

Berrimah Rail Terminal, Export Drive, Berrimah, NT

22 November 2024

Site Audit Report





Document Information

Site Audit Report,

Berrimah Rail Terminal, Export Drive, Berrimah, NT

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Senversa acknowledges the traditional custodians of the land on which this work was created and pay our respect to Elders past and present.



Contents

List of Acronyms	vi
1.0 Introduction	1
1.1 General and Audit Purpose.....	1
1.2 Audit Details	3
1.3 Notifications and Regulation	4
2.0 Site Information.....	7
3.0 Environmental Setting.....	9
3.1 Topography and Hydrology.....	9
3.1.1 Topography	9
3.1.2 Hydrology	9
3.2 Geology.....	9
3.2.1 Regional	9
3.2.2 Audit Site.....	10
3.3 Hydrogeology	10
3.3.1 Regional Hydrogeology.....	10
3.3.2 Groundwater Use	10
3.3.3 Local Hydrogeology	11
3.3.4 Relevant Environmental Values of Water	11
4.0 Audit Site History.....	12
4.1 General Site History.....	12
4.2 Spill Event History.....	12
4.3 Investigation / Assessment History	12
5.0 Chemicals of Potential Concern.....	14
6.0 Assessment Criteria	15
6.1 General	15
6.2 Soil	16
6.3 Sediment.....	16
6.4 Groundwater and surface water.....	17
7.0 Scope, Outcomes and Adequacy of Investigations	18
7.1 Greencap (2020a) – Draft Updated Interim Remediation Action Plan.....	19
7.2 Greencap (2020b) Groundwater Monitoring Event (GME) – July 2020.....	21
7.3 Greencap (2020c) Groundwater Monitoring Event – October 2020	23
7.4 Greencap (2021a) Groundwater Monitoring Event – January 2021	26
7.5 Greencap (2021b) Groundwater Monitoring and Management Plan.....	30



7.6	Greencap (2021c) Detailed Site Investigation	31
7.7	Greencap (2021e) Groundwater Monitoring Event, Annual Report – July 2021	34
7.8	Greencap (2021g) Surface Water and Sediment Sampling Report (February to September 2021).....	37
7.9	Greencap (2022a) Sampling, Analytical and Quality Plan – February 2022	39
7.10	Greencap (2023b) Detailed Site Investigation Report – Addendum (March 2023)	40
7.11	Greencap (2023c) Groundwater Monitoring and Management Plan (July 2023).....	43
7.12	Greencap (2023d) Environmental Management Plan (February 2024)	44
7.13	Agon Environmental (2024a), Sampling, Analytical and Quality Plan (6 November 2024)..	45
7.14	Agon Environmental (2024b); Soil Investigation Report (6 November 2024).....	46
8.0	Conceptual Site Model and Risk Assessment	47
8.1	Auditor CSM.....	47
8.2	Auditor Risk Assessment	50
9.0	Audit Determination, Conditions and Recommendations	52
9.1	General	52
9.2	Audit Determinations.....	52
9.2.1	Nature and Extent of Contamination.....	52
9.2.2	Appropriateness of Remediation / Management Plan	53
9.3	Audit Conditions	53
9.4	Audit Recommendations.....	54
10.0	Other Relevant Information.....	55
11.0	References.....	56

DRAFT



Tables in Text

Table 1: Audit Details	3
Table 2: Audit Notifications and Regulation	4
Table 3: Audit Site Information	7
Table 4: Audit Site Soil Profile / Geology	10
Table 5: Soil Assessment Criteria	16
Table 6: Sediment Assessment Criteria	16
Table 7: Groundwater and Surface Water Assessment Criteria	17
Table 8: Review of Greencap (2020b)	21
Table 9: Review of Greencap (2020c).....	23
Table 10: Review of Greencap (2021a)	26
Table 11: Review of Greencap (2021c).....	31
Table 12: Review of Greencap (2021e)	34
Table 13: Review of Greencap (2021g)	37
Table 14: Review of Greencap (2023b)	40
Table 15: Review of Agon (2024b).....	46
Table 16: Auditor Conceptual Site Model.....	47
Table 17: Auditor Risk Assessment	50

Appendices

Tables

Appendix A: Consultant Figures

Appendix B: Notifications and Relevant Regulatory Correspondence

Appendix C: Report and Information

Appendix D: Audit Criteria Tables



List of Acronyms

Acronym	Definition
Measures	
%	per cent
µg/L	Micrograms per Litre
ha	Hectare
m	Metre
mAHD	Metres Australia Height Datum
mbgl	Metres below ground level
mg/kg	Milligrams per Kilogram
ppm	Parts Per Million
General	
ACT	The Northern Territory Waste Management and Pollution Control Act 1998
ADWG	Australian Drinking Water Guidelines
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
AOD	Authorised Officer Direction
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999, as amended 2013)
ASRIS	Australian Soil Resource Information Centre
BaP	Benzo(a)pyrene
BGL	Below Ground Level
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes & Naphthalene

Acronym	Definition
CH ₄	Methane
COC	Chain of Custody
COPC	Chemicals of Potential Concern
CRC Care	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSM	Conceptual Site Model
CWB	California Water Boards
DO	Dissolved Oxygen
DGV	Default Guideline Value
DQO	Data Quality Objective
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ESL	Ecological Screening Level
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
GMMP	Groundwater Monitoring and Management Plan
HIL	Health Investigation Level
HSL	Health Screening Level
LNAPL	Light non-aqueous phase liquids
LOR	Limit of Reporting
ML	Management Limits



Acronym	Definition
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Non-Limiting
NAPL	Non-aqueous phase liquids
NEPC	National Environment Protection Council
NT EPA	Northern Territory Environment Protection Authority
OCPs	Organochlorine Pesticides
OPPs	Organophosphorus Pesticides
ORA	One Rail Australia (now Aurizon)
ORP	Oxygen Reduction Potential
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
pH	A measure of acidity, hydrogen ion activity
PID	Photoionisation Detector
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RAP	Remediation Action Plan
RMP	Remediation Management Plan
RPD	Relative Percent Difference
SAN	Site Audit Notification
SAQP	Sampling and Analysis Quality Plan
SAR	Site Audit Report
SAS	Site Audit Statement
SVOCs	Semi Volatile Organic Compounds
SWL	Standing Water Level
TDS	Total Dissolved Solids

Acronym	Definition
TEQ	Toxic Equivalent Quotient
TPH	Total Petroleum Hydrocarbon
TRH	Total Recoverable Hydrocarbon
VOCs	Volatile Organic Compounds
WHO	World Health Organisation
WQM	Water quality meter



1.0 Introduction

1.1 General and Audit Purpose

An environmental audit program (audit) as defined under Part 6 of the Northern Territory *Waste Management and Pollution Control Act 1998 (the Act)* has been conducted at the Berrimah Freight Terminal located at 338 Berrimah Road and 75 O'Sullivan Circuit, East Arm, NT (the site). The audit site is an operational freight rail terminal which One Rail Australia (ORA) (now Aurizon Ltd (Aurizon)), currently occupies and is licensed to transport listed waste products. The location of the audit site is shown in the figures presented in **Appendix A**.

The audit was commissioned by ORA in response to a notice (pursuant to Section 48(1) the Act) issued by the Northern Territory Environment Protection Authority (NT EPA) on 7 July 2021 to carry out an environmental audit program. The notice to carry out an audit relates to the loss of approximately 20,000 litres of diesel released to the environment during the automatic refuelling of a locomotive on 30 May 2020. Investigations and remediation work were subsequently undertaken following to the incident. However, based on observations made during an inspection on 21 February 2021 by NT EPA, concerns were raised regarding the risk to human health and the environment posed by remaining soil, groundwater and surface water contamination. The observations made by the NT EPA prompted the requirement for an environmental audit program.

The Section 48 notice specified the environmental audit program was required to be carried out to evaluate the following:

- *The types, amount, distribution and mobility of contaminants and wastes present in the environment resulting from “the incident;” and*
- *The extent to which actions are required to be taken, or results required to be achieved, for waste management or the prevention, reduction, control, rectification or clean-up of pollution or environmental harm resulting from pollution have been taken or achieved as a result of the incident.*

Further, the following clauses are included in the Section 48 notice, which have relevance to the environmental audit program:

- *20 – An evaluation of the suitability of the management of the contaminated soil stockpile at the premises is required to ensure that it is not causing pollution and environmental harm.*
- *21 – An evaluation of the effectiveness of prevention, reduction, control, rectification or clean up measures implemented following the incident, which resulted in pollution and environmental harm, is required to inform any additional actions to prevent further pollution or environmental harm.*
- *Attachment B:*
 - *9. The Environmental Audit Report referred to in requirement 4 must:*
 - a) indicate if the incident which occurred at the premises has caused a risk of any possible harm or detriment to the land, surface water and groundwater environments;*
 - b) where a risk of any possible harm or detriment to a segment of the environment has been determined in 9(a) recommend any measures necessary to reduce the risk to an acceptable level; and*
 - c) include an indicative implementation timetable for any recommended clean-up and / or management works referred to in requirement 9(b).*



This site audit report (SAR) and accompanying site audit statement (SAS) have been prepared using the guidance provided in the *Guidelines for the NSW site auditor scheme*¹ to make determinations on the above – which have been made by the auditor based on:

- The information provided in the reports and other documentation listed in **Table 1**.
- Site inspections by the auditor and/or the auditor's general support team.
- Reviews by the auditor's expert support team (refer to **Table 1**).
- Relevant soil, sediment, groundwater and surface water quality criteria based on the on-going use of the site as an operational freight rail terminal and the environmental values of adjacent land.
- Relevant guidance.

The determinations, conditions and recommendations in this audit are based only on the contamination resulting from the 30 May 2020 diesel spill event – and not any other contamination of the site which may have occurred prior or since.

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¹ NSW EPA (2017). *Guidelines for the NSW Site Auditor Scheme (3rd edition)*. October 2017.



1.2 Audit Details

Details of the audit are provided in the following table.

