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ENVIRONMENT PROTECTION
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INFORMATION SHEET 9

Management of groundwater impacted by light non-aqueous phase liquids (LNAPL)

Purpose: This information sheet provides information on the management (assessment and remediation) of LNAPL impacted groundwater

Background

Non-aqueous phase liquids (NAPL) are hydrocarbons that exist as a separate, immiscible phase when in contact with water. Differences in the physical and chemical properties of water and NAPL result in the formation of a physical interface between the liquids which prevents the two fluids from mixing.

NAPL are typically classified as either light nonaqueous phase liquids (LNAPLs) which have densities less than that of water, or dense nonaqueous phase liquids (DNAPLs) which have densities greater than that of water.

The ACT Environment Protection Authority (EPA) has adopted the NAPL definition from the Victoria EPA, Groundwater Sampling Guidelines, (April 2000), namely:

"Non-aqueous phase liquids – A liquid which has low solubility in water that is in sufficient quantity to form a discrete layer or separate phase"

For the purposes of practicality the EPA defines a "discrete layer" as being a thickness of NAPL of **3mm** or greater as measured by an interface probe**.**

Requirements

The EPA expects that steps are taken to identify any release of LNAPL as soon as practicable and that any release is stopped.

In addition to stopping any further release the following outlines the EPA's general expectations in relation to the management and remediation of LNAPL contamination.

Where LNAPL has been identified at **3mm** or greater at a site a follow-up gauging event must be performed within three (3) months of its original detection. Where LNAPL is again detected at **3mm** or greater active remediation or ongoing management of the LNAPL is required.

Notification

The presence of LNAPL in groundwater constitutes material or serious environmental harm under the *Environment Protection Act 1997* (the Act) and the person responsible for the activity associated with the contamination or land subject to the contamination **must** notify the EPA in accordance with section 23A of the Act. There are significant penalties under the Act for failure to notify the EPA.

Environmental Audit

Where LNAPL contamination is identified it is required that an independent EPA approved contaminated land auditor (section 75 of the Act) be engaged to review the adequacy of all assessment and remedial works and any proposed management strategies for the site.
The audit must:

- determine the nature and extent of contamination both on and off-site;
- determine the appropriateness of the assessment and remedial actions undertaken to date and the appropriateness of any proposed assessment and management strategies for the site; and
- assess the risks to human health and the environment both on and off-site from all identified impacts.

Where unacceptable risks are identified the EPA may also require an audit into the suitability of the land for the permitted and approved uses from a contamination perspective.

Assessment

Where LNAPL has been detected a LNAPL Conceptual Site Model (LCSM) must be developed by a suitably qualified environmental consultant as part of the site assessment process.

LNAPL contamination should be characterised in accordance with the *CRC CARE Technical Report 34: A practitioner's guide for the analysis, management and remediation of LNAPL.*

Additional references to consider when developing a LCSM and undertaking an assessment and any required remediation in the ACT include:

- *ACT EPA Contaminated Sites Environment Protection Policy, 2017*
- *Assessment of Site Contamination National Environment Protection Measure 1999 (as updated 2013)*
- *PFAS National Environmental Management Plan, 2018 (as updated from time to time).*

Management of groundwater impacted by LNAPL

Risk assessment

A LCSM should be used to identify potential risks. Depending on the risks identified, a qualitative or quantitative risk assessment may be required.

The risk assessment must follow appropriate guidance documents including:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Schedule B4 Guideline on Site-specific Health Risk Assessment Methodology*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Schedule B5a Guideline on Ecological Risk Assessment*
- *CRC CARE Technical Report 23: Petroleum hydrocarbon vapour intrusion assessment: Australian guidance*.

Remediation - LNAPL clean up

Any remedial action must demonstrate that there are no unacceptable risks to human health, the environment and the beneficial uses of the groundwater.

The results of the risk assessment will guide the level of LNAPL clean-up that is required. LNAPL needs to be cleaned up to such an extent that further removal or treatment of LNAPL no longer reduces the level of risk. In any case, LNAPL clean-up should continue if the LNAPL is still spreading. The need for LNAPL clean-up would also be indicated by a dissolved phase plume that continues to spread.

The technologies used for the clean-up of LNAPL should be carefully selected and implemented. Relevant guidance should be considered including:

- *CRC CARE Technical Report 34: A practitioner's guide for the analysis, management and remediation of LNAPL*
- *CRC CARE Technical Report 18: Selecting and assessing strategies for remediating LNAPL in soils and aquifers.*

Dissolved phase and vapour phase plumes

LNAPL petroleum hydrocarbons in the subsurface may provide an ongoing source for the dissolution of substances into groundwater resulting in a spreading dissolved phase plume. LNAPL and the dissolved phase petroleum hydrocarbon plumes can pose risks to human health and/or the environment from: vapour intrusion; groundwater extraction and use; seepage of contaminated groundwater (for example into adjacent basements); discharge of contamination into surface waters; explosion. These risks must be appropriately assessed, monitored and managed.

Ongoing management

Once active clean-up efforts have finished there is often a need for ongoing groundwater monitoring and long-term management. Ongoing management can involve measures such as the implementation of a long term Monitored Natural Attenuation (MNA) Strategy.

A MNA Strategy can address risks associated with dissolved phase and vapour phase plumes in groundwater. MNA guidelines include:

- *CRCCARE Technical Report 15: A technical guide for demonstrating monitored natural attenuation of petroleum hydrocarbons in groundwater*
- *NSW EPA's Guidelines for the Assessment and Management of Groundwater Contamination.*

Where on-going monitoring and/or management is required a Site Management Plan (SMP) must be implemented. The SMP must be developed by a suitably qualified environmental consultant and supported in writing by the Auditor and the EPA. The SMP is required to identify and manage potential risks to human health and the environment from the hydrocarbon release.

Where monitoring is required under the SMP, LNAPL persists and/or an increased risk is identified the monitoring data must be reviewed annually by the Auditor.

The SMP is to remain in force at the site until the Auditor and the EPA agree in writing that site management is no longer required.

Explosion risk

The accumulation of vapours from LNAPL may pose an explosion risk. This Information Sheet does not address explosion risk. It is important that this risk is recognised and appropriately assessed and managed.

For further information on managing explosion risk, including action levels for immediate or short-term response, see *CRC CARE Technical Report 23 Petroleum hydrocarbon vapour intrusion assessment: Australian guidance*.

For more information

Contact the Environment Protection Authority by contacting Access Canberra on 13 22 81 or www.accesscanberra.act.gov.au

* *Information reproduced in part from the NSW EPA Technical Note: Light Non-Aqueous Phase Liquid Assessment and Remediation 2015*

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