pdf. Every effort has been made to state the issue of concern, provide a specific example wherever possible and propose suggested language changes where appropriate.

LNAPL Guidance		
Page No.	**Section**	**Comment**
1	**2.0**	The guidance is limited to LNAPL in porous media. Guidance from MassDEP on LNAPL in bedrock and DNAPL is also needed.
5	**2.1**	Figure 1 seems to imply that some pores within an LNAPL-impacted zone will be fully saturated with LNAPL. It is more accurate to include language to indicate that even the most heavily LNAPL-impacted pore space will contain some water and/or air.
5	**2.1**	Last line of second paragraph states in part: *"…but the water present in smaller pore areas will be held tightly in place by capillary forces, causing the LNAPL globules to travel in a different direction (see Figure 1)."* [highlight added] Suggest changing the highlighted text to "inhibiting LNAPL migration into those smaller pores."
6	**2.1**	Suggest replacing the fifth paragraph of Section 2.1 (first full paragraph on page 6 that begins "In theory,…") with the following revised text: "Once the LNAPL release is halted (i.e., the spill/release is terminated),

		within a relatively short period of time (on the order of 1-2 years) a quasi-equilibrium state will become established where the lateral and vertical extent of the LNAPL-impacts will be largely stable (not migrating/expanding with time). At this point, the overall footprint of the LNAPL will cease to expand and the LNAPL is said to have *Macro-Scale Stability*. Localized mobility of LNAPL may persist within the stable LNAPL body, as LNAPL moves into and out of the pore space (and into and out of wells) largely due to fluctuations in hydraulic conditions."
6	**2.1**	Third from last paragraph of Section 2.1 states in part: *"In coarse soils (with large pore spaces), up to 70% of the pore spaces at and just below the water table interface could be filled with LNAPL, with the remaining 30% filled with water that could not be displaced by the migrating LNAPL globules. In finer grained soils, the maximum LNAPL saturation value could be less than 70%, as water present in smaller pore spaces is more closely held in place via capillary forces, making it harder for migrating LNAPL globules to displace."* Suggest adding a statement at the end of this paragraph that "At most LNAPL sites, LNAPL saturations will be found to be much lower than 70%."
11	**2.4**	Second paragraph states: *"The LNAPL Transmissivity metric provides a discrete numerical value that: (1) has nationwide regulatory precedent and acceptance; (2) has been confirmed and/or endorsed by a number of researchers; and (3) can indicate a point at which recovery (or further recovery) of LNAPL may be considered infeasible. The API and ASTM T_n methods listed in Section 6.0 – which include a method for direct-push micro-wells -are among the more recognized for determining LNAPL Transmissivity. The ITRC has reported that regulatory programs in a number of states have granted "no further action" status to sites that have demonstrated or achieved a T_n value of between 0.1 and 0.8 ft^2/day."* The highlighted text may be overstating the acceptance of LNAPL transmissivity. Suggest replacing the highlighted text with something like "is a science-based metric that correlates much better with LNAPL mobility and recoverability than in-well LNAPL thickness and is gaining more regulatory acceptance over time".

		Suggest inserting "*conventional*" in front of recovery in item (3), i.e. "…point at which conventional recovery."
12	**3.0**	Under the heading of "Permanent and Temporary Solutions" the second bullet point reads: *"At sites with* ***NAPL with Micro-scale Mobility, a Permanent Solution may be achieved****, but only after NAPL is removed if and to the extent feasible, as specified at 40.1003(7)(a)(2.) and described in Section 4.2, and all other MCP cleanup requirements relating to source and migration control and risk management are achieved. If NAPL with Micro-scale Mobility remains,* ***an AUL is required****, as specified at 40.1012(2)(d) and described in Section 4.3."* Since a NAPL body must by definition possess micro-scale mobility in order to be non-stable, the LSPA suggests more clearly differentiating between macro-scale mobility and micro-scale mobility by adding the highlighted text: "At sites with **stable** **NAPL with Micro-scale Mobility,** ***a Permanent Solution may be achieved****, but only after NAPL is removed ……"*
17	**4.1.2**	The LSPA believes the LNAPL guidance/policy should incorporate the use of redoxymorphic features as an additional or alternative means of determining seasonal water table fluctuations, along with monitoring well gauging. The use of soil evaluation of redoxymorphic features would be a benefit in environmental determination of seasonal high and low groundwater elevations, because this evaluation can be performed at any time of year and does not depend on having to gauge groundwater over extended periods or in particular seasons. Suggest adding to the end of the 5th complete paragraph in Section 4.1.2 a statement that "Acceptable methods to assess the groundwater elevation range at a site include evaluation of redoxymorphic features and well gauging."
18	**4.1.2**	The following line of evidence is discussed on Page 18:

		*"**Pore Entry Pressure Correlations:** Another well-known and referenced use of measured LNAPL thicknesses in a well is the correlation between soil type, LNAPL type, and "pore entry pressure," which equates to the height of a column of LNAPL (i.e., LNAPL thickness). Exceeding this pressure (or measured height of LNAPL) can indicate potential LNAPL migration. While "real world" site conditions are variable, this theory is sound and its use (with appropriate caution) as a Line of Evidence is simple and has regulatory precedent. Examples and applications of this approach, prepared by Golder Associates, were published by the British Columbia Ministry of Environment (2006 and 2010)."* It should be noted that this line of evidence is only valid to describe LNAPL moving into only water wet pore space (i.e., not impacted with LNAPL), and therefore is only potentially applicable along the very periphery of an LNAPL body (where a front may be advancing). As is stated throughout the draft guidance, most LNAPL bodies will stabilize in short timeframes following the cessation of a release (on the order of 1-2 years), and in many cases, large in-well LNAPL thicknesses will persist at these sites that are not representative of a driving migration head. Therefore, this approach can and will lead to very misleading/erroneous conclusions on migration potential at the many old, stable LNAPL bodies that have no residual LNAPL head that might drive new migration, no significant mobile/recoverable fraction, but still have large in-well LNAPL thicknesses that will be incorrectly compared to the pore entry pressure calculations.
18-19	**4.1.2**	In the discussion of "**Recovery Decline Curve Analysis**", the following points could be mentioned: • the x-intercept of a linear best-fit line through the latter portion of the Decline Curve represents the maximum volume of LNAPL that is theoretically recoverable via a given system operating under a given set of conditions • a semi-log plot of cumulative recovery vs. time can allow a projection of how much longer a given system may need to operate in order to recover the volume of LNAPL predicted by the Decline Curve • the difference between the cumulative recovery at a given point in time and the theoretical maximum predicted via Decline Curve provides an estimate of the fraction of the remaining LNAPL that might be mobile/recoverable, which in turn provides information relating to the overall stability of the LNAPL
19	**4.1.2**	In the discussion of LNAPL transmissivity, it could be clarified that an exceedance of the commonly

		accepted de minimis range from ITRC means that a minimum LNAPL recovery rate might be sustainable such that LNAPL recovery might be considered technically feasible. While it is true that LNAPL transmissivity is becoming commonly accepted as a maximum extent practicable demonstration, LNAPL transmissivity provides no information as to whether LNAPL recovery would be required or might provide some benefit with reference to potential saturation-based remedial drivers (e.g., to stabilize the LNAPL body) or whether LNAPL recovery might actually effect a tangible change in conditions (i.e., the fraction of LNAPL that is recoverable may be very small/negligible regardless of the presence of elevated T_n values).
24	**4.2**	Third paragraph states the following: *"It is MassDEP's position that the feasibility evaluations conducted at these and similar sites with conditions of high concern consider the full range of LNAPL remedial options, including excavation and conventional (hydraulic/vacuum recovery) technologies as well as alternative/innovative technologies (e.g., ISCO, soil flushing, soil heating), and that remedial operations deemed to be feasible are to be maintained for as long as it is necessary to eliminate these conditions."* Only active remedial techniques are mentioned; however, controls may be as or more effective at mitigating risk due to the technical limitations on what might reasonably be accomplished by active methods and implementability issues. This paragraph does not appear to allow for this possibility.
24	**4.2**	Fourth paragraph states the following: *"In contrast to the discussion above regarding sites of high concern, many sites contain relatively small quantities of oil or waste oil LNAPL, where (i) the LNAPL mobility is limited to Micro-scale Mobility, (ii) the LNAPL is not impacting drinking water, creating vapor pathways of concern or posing any other significant exposure threats, and (iii) the Source Elimination and Migration Control requirements of the MCP have otherwise been achieved. When these less serious and less time-critical conditions are considered along with the long-term biodegradation potential of petroleum LNAPLs, the balance of the benefit/cost evaluation for remedy selection is significantly shifted."*[highlight added]