Table 1: Audit Details

Item	Detail
Commissioned by	One Rail Australia Pty Ltd (now Aurizon)
Commencement	14 July 2021
Audit Notification	20 July 2021 (no. GM-NT01; NSW EPA Ref. No: 2017P0288) (attached in Appendix B).
Auditor	Mr. Graeme Miller of Senversa Pty Ltd.
Auditor Accreditation No.	No. 1509 (accredited under the <i>NSW site auditor scheme</i>)
Reviewed Information	<p>The following reports and information were reviewed to support the determinations made in this SAR:</p> <ul style="list-style-type: none"> • Greencap (2020a). <i>Re: Berrimah Freight Rail Terminal Diesel Spill – Updated Interim Remediation Action Plan</i>. DRAFT, 12 June 2020. • Greencap (2020b). <i>Re: Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event, July 2020</i>. 21 August 2020. • Greencap (2020c). <i>Re: Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event</i>. 4 December 2020. • Greencap (2021a). <i>Re: Berrimah Freight Rail Terminal Diesel Spill – Groundwater Monitoring Event (January 2021)</i>. 12 March 2021. • Greencap (2021b). <i>Groundwater Monitoring and Management Plan</i>. March 2021. • Greencap (2021c). <i>Detailed Site Investigation Report</i>. 14 April 2021. • Greencap (2021d). <i>Remediation management Plan</i>. One Rail Australia, Berrimah Freight Terminal. Interim report, 30 June 2021. • Greencap (2021e). <i>Groundwater Monitoring Event – Annual Report</i>. 19 August 2021. • Greencap (2021g). <i>Berrimah Freight Rail Terminal Diesel Spill – Surface Water and Sediment Sampling (February to September 2021)</i>. 11 October 2021. • Greencap (2022a). <i>Sampling, Analytical and Quality Plan</i>. 23 February 2022. • Greencap (2023a). <i>Groundwater Monitoring Events – September and December 2021. 23 February 2023 [attached to Greencap (2023b) report below]</i> • Greencap (2023b). <i>Detailed Site Investigation Report – Addendum</i>. 21 March 2023. • Greencap (2023c). <i>Groundwater Monitoring and Management Plan</i>. 24 July 2023. • Greencap (2023d). <i>Environmental Management Plan</i>. 23 February 2024. • Agon Environmental (2024a). <i>Sampling, Analytical and Quality Plan</i>. 6 November 2024. • Agon Environmental (2024b). <i>Soil Investigation Report</i>. 6 November 2024. • Environment Protection Licence <i>EPL No. 222-01</i>. • Various current and historical site layout and site service plans. <p>Copies of the above reports and information are provided in Appendix C.</p>
Site Inspections	<p>Inspections of the audit site were completed on the following occasions:</p> <ul style="list-style-type: none"> • By the auditor on 9 August 2021. The inspection was completed to assess the general condition of the site – including its layout and use. • By Simon Welsh (general audit support) on 6 June 2024. The inspection was completed to oversee the soil investigation completed by Agon in relation to assessing the quality of the backfill materials used in remedial excavations. The inspection was also used to assess the general condition of the site (and its immediate surroundings) following the remedial activities and near the completion date of the audit. <p>The observations made during these inspections have been utilised in preparing this SAR.</p>



Item	Detail
Expert Support	<p>The auditor obtained expert hydrogeological advice from Mr Barry Mann of Senversa during the preparation of this SAR. This included review of a solute transport model prepared by Greencap which was used to:</p> <ul style="list-style-type: none"> • assess potential risks posed by residual groundwater contamination, and • inform management measures for the site. <p>General audit support was provided by Dr Ian Lightfoot and Simon Welsh of Senversa.</p>
Independence, Compliance and Conflict of Interest	<p>The auditor confirms that he has acted independently and in compliance with the <i>Guidelines for the NSW Site Auditor Scheme (3rd Edition) (EPA, October 2017)</i> and Section 11.3 of the <i>Northern Territory Contaminated Land Guideline (NT EPA, June 2017, Version 1.0)</i> in conducting the audit and preparing this SAR and accompanying SAS. Other guidelines made or endorsed by NT EPA which have been considered in preparation of this SAR are listed in Section 7.0.</p>
Previous audits	<p>The auditor is not aware of any previous audits having been conducted or commenced at the audit site.</p>

1.3 Notifications and Regulation

The following table details the notifications made by the auditor, ORA/Aurizon and/or NT EPA in relation to the audit site – and relevant regulation imposed by the NT EPA in response to the spill event. Relevant responses provided by the auditor, Aurizon and/or NT EPA are also noted.

Table 2: Audit Notifications and Regulation

Date	Summary Information
30 May 2020	<p>Email correspondence from ORA with NT EPA regarding the diesel leak / spill event.</p>
1 June 2020	<p>NT EPA response with <i>Authorised Officer Direction (AOD)</i> issued by Lauren Cooper – Environmental Officer.</p> <p>The document detailed the events of the spill incident, and pursuant to section 72(k) of the Act, directed ORA to “immediately prevent pollution and environmental harm resulting from the spill – by the method of preventing the spilled liquids (including diesel/hydrocarbons) from contaminating soils, surface waters and ground waters”.</p> <p>ORA responded agreeing to provide NT EPA with a basic plan of action (within 24 hours) to delineate the likely diesel contamination at the premises from the spill.</p> <p>No plan or further communication was provided by ORA and a further AOD was subsequently issued with more specific directions (as below).</p>
4 June 2020	<p>NT EPA issued a further AOD directing ORA to immediately manage wastes on or in land by:</p> <ul style="list-style-type: none"> • Undertaking sufficient surface water, groundwater and soil analysis to determine the nature and extent of the diesel spill. • Determine and implement suitable actions to manage and start to recover wastes by 15:00 on 5 June 2020. • Undertake daily inspections and monitoring to detect any pollution or impact to the surrounding environment including the Significant Biodiversity Area located adjacent to the spill. <p>NT EPA requested that ORA provide a report detailing compliance with the above by 12 June 2020. An updated interim remediation action plan (Greencap (2020a) – as listed in Table 1) was produced and issued in draft on 12 June 2020.</p>



Date	Summary Information
4 February 2021	<p>NT EPA authorised officers attended the site to inspect remedial works being undertaken and observed that:</p> <ul style="list-style-type: none"> • A stockpile of visibly hydrocarbon impacted material with no pollution controls was stored approximately 10 metres from an unlined channel leading to Darwin Harbour. • Hydrocarbon-like sheens were seeping from the stockpile into the adjacent soils, ponded surface water and the unlined channel. • Hydrocarbon-like sheens were observed on surface water within the unlined channel downstream of the stockpile. <p>An employee of ORA was issued with a verbal direction to “<i>prevent environmental harm and clean-up pollution within 24 hours.</i>”</p>
5 February 2021	<p>Following the verbal direction issued above, NT EPA authorised officers re-attended the site to inspect remedial works being undertaken and observed that:</p> <ul style="list-style-type: none"> • <i>Hydrocarbon-like sheens were seeping from the stockpile and into the adjacent soils and on ponded surface waters at multiple locations around the stockpile.</i> • <i>Sediment from works at the premises in the flow of surface water in the unlined channel downstream of the works being conducted around the stockpile.</i>
12 February 2021	<p>NT EPA issued a further AOD detailing the findings of the above site visits conducted on 4 and 5 February 2021. The AOD instructed ORA to:</p> <ul style="list-style-type: none"> • Prevent environmental harm from the premises pursuant to section 72(k) of the Act; and within 48 hours of the AOD: <ul style="list-style-type: none"> ▪ Undertake measures sufficient to ensure that no: <ul style="list-style-type: none"> – Further seepage of hydrocarbons from the stockpile into the environment occurs. – Discharge of sediments from the premises into the environment occurs. ▪ Monitor and maintain the measures to ensure that they remain sufficient to prevent discharge of hydrocarbons and sediment into the environment at all times.
14 May 2021	<p>NT EPA issued a letter inviting ORA to ‘show cause’ in relation to alleged non-compliances with the Act. The letter included a summary of the AOD information outlined above and based on evidence obtained by NT EPA to date indicated that One Rail may have committed the following offences under Section 83 of the Act, including:</p> <ol style="list-style-type: none"> 1) Section 83 (5): A person must not cause an environmental nuisance; 2) Section 83 (6): A person must not intentionally cause or permit a contaminant or waste to be stored: <ol style="list-style-type: none"> a. In a manner or condition in which; or b. At a place from which, <p>It is reasonably likely that the contaminant or waste could:</p> <ol style="list-style-type: none"> c. Leak, spill or escape from storage into the environment; and d. In leaking, spilling or escaping from storage, cause environmental harm. 3) Section 83 (7): A person must not cause or permit a contaminant or waste to be stored: <ol style="list-style-type: none"> a. In a manner or condition in which; or b. At a place from which, <p>It is reasonably likely that the contaminant or waste could:</p> <ol style="list-style-type: none"> c. Leak, spill or escape from storage into the environment; and d. In leaking, spilling or escaping from storage, cause environmental harm. <p>ORA was issued a deadline of 28 May 2021 to ‘show cause’ as to why compliance and/or enforcement actions should not proceed.</p>
28 May 2021	<p>ORA issued a letter responding to the NT EPA’s show cause letter detailed above. The response lists:</p> <ul style="list-style-type: none"> • Emergency response, monitoring and remediation works that have taken place at the site since the diesel leak. • Post-spill monitoring details. • Stockpile containment measures. • Various fuel response and assessment reports. <p>The letter provides a detailed response to each of the three offences that the NT EPA alleged One Rail to have committed. The response concludes summarising the current status of the site and proposed future stockpile assessment and management measures to be implemented.</p>



Date	Summary Information
6 and 7 July 2021	<p>NT EPA issue a Section 48 Notice to ORA regarding the requirement to undertake an environmental audit program – pursuant to Section 48 of the Act.</p> <p>The requirement to undertake the environmental audit program was prompted based on the NT EPA having remaining concerns about the risk of environmental harm or pollution resulting from a stockpile of contaminated soils.</p> <p>Relevant directions from NT EPA for the scope of the audit provided in the Section 48 Notice are listed in Section 1.1.</p>
20 July 2021	<p>Following commissioning by ORA as the auditor, Mr Graeme Miller of Senversa issued a Site Audit Notification (SAN) to the NT EPA in relation to commencement of the audit.</p> <p>NT EPA environmental officer Claudia Bennett confirmed receipt of the notification via email.</p>
30 July 2021	<p>The auditor issued a letter to the NT EPA regarding the proposed audit program scope, comprising:</p> <ul style="list-style-type: none"> • SAN to the NT EPA (as detailed above). • A site visit / site inspection – to confirm the current site conditions and provide an understanding of the scope of remediation and investigation conducted to date. • Report review of existing reports and documentation. • Preparation of this SAR and SAS (provided separately) – which will make determinations to address the requirements set out in Section 1.1. <p>The proposed audit program listed the determinations to be made in the SAR and SAS, which have been applied in Section 9.2.</p>
23 August 2021	<p>NT EPA email confirmation of proposed audit program scope receipt (Claudia Bennett – Environmental Officer).</p>

Copies of the notification and relevant regulatory correspondence are attached to **Appendix B**.



2.0 Site Information

Relevant information on the audit site and surrounding land is provided in the following table. Figures attached in **Appendix A** show the locations and use of the site and surrounding land.

Table 3: Audit Site Information

Item	Detail
Address	Sections 5411 and 5641, Hundred of Bagot (known as Berrimah Freight Terminal, Export Drive, Berrimah NT.
Land Titles Information	Section 5411 and 5461, Hundred of Bagot Certificate of Title Volume 757 Folio 262 and Volume 754 Folio 416
Audit Site Area	Approximately 19 hectares.
Occupier	Aurizon Ltd
Local Government Area	Darwin City
Zoning	The current zoning of the site is Railway (RW) under the NT Planning scheme 2020 ² . The land use within this zone is reserved for current or future development of a railway or railway corridor.
Current Audit Site Condition and Use	<p>The site is an operational freight rail terminal. Greencap (2021c) noted the following in relation to the condition and use of the site:</p> <ul style="list-style-type: none"> • The audit site is mostly unsealed and generally flat. • Four railway lines (Main Line, 1 Road, Auxiliary Road and Ramp Road) run through the site in a general east-west direction. • An asphalt sealed container pad is located to the north of the railway lines and south of the intertidal mangrove zone. • Locomotive and rail car maintenance sheds are located towards the eastern site boundary. • An office building, parking area and gatehouse are located towards the southern site boundary adjacent to Export Drive. <p>The general layout and use of the site is shown in the figures attached in Appendix A. Photographs collected by the NT EPA during its inspections are shown in the Section 48 notice appended to Appendix B and photographs collected by Greencap (during the assessment/remediation process) are provided in the reports attached to Appendix C.</p>
Licensing	<p>The following Environment Protection Licence (EPL) is currently held by Aurizon for its operations in the Northern Territory (<i>Pursuant to section 34 of the Act</i>):</p> <ul style="list-style-type: none"> • Licence Number: EPL222-02 (attached to Appendix C) – current licence for <i>Scheduled Activities: Collecting, transporting, storing, re-cycling, treating or disposing of a listed waste (as per Table 1) on a commercial or fee for service basis, other than in or for the purpose of a sewage treatment plant.</i> • Licence Commencement Date: 27/03/2024. • Licence Expiry Date: 26/03/2034. • The licensee must implement, maintain and follow the documents (listed in Table 2): <ul style="list-style-type: none"> ▪ Pollution Incident Response Management Plan – Aurizon Bulk Central (17 January 2024) ▪ Aurizon Bulk Central Environmental Management Plan - Tarcoola to Darwin Network (12 February 2024) ▪ Environmental Aspects and Impacts Register - Tarcoola to Darwin Railway Corridor (22 August 2023) ▪ Work Instruction - Waste Tracking Between NT and SA (HS-WIN-001).

² NT Atlas and Spatial Data Directory (accessed 14/03/2024)



Item	Detail
Proposed Future Use of Audit Site	<p>The auditor understands that the site will remain as an operational rail freight transport terminal. This proposed future use of the site is consistent with the commercial/industrial land use scenarios defined by the <i>National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999, as amended 2013) (ASC NEPM)</i>, and is therefore the land use considered in making the audit determinations.</p>
Surrounding Land Use	<p>The audit site is located within an area of commercial/industrial land use. The areas surrounding the audit site include:</p> <ul style="list-style-type: none"> • North – intertidal mangroves (zoned 'Development') with Blesers Creek (Darwin Harbour) and further mangroves (zoned 'Conservation') beyond. • East – vacant land (zoned 'Development') with Berrimah Road and native vegetation beyond. • South – various commercial/industrial and vacant properties (zoned 'Development'). • West – the Darwin Passenger Rail Terminal (zoned 'Development').

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3.0 Environmental Setting

3.1 Topography and Hydrology

3.1.1 Topography

The site is approximately level and located at approximately 4-7 m Australian Height Datum (AHD). The ground surface within the audit site generally slopes to the north (north of the rail lines toward the mangrove community) and south – toward Ramp Road south of the rail lines toward unlined stormwater drains³.

Beyond the audit boundaries, the mangrove swamps to the north are approximately 2 m lower than the audit site which would suggest the site may have been historically subject to infilling / reclamation.

3.1.2 Hydrology

Surface water bodies are not present on the audit site. Immediately north of the site are intertidal mangroves (of Bleezers Creek and Darwin Harbour) which receive surface water drainage from the site stormwater network (refer below) and surrounding areas during periods of rain.

A drainage plan provided by ORA (attached to **Appendix C**) shows the stormwater drains in the southern portion of the site (south of the rail lines) (as referred to in **Section 3.1.1**) – the locations of which were confirmed during the site inspection conducted by the auditor.

The site is predominantly unsealed and therefore infiltration of some surface water is likely to occur. This is reflected in changes in hydrogeological conditions which are apparent between dry and wet periods of the year (refer to **Section 3.3**).

3.2 Geology

3.2.1 Regional

The 1:100 000 scale geological map published by the Department of Mines and Energy, Darwin in 1983 (Map Sheet No. 5073) indicates the audit site is likely underlain by Quaternary and/or Tertiary aged sands, silts and clays, including intertidal marine and river alluvium – underlain by Proterozoic aged siltstone, shale, sandstone and phyllites of the Burrell Creek Formation.

The site is in an area identified as having a high probability of occurrence (with very low confidence) of the presence of acid sulfate soils (ASRIS online database, 2020). This is consistent with observations made by Greencap (2021c) where sulfurous odours were noted in natural materials encountered on the edge of the mangrove.

³ Referred to as v-drains in the consultant reports.



3.2.2 Audit Site

The soil profile / geology underlying the audit site is summarised in the following table.

Table 4: Audit Site Soil Profile / Geology

Audit Site	Audit Site
Fill / Reclaimed Material	<p>Pre-Remediation</p> <p>Fill material was encountered throughout the soil profile at the majority of test locations investigated by Greencap (2021c) – with inferred natural soil only encountered at three test pits locations TP05, TP06 and TP08 investigated at the northern edge of the site adjacent to the interface with the intertidal mangrove shoreline. The fill materials generally comprised a combination of either surface asphalt, rail ballast and brown-yellow to red-brown sandy gravelly silt reworked soils which contained boulder and cobble-sized inclusions of claystone or siltstone at some locations and depths. Fill soils were encountered to depths ranging from 0.3 mbgl to greater than 4 mbgl. Fill was generally thickest at the northern boundary of the site, adjacent to the mangroves – indicating that that part of the site was reclaimed from the mangrove area.</p> <p>Indicators of hydrocarbon contamination (odours, staining, sheens or detectable concentrations of volatile organic compounds (VOCs) measured using a photoionisation detector (PID)) were observed at the majority of the areas investigated with the exception of test pits advanced adjacent the mangrove shoreline.</p> <p>Post-Remediation</p> <p>The general soil profile remained the same following remediation, noting the following changes:</p> <ul style="list-style-type: none"> soils containing odours and staining from the diesel spill incident were removed to the extent practicable (to groundwater and / or to the margins of operation rail lines), and the removed soils were replaced with material of unknown origin, but which post-placement investigation (Agon, 6 November 2024b) consisted of grey-brown silty sands with asphalt inclusions.
Natural Material	Natural material generally comprised light grey to greenish grey silty clay containing organic matter and was encountered below the fill layer.

3.3 Hydrogeology

3.3.1 Regional Hydrogeology

Greencap (2021c) presents a summary of regional hydrogeological information for the Darwin region – sourced from Verma (2002). In summary, key information from Greencap (2021c) indicates that the site is underlain by the Burrell Creek Formation which is a fractured weathered rock formation typically containing minor aquifers / groundwater resources. Aquifer recharge in the Darwin Harbour catchment (in which the site is located) occurs during wet seasons from the direct infiltration of surface water generally between the months of December through to May.

3.3.2 Groundwater Use

A groundwater bore search completed by Greencap (2021c)⁴ indicated that there were no registered groundwater bores within 1.5 km of the site. This was confirmed by the auditor during a search completed on 7 November 2024.

⁴ Verified by the auditor's own 2024 search.



3.3.3 Local Hydrogeology

Groundwater occurrence and quality data obtained during the assessments completed by Greencap indicate the following:

- Groundwater was generally encountered at approximately 3.5 mbgl within fill and natural soils.
- The inferred direction of groundwater movement is north-northwest - towards the intertidal mangrove community. The maximum hydraulic gradient is 0.0007 and the estimated flow velocity is 12 m/year.
- Groundwater levels and quality appeared to vary seasonally, with:
 - Overall fluctuation of 0.5-0.7 metres between wet and dry seasons.
 - Overall salinity measured to range between approximately 2,000 and 25,000 mg/L (generally considered to be brackish to saline) with groundwater observed to be slightly acidic.
 - Measured levels of oxygen reduction potential (ORP) and dissolved oxygen generally indicative of oxidising conditions – potentially favourable for aerobic biodegradation of petroleum hydrocarbons.

3.3.4 Relevant Environmental Values of Water

The following environmental values of groundwater (and surface water) were established by Greencap (2023c) – which are considered relevant and appropriate in the context of the site environmental setting and use:

- **Marine aquatic ecosystems** – associated with the potential risks posed to the marine / mangrove environment immediately north of the site (potentially resulting from the discharge of site-related surface water and groundwater contamination into the down-hydraulic gradient mangrove area).
- **Primary contact and recreation** – associated with potential risks posed to human health through recreational use within the adjacent marine / mangrove environment (resulting from the discharge of site-related surface water and groundwater contamination into the down-hydraulic gradient mangrove area).
- **Vapour intrusion** – associated with potential risks posed to human health (site workers and visitors) through vapour inhalation from the contaminated groundwater.

Drinking water, irrigation and stock watering uses for groundwater have been excluded as relevant environmental values for the purposes of the audit for the following reasons:

- absence of registered groundwater bores in the vicinity of the site (refer **Section 3.3.2**),
- groundwater not being of suitable quality for potable use (e.g salinities exceeding the Australian drinking water guideline⁵ (ADWG) limit of 1,200mg/L),
- availability of reticulated mains water at and surrounding the site, and
- the commercial / industrial nature of the surrounding land uses and adjacent (down hydraulic gradient) marine surface water body.

⁵ ADWG, (2011). Australian Drinking Water Guidelines, 2011. Version 3.8, updated September 2022.



4.0 Audit Site History

4.1 General Site History

In the context of the purpose of the audit (which was specifically to assess the appropriateness of investigation and remediation of contamination from a specific diesel spill event – refer to **Section 1.1** and **Section 4.2**), a review of the history of the site was not considered necessary. However, it is apparent that:

- A portion of the site has been reclaimed from the adjacent mangroves / Blessers Creek – based on the general thickening of the fill profile towards the northern part of the site.
- The recent use of the site has been for rail freight services, including supporting maintenance and administration services.

Notwithstanding that the historical uses of the site have not been assessed, an adequate understanding of the environmental setting (refer **Section 3.0**) has been developed throughout the course of the investigation and audit program – to inform the auditor's understanding of the movement of, and potential risks posed by, the contamination from the diesel spill event.

4.2 Spill Event History

A loss of approximately 20,000 litres of diesel fuel occurred at the site during the automatic refuelling of a locomotive (ALF22) on 30 May 2020. The cause of the diesel spill was reported to be a failure of the unattended automatic filling system which failed to stop when the locomotive tanks were full. The location of the spill event is shown in some of the figures attached in **Appendix A** and the reports in **Appendix C** and is near the junction of the One Road and Auxiliary Road rail lines.

A chronological history of the notifications made by ORA and NT EPA in relation to the spill and consequential regulation imposed by the NT EPA are provided in **Table 2; Section 1.0**.

4.3 Investigation / Assessment History

Greencap and Agon Environmental completed a number of investigations and remedial tasks in response to the spill event, which are documented in the reports listed in **Table 1 (Section 1.0)**. These included the following – with the auditor's review and opinion on the adequacy of these investigations provided in **Section 7.0**:

- An interim remediation action plan (RAP).
- A remediation management plan (RMP).
- Multiple groundwater monitoring events (GMEs).
- Surface water and sediment sampling events.
- A sampling, analytical and quality plan (SAQP).
- Detailed site investigations (DSIs).
- An environmental management plan (EMP).
- A groundwater monitoring and management plan (GMMP).
- A supplementary SAQP and soil investigation report assessing the quality of the backfill material used to reinstate the remedial excavations.