		The LSPA suggests the highlighted text be removed as the reference to size is qualitative and subjective, and the other conditions contained in the paragraph are really what matter.
25	**4.2**	Fourth paragraph states the following in relation to soil flushing, steam/hot air injection, electrical resistance/radio frequency heating, and in-situ chemical oxidation: *"While these treatment technologies may be more costly than conventional systems, they can generally achieve a higher level of LNAPL recovery or control and may be appropriate or required in some cases depending on site circumstances."* The LSPA suggests the following: "While these treatment technologies may be more costly than conventional systems, they may be able to achieve a higher level of LNAPL recovery. However, they may also have much more remedial risk associated with them. Nonetheless, their use may be appropriate or required in some cases depending on site circumstances."
	4.2	There is no mention of sustainability considerations or net environmental benefit in the evaluation of the feasibility of remedial options. Given that many sites will be found to be stable/non-migrating, will have limited recoverable fractions, and will not present unacceptable exposures (or potential exposures can be easily and effectively be controlled), the remediation of LNAPL sites will often not provide any technical benefit in terms of the mitigation of migration potential or risk. In other words, the only applicable remedial driver will often be the regulatory requirement to recover LNAPL to the maximum extent practicable, which in this common case will be simply prescriptive rather than risk-based, particularly since most of the LNAPL is likely to remain as unrecoverable residual anyway. The consideration of remedial risk and the direct or indirect environmental emissions (e.g., carbon footprint) of potential remedial activities themselves is therefore a very important one. This section could be revised to better reflect the MCP requirements at 40.0858 (4)(5) and (6).
29	**5.3**	Last paragraph states, in part: *"These proactive investigatory steps shall include as appropriate soil borings, test pits, groundwater monitoring wells, and/or soil cores/samples."*

		The LSPA suggests revising the end of this sentence to read "…wells, soil cores/samples, and other site characterization technologies that may be considered scientifically sound."
	Before Section 6.0	Due to the complexity of LNAPL behavior, the LSPA believes that FPT does not correlate to meaningful metrics for LNAPL mobility or recovery. While MassDEP's initial draft LNAPL guidance presented information reflecting current scientific thinking, the LSPA expects this landscape to be changeable in the near term future. As the science of the assessment and remediation of LNAPL rapidly evolves, so will justifiable technical approaches. The LSPA suggests that MassDEP consider adding a short new section that just precedes Section 6.0 "Recommended Supporting Technical References" called something like "State of the Science." This section can acknowledge that investigators may consider current state of the art when evaluating NAPL and also reaffirm, as in other MassDEP guidance documents, that LSPs can use technical justification to depart from guidelines. This approach has the added benefit of allowing MassDEP to easily incorporate new science by putting out Technical Updates from time to time (as done for Sediment Screening and RCRA LDR). These might be easier to develop and disseminate, and in practice carry the same weight as the more detailed guidance document.
39	**Appendix I**	Suggest adding the MCP definitions of Migration Pathway (40.0006), Source Elimination or Control (40.1003) and Migration Control (40.1003) to the definition section here.
General		With the increasing awareness of the central role that natural attenuation (i.e., natural source zone depletion) will play in the remediation/management of petroleum LNAPL sites, MassDEP might consider adding a discussion of natural attenuation and the appropriate role of natural biodegradation processes in progressing towards a Permanent Solution.