Several of these reports were prepared prior to the auditor's appointment (relevant reports are identified in **Section 7.0**) and thus were not subject to review and comment by the auditor prior to finalisation.

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5.0 Chemicals of Potential Concern

The key chemicals of potential concern (COPCs) associated with the diesel spill incident are total recoverable hydrocarbons (TRH) (>C10 to C34 fractions)⁶. Accordingly, TRH fractions were the main COPCs analysed by the consultant during the investigation and remediation programs at the site. However, the following COPCs were also analysed by the consultant at the request of the auditor (following his appointment) to ensure an assessment of other possible COPCs was completed:

- BTEX.
- Polycyclic aromatic hydrocarbons (PAH).
- Phenolic compounds.

Select groundwater samples were also analysed for the following indicator compounds of natural attenuation:

- Alkalinity.
- Ferrous Iron (Fe^{2+}).
- Manganese.
- Methane (CH_4).
- Nitrate (NO_3).
- Sulfate (SO_4).

These are not considered COPCs, but rather chemicals used to assess potential for attenuation and migration of residual spill-related contamination in groundwater.

⁶ Diesel hydrocarbon fractions are typically in the C8 to C26 carbon fraction range with an approximate 20:80 aliphatic to aromatic split. The benzene, toluene, ethylbenzene and xylenes (BTEX) component in diesel is generally less than 1% (mass fraction) [CRC Care Technical Report 10 (Table C5), dated September 2011].



6.0 Assessment Criteria

6.1 General

Consistent with the *Northern Territory Contaminated Land Guideline*⁷, the auditor has assessed the results⁸ against the investigation, screening and/or guideline values provided in the ASC NEPM.

Other guidance documents were utilised where the ASC NEPM did not provide relevant investigation, screening and/or guideline values (e.g. for sediment), including:

- **Australian:**
 - Australian and New Zealand Environment and Conservation Council (October 2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
 - NHMRC (2008) Guidelines for Managing Risks in Recreational Water.
 - CRC Care (2011) Health Screening Levels (HSLs) for direct contact and vapour intrusion exposure pathways (intrusive worker).
 - HEPA. 2020. PFAS National Environmental Management Plan. Heads of EPAs Australia and New Zealand (January 2020).
 - National Health and Medical Research Council (2011, as updated September 2022). Australian Drinking Water Guidelines.
 - *National Remediation Framework (CRC Care, June 2019)*.
 - Water Quality Australia (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- **International:**
 - WHO (2008) – Drinking Water Values – as updated 2022.
 - California Water Boards (2019) – San Francisco Bay Regional Water ESLs.

The investigation, screening and/or guideline values from the above sources are used as criteria for the audit and have been selected taking the following into consideration:

- **Ongoing land use:** site usage is expected to remain commercial/industrial and equivalent to the Health Investigation Level (HIL/HSL) D scenario described in the ASC NEPM – including consideration of potential future human health exposure to intrusive maintenance workers.
- **Environmental values of groundwater:** refer to **Section 3.3.4**.
- **Pathways for exposure:** as described in the auditor's conceptual site model (CSM) (refer to **Section 8.0**).

Sources of the investigation, screening and/or guideline values for each media are described in the following sections and presented in tables (as sourced from the consultant's reports) attached to **Appendix D**. An exception to this is the ecological criteria applied to assess the sediment sample results obtained by Greencap (refer **Section 7.4**) – this criterion is presented in **Table 6** below.

⁷ NT EPA (2017). *Northern Territory Contaminated Land Guideline*. June 2017, Version 1.0

⁸ Relevant to soil, sediment, surface water and groundwater.



6.2 Soil

The Auditor has assessed the soil sample results against the investigation and screening levels described below and presented in **Appendix D**.

Table 5: Soil Assessment Criteria

Receptor Group	Source of Investigation, Screening and/or Guideline Value
Human Health	<ul style="list-style-type: none"> ASC NEPM (2013) – Commercial/industrial HIL D. ASC NEPM (2013) – Commercial/industrial HSL D for vapour intrusion. CRC CARE (2011) – Direct Contact Commercial/industrial HSL D. HEPA (2020) – Human Health Investigation Levels Industrial / Commercial (HIL D). <hr/> <ul style="list-style-type: none"> CRC CARE (2011) – Intrusive Maintenance Worker HSL for vapour intrusion. CRC CARE (2011) – Direct Contact Intrusive Maintenance Worker.
Ecological	<ul style="list-style-type: none"> ASC NEPM (2013) – Ecological Screening Levels (ESLs) Commercial/ Industrial land use. ASC NEPM (2013) – Ecological Investigation Levels (EILs) Commercial/ Industrial land use HEPA (2020) – Direct and Indirect Ecological Exposure All Land uses
Aesthetic and Built Structures	<ul style="list-style-type: none"> ASC NEPM (2013) – Management Limits (MLs) – Commercial/Industrial assuming coarse soil.

It is noted that the ESLs and EILs have limited relevance to the site since:

- it is sealed with bitumen or gravel / ballast, and
- is likely to have the same ongoing characteristics given its continuing use as a freight rail terminal.

6.3 Sediment

The Auditor has assessed the sediment sample results against the human health and ecological screening levels described below.

Table 6: Sediment Assessment Criteria

Receptor Group	Source of Investigation, Screening and/or Guideline Value	Investigation, Screening and/or Guideline Value
Human Health	<ul style="list-style-type: none"> ASC NEPM (2013) – Commercial/industrial HIL D. ASC NEPM (2013) – Commercial/industrial HSL D for vapour intrusion. CRC CARE (2011) – Direct Contact Commercial/industrial HSL D. <hr/> <ul style="list-style-type: none"> CRC CARE (2011) – Intrusive Maintenance Worker HSL for vapour intrusion. CRC CARE (2011) – Direct Contact Intrusive Maintenance Worker. <hr/> <ul style="list-style-type: none"> ASC NEPM (2013) – Recreational / Public Open Space (HIL C)9. ASC NEPM (2013) – Recreational / Public Open Space HSL C for vapour intrusion. CRC CARE (2011) – Direct Contact Recreational / Public Open HSL C 	<p>For site areas. Refer Appendix D.</p> <hr/> <p>For off-site areas. Refer Appendix D.</p>
Ecological	<ul style="list-style-type: none"> Simpson et al (2013) – Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines, CSIRO Land and Water Report 8/07, CSIRO Land and Water. 	<ul style="list-style-type: none"> TPHs (Sum of TPH C10-C36 or TRH C10-C40) – 280 mg/kg

⁹ Recreational / Public open space soil investigation levels have been adopted as the closest and appropriately conservative scenario in the context of the adjacent mangrove environmental setting.



6.4 Groundwater and surface water

The Auditor has assessed the groundwater and surface water sampling results against the investigation and screening levels described below and presented in **Appendix D**.

Table 7: Groundwater and Surface Water Assessment Criteria

Receptor Group	Source of Investigation, Screening and/or Guideline Value
Human Health	<ul style="list-style-type: none"> • ASC NEPM (2013) Commercial/Industrial HSL D (sand, 2 m to < 4 m). • CRC CARE (2011) Intrusive maintenance workers HSL for Vapour Intrusion. The most conservative criteria were adopted (assumed depth to source 2 m to < 4 m and assuming sand). • Australian Drinking Water Guidelines (ADWG) (2019) – as updated 2022 (to assess risks in a recreational setting). • WHO (2008) – Drinking Water Values – as updated 2022 (to assess risks in a recreational setting).
Ecological	<ul style="list-style-type: none"> • ANZECC (2000) - Australian and New Zealand Guidelines for Fresh and Marine Water Quality¹⁰. • ASC NEPM (2013) Groundwater Investigation Levels (GILs) for protection of aquatic ecosystems. • California Water Boards, San Francisco Bay Regional Water Quality Control Board (2019) (CWB, 2019). Environmental Screening Levels (Rev 2), Marine Water ESLs for gasoline and diesel.

¹⁰ The ANZECC 2000 guidelines have been updated in ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. (Available at www.waterquality.gov.au/anz-guidelines). The Default Guideline Values (DGV) provided are concentrations of toxicants that should have no significant adverse effects on the aquatic ecosystem. The marine water 99% level of protection was adopted. Some have been modified based on bioaccumulation or acute-toxicity or potential toxicity to particular species. Low reliability ANZECC (2000) trigger values (TVs) have been used where they exist and no DGV is available.



7.0 Scope, Outcomes and Adequacy of Investigations

This section provides a summary of the key investigations completed for the audit site – including:

- The scope of each of the investigations.
- Key outcomes.
- The auditor's opinion on the adequacy of each of the investigations.

The relevant territory, national and international guidance utilised by the auditor in assessing the adequacy of the investigation, remediation and management works and reports is listed below.

- **NT EPA Guidance:**
 - *NT EPA (May 2015). Guideline for the Preparation of an Environmental Management Plan.*
 - *NT EPA (May 2016). Guideline for Reporting on Environmental Monitoring.*
 - *NT EPA (June 2017). Northern Territory Contaminated Land Guideline, June 2017.*
- **National Guidance:**
 - Australian and New Zealand Environment and Conservation Council (October 2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
 - NHMRC (2008) Guidelines for Managing Risks in Recreational Water.
 - *CRC Care (September 2011). Technical Report 10. Health screening levels for petroleum hydrocarbons in soil and groundwater.*
 - *National Environment Protection Council (1999, as amended 2013). National Environment Protection (Assessment of Site Contamination) Measure.*
 - *National Health and Medical Research Council (February 2008). Guidelines for Managing Risks in Recreational Water.*
 - *National Remediation Framework (CRC Care, June 2019).*
 - HEPA. 2020. PFAS National Environmental Management Plan. Heads of EPAs Australia and New Zealand (January 2020).
 - National Health and Medical Research Council (2011, as updated September 2022). Australian Drinking Water Guidelines.
 - Water Quality Australia (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- **International:**
 - WHO (2008) – Drinking Water Values – as updated 2022.
 - California Water Boards (2019) – San Francisco Bay Regional Water ESLs.

Copies of the reports reviewed are attached in **Appendix C**.

The auditor notes that:

- He was engaged in July 2021 and therefore was only able to provide input on the scope and reported outcomes of investigations completed after this date. Some of the investigations completed after the auditor's appointment were commissioned at the auditor's request - to address information gaps and uncertainties which remained following the investigation and remediation works that were completed prior to his appointment.



- The remediation management plan (RMP) prepared by Greencap (Greencap, 2021d) does not form part of the audit -since it relates to bioremediation of contaminated soils from the spill remedial excavations (which the auditor understands are ongoing and yet to be completed). However, future management of this material (which has been moved more than 150 m away from the adjacent mangroves and surface water drains and is covered in plastic) forms a recommendation of the audit (refer to **Section 9.4**).

7.1 Greencap (2020a) – Draft Updated Interim Remediation Action Plan

Prepared prior to auditor engagement

Greencap prepared a draft updated interim remediation action plan (RAP) to assist ORA in the management of soil and groundwater diesel contamination on the site. The updated interim RAP references an interim RAP letter (dated 1 June 2020) that had previously been prepared for ORA by Greencap.

The updated draft interim RAP was intended to outline the activities that would be required to complete the remediation of the site and outline future monitoring required to prevent immediate and long-term environmental impacts from the diesel spill.

The updated interim RAP included the following information:

- The diesel spill event and initial regulator involvement.
- The site and environmental setting.
- Preliminary findings of a targeted site contamination investigation following the spill (see **Section 7.6**) – which suggested soil contamination was relatively shallow and extended under the 1 Road rail line.
- Remediation works completed at that time - which were reported to include:
 - construction of a temporary sump to collect spilt diesel,
 - placement of oil-absorbent socks in down-hydraulic surface water drains, and
 - initial remedial excavation works with placement of contaminated soils on plastic sheeting.
- Remediation which remained to be completed, consisting of:
 - further remedial excavations,
 - validation sampling,
 - management of the excavated contaminated soils (recommended to be either off-site disposal or on-site remediation),
 - ongoing monitoring required to comply with the NT EPA AOD – including daily inspections and the establishment of a groundwater monitoring well network, and (if required) groundwater remediation, and
 - Reporting.

The auditor acknowledges that the general scope and detail of the updated interim RAP was reasonably limited and restricted to the need to commence remediation of the spill and document the process (the report was issued less than two weeks after the spill occurred) given:

- large volume of spilled diesel.
- the close proximity of a marine aquatic ecosystem (mangroves to the north of the site).



Accordingly, the RAP did not conform with certain aspects of relevant guidance (e.g., *National Remediation Framework (CRC Care, June 2019)* and *Northern Territory Contaminated Land Guideline (NT EPA, June 2017, Version 1)*), including the following:

- It does not contain a statement of remedial objectives.
- A remediation options assessment (ROA) was not prepared.
- A clear depiction (in figures and tables) describing the spill location and nature and extent of contamination requiring remediation is not included.
- Health, safety and environmental controls are not presented.
- Remediation validation scopes and criteria are not included.
- The RAP does not conform with the reporting checklist in the *Northern Territory Contaminated Land Guideline (NT EPA, June 2017, Version 1)*.

Notwithstanding the shortcomings of the draft interim RAP, it was considered generally appropriate given the circumstances and need to present a broad approach to address an emergency response incident – since it included:

- Site location.
- General spill details.
- Summary information on regulatory requirements.
- Works that had already been completed and planned (which appear to have been appropriate and reasonable and likely to address remedial goals in the Northern Territory)).
- Management options for contaminated excavated soil and contaminated soil under the rail lines.
- General understanding of land use scenarios, and
- Provision for later reporting, including development of a CSM and remediation validation report.

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7.2 Greencap (2020b) Groundwater Monitoring Event (GME) – July 2020

Prepared prior to auditor engagement

Greencap completed an initial GME on 30 July 2020 – the scope of which was reported to have been completed in accordance with a Groundwater Monitoring and Management Plan (GMMP) prepared for the site by Greencap in July 2020. The GMMP was not provided and therefore the auditor could not verify its content and adequacy, nor its compliance (with scopes of work and methodologies prescribed in the GMMP).

The purpose of the GME was to:

- Determine whether diesel had migrated into groundwater under the audit site, and if so, whether the reported concentrations presented a potential risk to off-site receptors located down-hydraulic gradient of the spill area (mangroves of Blessers Creek).
- Inform whether additional mechanisms and management measures or remedial actions should be implemented (as detailed under the GMMP).

The scope, key outcomes and adequacy of the Greencap (2020b) report is summarised in the following table.

Table 8: Review of Greencap (2020b)

Aspect	Details
Scope	<p>The scope of works consisted of the following tasks:</p> <ul style="list-style-type: none"> • Gauging of water levels from four groundwater monitoring wells (MW01 to MW04) using a water/product interface meter. • Purging of groundwater using low-flow (peristaltic) techniques to record groundwater quality field parameters – including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO) and oxidation-reduction potential (ORP). • Collection of groundwater samples using low flow sampling techniques once the field parameters (and standing water levels) had stabilised. • Laboratory analysis of groundwater samples for BTEXN and TRH – including the collection and analysis of field duplicate and blank samples. <p>The locations of the four monitoring wells which were gauged and sampled are shown in a figure presented in Appendix A.</p>
Key outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none"> • The depth to groundwater measured during the gauging round: <ul style="list-style-type: none"> ▪ Ranged from approximately 1.788 m btoc (MW02) to 2.963 m btoc (MW04). ▪ Groundwater elevations ranging from 3.238 mAHD at MW02 to 2.904 mAHD at MW04, within an inferred groundwater flow direction to the north/north-west (toward the intertidal mangrove community). • Groundwater was generally saline and slightly acidic with dissolved oxygen and oxidation-reduction potential levels indicating oxidising conditions. • No odours, sheens or non-aqueous phase liquids (NAPL) were identified during the purging and sampling of all groundwater monitoring wells.



Aspect	Details
	<ul style="list-style-type: none"> • Benzene, toluene and naphthalene were not detected above the limits of reporting, whilst TRH fractions were reported in monitoring wells MW01 (F2, 140 ug/L) and MW04 (F2, 240 ug/L and F3, 400 ug/L), and ethylbenzene and xylene in MW01. The concentrations were less than the criteria used in the GME and the audit criteria. MW01 and MW04 were reported to be located where spill-related contamination in soil was known to exist. These wells are located approximately 30 m – 40 m up hydraulic gradient of boundary of the site (and the adjoining mangroves). • The presence and extent of possible contamination associated with the diesel spill was not determined, noting that further monitoring was planned (and ultimately completed – refer to following sections):
Adequacy and Compliance	<p>The groundwater investigation methodology details provided were limited but overall, the GME was considered generally adequate and appropriate for the following reasons:</p> <ul style="list-style-type: none"> • The field methods for groundwater investigations were considered generally appropriate, and generally consistent with the ASC NEPM – noting the limitations and discrepancies detailed below. • The analytical schedule applied to the groundwater samples was generally appropriate in the context of a preliminary assessment of the diesel contamination following the spill. • NATA accredited laboratories were used in sample testing. • The observations, methodologies and outcomes of the GME were generally consistent with those undertaken later in the assessment program when the auditor was involved – and in general accordance approaches endorsed by the auditor (as applied in later investigations subject to review by the auditor). <p>The following was, however, noted by the auditor:</p> <ul style="list-style-type: none"> • The GME report does not include some of the reporting requirements specified in Table 1 of the <i>Guideline for Reporting on Environmental Monitoring (NT EPA, May 2016)</i>. • The report does not: <ul style="list-style-type: none"> ▪ Identify the relevant environmental values of water. ▪ Does not clearly specify the source (or applicability) of the nominated guideline values. ▪ Is missing some guideline values. • There was limited discussion of the results of the GME – in particular the limitations in the understanding of the extent of contamination and potential risks to downgradient receptors (noting a clear statement of the nature of these receptors is also not included). • Groundwater samples were not tested for PAHs or phenols (which are COPC for diesel fuels). • Other minor non-conformances were identified which are not considered to materially affect the outcomes of the GME included: <ul style="list-style-type: none"> ▪ Calibration documentation for the water quality meter is absent / not attached to the report. ▪ No detail is provided regarding the decontamination procedures adopted during the sampling activities. ▪ Several minor transcription errors were noted (e.g in Table 3 the total TRH concentration at MW01 and MW04 equal 140ug/L and 640 ug/L respectively according to laboratory report. • The report states that groundwater samples were collected using a low flow sampling techniques – however, the appended field record sheets for MW03 and MW04 indicate these wells were purged dry. Senversa notes that Section 7.2.3.1 of Schedule B2 of the NEPM stipulates that bailers are not considered appropriate for the sampling of volatile organic compounds (VOCs) or semi volatile organic compounds (SVOCs). • Survey data used to generate the groundwater elevation contour plan in Attachment 4 of the report was not provided. • The sampling methodology indicates that sampling occurred when the drawdown and physico-chemical parameters had stabilised within the ranges presented in the NT <i>Methodology for the Sampling of Ground Waters (2009)</i>. This document could not be located to verify its currency. Regardless, the appended field sampling sheets indicates sampling occurred prior to water levels and/or parameters stabilising.



7.3 Greencap (2020c) Groundwater Monitoring Event – October 2020

Prepared prior to auditor engagement

Greencap completed a second GME on 14 and 30 October 2020 – the scope of which was also reported to have been completed in accordance with the GMMP prepared for the site in July 2020. The GMMP was not provided and therefore the auditor could not verify its content and adequacy nor its compliance (with scopes of work and methodologies prescribed in the GMMP).

The purpose of the October 2020 GME was to:

- Determine whether diesel had migrated into groundwater under the audit site, and if so, whether the reported concentrations present a potential risk to off-site receptors located down-hydraulic gradient of the spill area (mangroves of Blessers Creek).
- Inform whether additional mechanisms and management measures or remedial actions should be implemented (as detailed under the GMMP).

The scope, key outcomes and adequacy of the Greencap (2020c) report is summarised in the following table.

Table 9: Review of Greencap (2020c)

Aspect	Details
Scope	<p>The scope of works consisted of the following tasks:</p> <ul style="list-style-type: none"> • The installation of four additional monitoring wells (MW05 to MW08) – with the aim of delineating the extent of spill-related groundwater contamination. • Gauging of groundwater levels at the new and existing monitoring wells using a water/product interface meter. • Purging of groundwater using low-flow (peristaltic) techniques to record groundwater quality field parameters – including pH, EC, temperature, DO and ORP. • Collection of groundwater samples using low flow sampling techniques once the field parameters (and standing water levels) had stabilised. The sampling was undertaken on the following two occasions: <ul style="list-style-type: none"> ▪ 14 October 2020 – sampling of monitoring wells MW01a¹¹ to MW04 (prior to the installation of new monitoring wells MW05 to MW08). ▪ 30 October 2020 – sampling of new monitoring wells MW05 to MW08. • Laboratory analysis of groundwater samples for TRH and BTEXN – including the collection and analysis of field duplicate and blank samples. <p>The locations of monitoring wells which were gauged and sampled are shown in a figure in Appendix A.</p>

¹¹ MW01 was not sampled as gauging indicated 6cm of LNAPL was present within the monitoring well. MW01A was subsequently sampled in place of MW01.



Aspect	Details
Outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none">• The depth to groundwater measured during the gauging round ranged from approximately 1.807 m btoc (MW02) to 2.739 m btoc (MW08) which equated to groundwater elevations ranging from 3.248 m AHD at MW07 to 2.904 m AHD at MW04.• The inferred groundwater flow direction could not be determined – which was indicated by Greencap to be:<ul style="list-style-type: none">▪ due to flat nature of the groundwater surface, and▪ possibly attributed to heavy rains which occur in Darwin during the tropical wet season (discussed further below).• LNAPL was observed within monitoring well MW01 with an apparent thickness of 6 cm.• Groundwater was generally saline and slightly acidic with dissolved oxygen and oxidation-reduction potential levels indicating reducing to oxidising conditions.• Slight hydrocarbon odours were noted during the sampling of monitoring wells MW07 and MW08 – with a hydrocarbon sheen also observed during the sampling of monitoring well MW08. Monitoring well MW07 is located near to where a sump was created to capture and collect split diesel that was running across the ground surface. MW08 is located adjacent to the spill location.• The reported concentrations of TRH (all fractions) and BTEXN concentrations were below the audit criteria, except for a TRH F3 (C16-C34) concentration of 1,300 µg/L and total TRH C10-C40 concentration of 1,820 µg/L reported at MW04, which exceeded:<ul style="list-style-type: none">▪ The adopted CWB 2019 ecological screening levels.▪ The adopted WHO (2008) drinking water value (900 µg/L) adjusted for a primary contact recreation exposure.
Adequacy and Compliance	<p>The groundwater investigation methodology details provided were limited. However, the GME was considered generally adequate for the following reasons:</p> <ul style="list-style-type: none">• The field methods for groundwater investigations were considered generally appropriate and consistent with the ASC NEPM – noting the limitations and discrepancies detailed below.• The analytical schedule applied to the groundwater samples was generally appropriate in the context of source of the contamination (diesel spill).• NATA accredited laboratories were used in sample testing.• The observations, methodologies and outcomes of the GME were generally consistent with those undertaken later in the assessment program when the auditor was involved. <p>The following was, however, noted by the auditor:</p> <ul style="list-style-type: none">• The GME report was prepared in accordance with a previous version of the GMMP which was not provided for review and comment.• The GME report does not include some of the reporting requirements specified in Table 1 of the Guideline for Reporting on Environmental Monitoring (NT EPA, May 2016).• The report does not:<ul style="list-style-type: none">▪ Identify the relevant environmental values of water.▪ Does not clearly specify the source (or applicability) of the nominated guideline values.▪ Is missing some guideline values.• There was limited discussion of the results of the GME – including the understanding of the extent of contamination and potential risks to downgradient receptors (noting a clear statement of the nature of these receptors is also not included).• Groundwater samples were not tested for PAHs or phenols (which are COPC for diesel fuels) nor for analytes indicative of natural attenuation.



Aspect	Details
	<ul style="list-style-type: none">• The gauging event does not appear to have been undertaken as one event prior to sampling but was instead conducted throughout the course of the day when sampling activities were completed. Given the potential for groundwater levels to change in response to tidal stage, then the groundwater elevations used to support the derivation of groundwater contours are not considered reliable.• The report notes that MW01A, MW03 and MW04 were purged dry with a bailer, which is not considered an appropriate sampling method for volatile and semi-volatile organic compounds (VOCs and SVOCs).• Other minor non-conformances were identified which are not considered to materially affect the outcomes of the GME included:<ul style="list-style-type: none">▪ Calibration documentation for the water quality meter is absent / not attached to the report.▪ No detail is provided regarding the decontamination procedures adopted during the sampling activities.▪ Referencing errors within the report.▪ Several minor transcription errors were noted; including:<ul style="list-style-type: none">- Table 1 includes an incorrect groundwater investigation level (GIL) unit for toluene.- Table 2 includes incorrect SWLs and therefore incorrectly calculated groundwater elevations (mAHD) for monitoring wells MW01, MW03 and MW04 compared to those presented in Attachment 4.- The pH reading in Table 3 should be 5.24 for MW7 according to the appended sampling sheet.- Table 4 (including the attached results summary table) includes incorrect analyte concentration data for total TRH (C10-C40; MW01 and MW04), TRH F2 (MW01A), ethylbenzene and/or o-xylene (MW01A and MW04) compared to the laboratory reports.▪ The field sampling sheet for MW08 also indicates the well was purged dry due to poor recharge, but this is not discussed in the report.▪ No survey data was provided in relation to the newly installed monitoring wells MW05 to MW08.▪ There were several quality assurance (QA) non-conformances reported by the analytical laboratories, however, the significance of these have not been discussed.▪ The sampling methodology indicates that sampling occurred when the drawdown and physico-chemical parameters had stabilised within the ranges presented in the NT Methodology for the Sampling of Ground Waters (2009). However:<ul style="list-style-type: none">- this document could not be located to verify its currency or confirm the validity of this statement, and- this did not actually occur at monitoring wells which were purged using bailers.



7.4 Greencap (2021a) Groundwater Monitoring Event – January 2021

Prepared prior to auditor engagement

Greencap completed a third GME on 21 January 2021, including surface water and sediment sampling – the scope of which was also reported to have been completed in accordance with the GMMP prepared for the site. The GMMP was not provided and therefore the auditor could not verify its content and adequacy, nor compliance of the assessment (with scopes of work and methodologies prescribed in the GMMP).

The purpose of the January 2021 GME was to:

- Determine whether diesel had migrated into groundwater under the audit site, and if so, whether the reported concentrations present a potential risk to off-site receptors located down-hydraulic gradient of the spill area (mangroves of Blessers Creek).
- If there was any evidence of surface water or sediment contamination on site or down hydraulic gradient of the site (at the point of discharge and in the mangroves).
- Inform whether additional mechanisms and management measures or remedial actions should be implemented (as detailed under the GMMP).

The scope, key outcomes and adequacy of the Greencap (2021a) report is summarised in the following table.

Table 10: Review of Greencap (2021a)

Aspect	Details
Scope	<p>The scope of works consisted of the following tasks:</p> <ul style="list-style-type: none"> • Gauging of water levels from 10 existing monitoring wells using a water/product interface meter on 21 January 2021 (MW01, MW01A, MW02, MW03, MW04, MW04A, MW05, MW06, MW07 and MW08). • Purging of groundwater using low-flow (peristaltic) techniques to record groundwater quality field parameters – including pH, EC, temperature, DO and ORP. • Collection of groundwater samples from eight of the ten monitoring wells on 21 January 2021 using low flow sampling techniques once the field parameters (and standing water levels) had stabilised. Sampling was not undertaken on: <ul style="list-style-type: none"> ▪ Monitoring well MW01 due to the presence of LNAPL. ▪ Monitoring well MW04a as it appears to have only been utilised for gauging and groundwater flow direction purposes. • Collection of two sediment samples (SS01 and SS02) and two surface water samples (SW03 and SW04) from four sampling locations within a culvert and stormwater drains (Location IDs 1-4). Sediment samples were collected at locations where no surface water was present at the time of sampling. • Laboratory analysis of groundwater samples for TRH, BTEXN and natural attenuation parameters (methane, ferrous iron, manganese, nitrate, sulfate and total alkalinity) – including the collection and analysis of field duplicate and blank samples. • Laboratory analysis of sediment and surface water samples for TRH and BTEXN – including the collection and analysis of field duplicate and blank samples. <p>The locations of monitoring wells which were gauged and sampled and the soil and sediment sampling locations are shown in figures in Appendix A.</p>



Aspect	Details
Outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none">• The depth to groundwater measured during the gauging round ranged from approximately 1.174 m b to c (MW02) to 2.514 m b to c (MW08), which equated to (density corrected) groundwater elevations ranging from 3.869 m AHD at MW02 to 3.459 m AHD at MW08.• The groundwater flow direction was inferred to be north toward the mangroves (noting this was not necessarily supported by the information presented in the report).• LNAPL with an apparent thickness of 2 cm was at monitoring well MW01 (which represented a reduction compared the October 2020 GME when approximately 6 cm was measured).• Slow groundwater recharge was noted during the sampling of monitoring well MW01A. The monitoring well was subsequently purged dry and sampled with a bailer.• Groundwater was brackish to saline and slightly acidic with dissolved oxygen and oxidation-reduction potential levels indicating reducing to oxidising conditions.• TRH and BTEXN concentrations were reported below the adopted ecological and human health investigation and screening levels (i.e., trigger levels stipulated in the GMMF) and audit criteria. However, TRH concentrations were detected in monitoring wells MW03 and MW08 for the first time. MW03 and MW08 are located adjacent to the spill location.• Nitrate and manganese concentrations were reported to exceed the adopted investigation and/or screening levels from the following monitoring wells:<ul style="list-style-type: none">▪ Nitrate – MW03 (1 mg/L), MW04 (1.2 mg/L), MW06 (1.1 mg/L) and MW08 (1.2 mg/L) exceeding the adopted ANZECC 2000 aesthetic criterion of 0.7 mg/L.▪ Manganese:<ul style="list-style-type: none">- All monitoring wells exceeding the adopted ADWG, 2011 aesthetic criterion of 0.1 mg/L.- MW02 (3.8 mg/L) and MW08 (1.3 mg/L) exceeding the adopted ANZECC 2000 screening level of 1.2 mg/L.- MW02 (3.8 mg/L) exceeding the adopted ASC NEPM GIL of 1.9 mg/L.• Sediment sample results indicate:<ul style="list-style-type: none">▪ Sum of TPH C10-C36 and TRH C10-C40 concentrations were reported at 980 mg/kg and 760 mg/kg at location SS01 respectively – which exceed the adopted criteria of 280 mg/kg.▪ TRH and BTEXN concentrations at location SS02 were below the adopted criteria of 280 mg/kg.• TRH and BTEXN concentrations in surface water at locations SW03 and SW04 were reported below the adopted audit criteria.• As a result of the contamination identified at location SS01, approximately one tonne of potentially impacted ballast and sediment material was excavated from this location¹². Subsequent validation sampling indicated that sum of TPH C10-C36 and TRH C10-C40 concentrations were reported below the adopted criteria and the LOR from sample SED 1.
Adequacy and Compliance	<p>The groundwater investigation methodology details provided were limited but overall, the GME was considered generally adequate for the following reasons:</p> <ul style="list-style-type: none">• The field methods for groundwater investigations were considered generally appropriate and consistent with the ASC NEPM – noting the limitations and discrepancies detailed below.• The analytical schedule applied to the groundwater samples was generally appropriate in the context of source of the contamination (diesel spill).• NATA accredited laboratories were used in sample testing.• The observations, methodologies and outcomes of the GME were generally consistent with those undertaken later in the assessment program when the auditor was involved.

¹² The fate of this excavated material is however unclear based on a review of the report.



Aspect	Details
	<p>The following was, however, noted by the auditor:</p>
	<ul style="list-style-type: none">• The GME report was prepared in accordance with a previous version of the GMMP which was not provided for review and comment.
	<ul style="list-style-type: none">• The GME report does not include some of the reporting requirements specified in Table 1 of the Guideline for Reporting on Environmental Monitoring (NT EPA, May 2016).
	<ul style="list-style-type: none">• The report does not:<ul style="list-style-type: none">▪ Identify the relevant environmental values of water.▪ Does not clearly specify the source (or applicability) of the nominated guideline values.▪ Is missing some guideline values.
	<ul style="list-style-type: none">• There was limited discussion of the results of the GME – including the understanding of the extent of contamination and potential risks to downgradient receptors (noting a clear statement of the nature of these receptors is also not included).
	<ul style="list-style-type: none">• Groundwater samples were not tested for PAHs or phenols (which are chemicals often present in diesel fuels).
	<ul style="list-style-type: none">• The gauging event does not appear to have been undertaken as one event prior to sampling but was instead conducted throughout the course of the day when sampling activities were completed. Given the potential for groundwater levels to change in response to tidal stage, the groundwater elevations used to support the derivation of groundwater contours are not considered reliable.
	<ul style="list-style-type: none">• The report notes that MW01A was purged dry with a bailer, which is not considered an appropriate sampling method for VOCs and SVOCs.
	<ul style="list-style-type: none">• The fate of the excavated (contaminated) sediment and ballast materials from location SS01 is not clear.
	<ul style="list-style-type: none">• Other minor non-conformances identified which are not considered to materially affect the outcomes of the GME included:<ul style="list-style-type: none">▪ Section 3 indicates:<ul style="list-style-type: none">– MW01A, MW03A and MW04a were constructed surveyed, gauged and sampled prior to undertaking the first GME in Jul 2020 – however, this is the first time this has been mentioned and the outcomes of these prior investigations have not been appropriately documented for auditor review.– Only four wells were sampled in the October 2020 monitoring event (which is incorrect).▪ Section 4.1, paragraph 1 indicates 10 monitoring wells were sampled, however, only 9 monitoring wells were actually sampled (MW01 was not sampled).▪ Calibration certificate for WQM attached – however the form appears to be missing data on the buffer solution conditions.▪ The sampling methodology indicates that sampling occurred when the drawdown and physico-chemical parameters had stabilised within the ranges presented in the NT Methodology for the Sampling of Ground Waters (2009) – however, this document could not be located to verify its currency or confirm the validity of this statement.▪ Groundwater elevations table (Table 3) has been repeated within the body of the report three times.▪ Sampling sheet for MW03 indicates sampling occurred after 10L of groundwater was purged, although 11 L appear to have been purged.▪ There is no plan or text showing or describing a number of the sediment and surface water sampling locations – which appear to have been collected according to the laboratory documentation attached (e.g SED1 to SED8 etc).▪ Density correction appears to be applied to calculate the groundwater elevations – however, the method adopted has not been discussed, or working calculations appended, to verify the validity of these calculations.▪ Attachment 4 indicates the groundwater elevation at MW02 is incorrect (density corrected elevation should be 3.869 m according to the gauging form).▪ Table 4 (including the attached results summary table) includes incorrect analyte concentration data for total TRH (C10-C40; MW01A and MW04), ethylbenzene and/or o-xylene (MW01A, MW03 and MW04) compared to the laboratory reports.▪ QC01 (W) indicates TRH concentrations were detected within monitoring well MW02 – which do not appear to be shown for TRH F3 and total C10-C40 concentrations in Attachment 6; therefore the relative percentage difference (RPD) calculations are incorrect.



Aspect	Details
	<ul style="list-style-type: none"><li data-bbox="284 712 304 1832">▪ Attachment 6 (QA/QC results) does not include RPD analysis for all analytes (e.g natural attenuation parameters).<li data-bbox="316 219 368 1832">▪ The report states that MW04A was gauged and sampled. The well was gauged but does not appear to have been sampled. The gauged groundwater level for MW04A was also not included in the January 2021 GME Groundwater Levels Table.<li data-bbox="379 219 448 1832">▪ Table 7 references results for SS01 from a sampling event undertaken on 5 February 2021 (after the removal of one tonne of sediment). These concentrations (from location SED1) are not included in the sediment results table in Attachment 5 – nor are a number of other sediment samples (labelled SED2 to SED8 and MANGROVE as indicated in the attached laboratory reports)¹³.<li data-bbox="459 237 512 1832">▪ A number of other samples labelled SPR1 to SPR6 are also included in the attached laboratory reports, however, it is unclear to what these samples relate (stockpile samples of the excavated sediment perhaps).

¹³ TRH and BTEXN were not detected in any SED series samples



7.5 Greencap (2021b) Groundwater Monitoring and Management Plan

Prepared prior to auditor engagement

Greencap prepared a GMMP for the management of remaining groundwater, surface water and sediment contamination associated with the diesel spill. The purpose of the GMMP was to outline the scope and approach to groundwater monitoring. Management measures are also provided if the monitoring data indicated the potential for risk to relevant receptors.

The scope and content of the GMMP included descriptions of:

- Introduction and background to the spill event and associated regulation – including that the GMMP was prepared to address a requirement of the EPA Authorised Officer Direction of 4 June 2020.
- The site and environmental setting.
- A summary of completed works to that point.
- Monitoring and management measures, consisting of:
 - The groundwater monitoring well network – including recommended monitoring well maintenance activities.
 - Proposed groundwater, surface water and sediment sampling locations, methodologies, frequencies and trigger values.
 - Quality assurance measures and quality control samples.
 - Contingency measures established for the situations if the trigger levels are exceeded.
 - Review and triggers for ceasing monitoring.
- Roles and responsibilities.

The auditor considers that generally the scope and content of the GMMP was adequate and appropriate in the context of (and in response to) the spill event. However, the document was limited and lacked sufficient detail in relation to:

- The outcomes of the preceding works.
- Clearly and accurately representing the current understanding of the site environmental setting and nature and extent of remaining contamination.
- Including relevant environmental values of water and associated receptor groups and trigger values. For example, trigger values for primary contact recreation are not included.

The GMMP was not prepared in a manner consistent with the *Guideline for the Preparation of an Environmental Management Plan (NT EPA, May 2015)*, some of the guidance referenced in the report had been rescinded at the time of preparation, and there were some inconsistencies between the GMMP report text and appendices.

The GMMP was subsequently updated and reviewed by the auditor (refer to **Section 7.11**) following his engagement and includes relevant and appropriate trigger values



7.6 Greencap (2021c) Detailed Site Investigation

Prepared prior to auditor engagement

The Greencap Detailed Site Investigation (DSI) report presents the outcomes of soil and groundwater investigations completed in response to the diesel spill event – including associated soil remediation completed in accordance with a Remediation Action Plan (RAP) presented within the DSI report.

As with the previous reports summarised in **Sections 7.1 to 7.5**, the DSI report was prepared prior to commencement of the audit and appointment of the auditor. However, following a preliminary review of the document completed by the auditor (once engaged), a number of data gaps were identified and subsequently addressed through:

- The preparation and endorsement of a sampling, analytical and quality plan (SAQP) – as detailed in **Section 7.9**.
- The preparation and endorsement of an addendum to the DSI report – as detailed in **Section 7.10**.

A brief summary of the scope, outcomes and adequacy of the Greencap (2021c) DSI report is presented below in **Table 11**.

Table 11: Review of Greencap (2021c)

Aspect	Details
Scope	<p>The scope of the DSI included the following:</p> <ul style="list-style-type: none"> • A desktop study into the local and regional environmental setting and land uses. • A soil investigation comprising the excavation and sampling from more than 50 test pits and 17 soil bores to assess the nature and extent of the hydrocarbon contamination from the spill event. • Soil remediation works comprising excavation of approximately 770 cubic metres (m³) of diesel impacted soil and subsequent collection of 170 soil validation samples. Other remedial works included placement of bunds and oil absorbent material to prevent migration of contamination from the spill and excavated contaminated soils. • A groundwater investigation comprising the installation and sampling from 11 groundwater monitoring wells (MW01, MW01a, MW02, MW03, MW03a, MW04, MW04a and MW05 to MW08) to assess the nature and extent of hydrocarbon contamination in groundwater following the spill event. • Preparation of a DSI report to document the outcomes of the above work – including the preparation of a CSM and recommendations. <p>The soil investigation and validation sample locations and monitoring well locations are shown in figures in Appendix A.</p>
Outcomes	<p>The key investigation observations and outcomes included the following:</p> <ul style="list-style-type: none"> • The diesel spill contaminated soil along the drainage line between and underlying the Auxiliary Road and Ramp Road rail lines. The diesel migrated from the original location on the 1 Road Rail line to the south and then west where it was collected in a swale which drained towards the road culvert approximately 100 m to the west. A temporary sump was excavated to prevent movement off-site and enable the recovery of spilled diesel. • Visual or olfactory evidence of hydrocarbon contamination (related to the spill event) was noted at a number of investigation locations within and surrounding the spill location – with subsurface diesel impacts typically present within 0.5 m of the ground surface.



Aspect	Details
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| <ul style="list-style-type: none"> • Residual TRH contamination following the investigation, delineation, remediation and validation works included the following: <ul style="list-style-type: none"> ▪ TRH F1 contamination (concentrations reported greater than the adopted ASC NEPM commercial/industrial HSL-D criteria) at the following locations and concentrations – the extent of which appears to be delineated and limited to two isolated areas: <ul style="list-style-type: none"> – BH13 to BH15 beneath the One Road Rail Line (immediately north of the spill location) ranging from 270 to 440 mg/kg greater than the adopted commercial/industrial HSL of 260 mg/kg. – NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 590 mg/kg greater than the adopted commercial/industrial HSL of 370 mg/kg. ▪ TRH C10-C16 contamination (concentrations reported greater than the adopted CRC Care commercial/industrial direct contact HSL-D criteria) at the following locations and concentrations – the extent of which appears to be limited to two isolated areas: <ul style="list-style-type: none"> – BH13 and BH15 beneath the One Road Rail Line (immediately north of the spill location) at concentrations of 24,000 mg/kg and 27,000 mg/kg respectively – greater than the adopted commercial/industrial direct contact HSL of 20,000 mg/kg. – NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 31,000 mg/kg greater than the adopted commercial/industrial HSL of 20,000 mg/kg. ▪ TRH F1, F2, F3 and/or F4 contamination (concentrations reported greater than the adopted commercial/industrial ESL criteria) at several locations beneath the One Road, Ramp Road and Auxiliary Rail lines. ▪ TRH C10-C16 and TRH F3 contamination (concentrations reported greater than the adopted commercial/industrial MLs) at several locations beneath the One Road, Ramp Road and Auxiliary Rail lines. The extent of the remaining contamination appears to be delineated and limited to areas in the vicinity of the original spill location and the temporary recovery sump within the western portion of the assessment area. • Diesel impacted soil following the remediation works was excavated and stockpiled on the site – south west of the area impacted by the spill. • A mass balance calculation indicated that approximately 18,000 litres of diesel had been recovered and that approximately 2,000 litres of diesel remained in situ at and in the vicinity of the spill site. • Leachate analysis undertaken indicated that the residual hydrocarbon impacted soil could leach into groundwater and form a source of ongoing groundwater contamination – and potentially risks to downgradient receptors in the nearby Blessers Creek. These potential risks were reportedly being managed through the implementation of an ongoing stormwater, sediment and groundwater monitoring program developed for the site. • The groundwater section within the DSI presented a summary of the monitoring events described in Sections 7.2, 7.3 and 7.4 of this SAR – which indicated: <ul style="list-style-type: none"> ▪ The groundwater flow direction was inferred to be in a north westerly direction towards the intertidal mangrove community during the July 2020 GME. However, no discernible groundwater flow direction could be determined based on the data from the October 2020 and January 2021 GMEs (reported to be due to, and influenced by, the wet season rainfall). ▪ The residual hydrocarbon impacted (contaminated) soils located at the groundwater interface will likely act as ongoing secondary source of hydrocarbon impacts in groundwater. ▪ TRH concentrations increased in MW01 and MW04 between the July and October GMEs (including the presence of LNAPL identified in MW01), which Greencap suggested was indicative of the hydrocarbon groundwater contamination plume migrating towards the down gradient towards Blessers Creek. • The DSI included recommendations to: <ul style="list-style-type: none"> ▪ Develop and implement the RAP presented in the DSI – as well as a GMMP and EMP to monitor and manage the identified contamination remaining after remediation into the future. ▪ Consider undertaking predictive groundwater modelling to predict future migration of the hydrocarbon groundwater contamination toward the sensitive marine receptor. | |
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Aspect	Details
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Adequacy and Compliance	<p>The auditor considers that the scope of the works described within the DSI was generally adequate and appropriate in the context of rapidly assessing, remediating and validating the contamination which occurred from the spill event. This included collection and analysis of many soil samples for the purpose of assessing the extent of contamination and validating soil remedial works.</p> <p>However, the document was not clearly structured (nor the data clearly presented), transcription errors were identified, and the following key data gaps were identified:</p> <ul style="list-style-type: none"> • Some investigation and screening levels that should have been applied to the assessment weren't considered. • Nature of contamination: <ul style="list-style-type: none"> ▪ Testing of soil and groundwater samples appears have been limited to BTEXN and TPH – noting that the BTEX component of diesel is only about 1% (CRC Care Tech report 10 – Table C3), with the virtually all of aromatic compounds being PAHs (21.8%). ▪ Phenols are also known to be present in diesel fuels – therefore, the potential presence (and extent) of contamination as it related to PAHs and phenols was not assessed. • Extent of contamination: <ul style="list-style-type: none"> ▪ Soil: <ul style="list-style-type: none"> – The extent of soil contamination appears to have been delineated as it related to TRH and BTEXN – noting that: <ul style="list-style-type: none"> ▪ PAHs and phenols were not tested. ▪ TRH contamination remained in soil (concentrations were reported to be predominantly below the commercial and industrial land use guidelines, but could form an ongoing source of groundwater contamination). – There was the potential for contamination in soil to have migrated beyond the sampled area – particularly given: <ul style="list-style-type: none"> ▪ The samples at and immediately down gradient of the spill were collected immediately after the spill. ▪ There is evidence of later stage migration of the fuel in the subsurface. – Remediation of the excavated material has not been completed. ▪ Groundwater: <ul style="list-style-type: none"> – Hydrocarbons remained in soil at and surrounding the spill area (and to a lesser extent near the collection sump) – which had the potential to form an ongoing source of groundwater contamination. – There were no monitoring wells located directly down hydraulic gradient of the spill area and other areas where residual contamination remained in groundwater. – The potential for contaminated groundwater to migrate towards (and impact upon) the down gradient receptor in the future required further assessment. <p>The auditor subsequently requested supplementary investigations be undertaken through:</p> <ul style="list-style-type: none"> • The preparation and endorsement of a sampling, analytical and quality plan (SAQP) – as detailed in Section 7.9. • The preparation and endorsement of an addendum to the DSI report – as detailed in Section 7.11. <p>The addendum to the DSI report:</p> <ul style="list-style-type: none"> • Satisfactorily addressed the data gaps. • Corrected data and transcription errors. • Presented a consolidated and coherent understanding of the condition of soil and groundwater on and under the site following remediation.
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7.7 Greencap (2021e) Groundwater Monitoring Event, Annual Report – July 2021

Prepared prior to auditor engagement

Greencap completed a fourth GME in April/May 2021, including surface water and sediment sampling – the scope of which was also reported to have been completed in accordance with the GMMP prepared for the site (refer **Section 7.5**). The July 2021 report represents an annual GME and included analytical trend analysis and groundwater seepage velocity calculations to further assess:

- Whether the reported concentrations could form a potential risk to off-site receptors located down-hydraulic gradient of the spill area.
- Inform whether additional mechanisms and management measures or remedial actions should be implemented (as described in the GMMP being implemented at the time of the monitoring).

The scope, key outcomes and adequacy of the Greencap (2021e) report is summarised in the following table.

Table 12: Review of Greencap (2021e)

Aspect	Details
Scope	<p>The scope of works consisted of the following tasks:</p> <ul style="list-style-type: none"> • Gauging of groundwater levels at ten existing monitoring wells using a water/product interface meter on 5 May 2021 (MW01, MW01A, MW02, MW03, MW04, MW04A, MW05 - MW08). • Purging of groundwater using low-flow (peristaltic) techniques and recording groundwater quality field parameters – including pH, EC, temperature, DO and ORP. • Collection of groundwater samples from eight of the ten monitoring wells on 20 April, 5 May and 20 May 2021 using low flow sampling techniques once the field parameters (and standing water levels) had stabilised. Sampling was not undertaken on: <ul style="list-style-type: none"> ▪ Monitoring well MW01 due to the presence of LNAPL. ▪ Monitoring well MW04a as it appears to have only been utilised for gauging and groundwater flow direction purposes. • Collection of one sediment sample (SED2) and three surface water samples (SW02, SW03 and SW04) from within a culvert and stormwater drains (Location IDs 2-4). • Laboratory analysis of groundwater samples for TRH, BTEXN and natural attenuation parameters (methane, ferrous iron, manganese, nitrate, sulfate and total alkalinity). Quality control samples (field duplicate and blank samples) were also collected and analysed. • Laboratory analysis of surface water samples SW03 and SW04 (point of discharge from the site and in the mangroves) for TRH and BTEXN (sediment sample SED2 was not analysed). Surface water samples were not collected from locations SW01 and SW02 due to an absence of water. Quality control samples (field duplicate and blank samples) were also collected and analysed. • Trend analysis on hydrocarbon concentrations reported in groundwater at monitoring well locations MW03 and MW04 (where an adequate dataset was available). • Groundwater seepage velocity estimates calculated across the monitoring well network. <p>The locations of monitoring wells which were gauged and sampled are shown in a figure in Appendix A.</p>



Aspect	Details
Outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none"> • The depth to groundwater measured during the gauging round ranged from approximately 1.29 m btoC (MW02) to 2.66 m btoC (MW08), which equated to (density corrected) groundwater elevations ranging from 3.767 m AHD at MW02 to 3.329 m AHD at MW06. • The inferred groundwater flow direction was north toward the mangroves. • LNAPL was observed within monitoring well MW01 consisting of approximately 5cm of likely diesel product (an increased apparent thickness compared the January 2021 GME where approximately 2 cm was measured). • Slow groundwater recharge was noted during the sampling of monitoring wells MW01A and MW03. These monitoring wells were subsequently purged dry and sampled with a bailer. • Groundwater was brackish to saline and slightly acidic with dissolved oxygen and oxidation-reduction potential levels indicating reducing to oxidising conditions. • No hydrocarbon odours or sheens were noted during the sampling of the monitoring wells. • The groundwater analytical results indicated the following: <ul style="list-style-type: none"> ▪ TRH (all fractions) and BTEXN concentrations were reported below the adopted ecological and human health investigation and screening levels (i.e trigger levels stipulated in the GMMP). TRH was only detected in monitoring well MW04. ▪ Nitrate and manganese concentrations were reported to exceed the adopted investigation and/or screening levels from the following monitoring wells: <ul style="list-style-type: none"> - Nitrate – MW03 (1.7 mg/L), MW04 (0.78 mg/L) and MW08 (1.3 mg/L) exceeding the adopted ANZECC 2000 aesthetic criterion of 0.7 mg/L. - Manganese: <ul style="list-style-type: none"> ▪ All monitoring wells exceeding the adopted ADWG, 2011 aesthetic criterion of 0.1 mg/L. ▪ MW01a (2.2 mg/L), MW02 (9.8 mg/L), MW04 (2.4 mg/L), MW06 (1.5 mg/L), MW07 (1.4 mg/L) and MW08 (1.6 mg/L) exceeding the adopted ANZECC 2000 screening level of 1.2 mg/L. ▪ MW01a (2.2 mg/L), MW02 (9.8 mg/L) and MW04 (2.4 mg/L) exceeding the adopted ASC NEPM GIL of 1.9 mg/L. ▪ MW02 (9.8 mg/L) exceeding the adopted primary contact recreational criterion of 5 mg/L. • Mann-Kendall statistical trend analysis was undertaken on monitoring wells MW03 and MW04 where statistically viable datasets were reportedly available. No increasing trends in diesel-related hydrocarbons were identified. • Potential biodegradation of spill related contamination was inferred based on reported changes in dissolved iron concentrations. • The potential groundwater seepage velocity was estimated using calculated hydraulic conductivities across the monitoring well network based on the low-flow groundwater sampling technique and using Thiem's equation. The estimated well-specific average hydraulic conductivity values ranged between 0.16m/day and 7.3m/day – with a geometric mean for hydraulic conductivity at the site calculated to be 2.7 m/day. The groundwater flow velocity was estimated to be in order of 25m/year (calculated using the geometric mean of the hydraulic conductivity values, a hydraulic gradient of 0.005 and an effective porosity of 0.2 (published data for sandy aquifers). An un-retarded travel time for the plume to reach the receptor was estimated to be greater than 10 years. • TRH and BTEXN concentrations from in surface water samples SW03 and SW04 were reported below the adopted audit criteria (and below the LOR). No sediment samples were analysed as part of the April/May 2021 sampling event. • Greencap concluded that there was no evidence of off-site migration of spill related contamination in groundwater or surface water. Ongoing sampling of groundwater, surface water and sediment was recommended, with surface water and sediment phased out once the stockpile of excavated contaminated soils was relocated.



Aspect	Details
Adequacy and Compliance	<p>The groundwater investigation methodology details provided were limited but overall, the GME was considered generally adequate and appropriate for the following reasons:</p> <ul style="list-style-type: none"> • The field methods for groundwater investigations were considered generally appropriate, and generally consistent with the ASC NEPM – noting the limitations and discrepancies detailed below. • The analytical schedule applied to the groundwater and surface water samples was generally appropriate in the context of source of the contamination (diesel spill). • NATA accredited laboratories were used in sample testing. • The observations, methodologies and outcomes of the GME were generally consistent with those undertaken later in the assessment program when the auditor was involved – including in accordance with documents reviewed and endorsed by the auditor. <p>The following was, however, noted:</p> <ul style="list-style-type: none"> • The GME report does not include some of the requirements specified in Table 1 of the Guideline for Reporting on Environmental Monitoring (NT EPA, May 2016). • The report does not: <ul style="list-style-type: none"> ▪ Identify the relevant environmental values of water. ▪ Does not clearly specify the source (or applicability) of the nominated guideline values. ▪ Is missing some guideline values. • There was limited discussion of the results of the GME – including the understanding of the extent of contamination and potential risks to downgradient receptors (noting some receptors are missing (primary contact recreation – human health)). • Groundwater and surface water samples were not tested for PAHs or phenols (which are chemicals often present in diesel fuels). • The report text indicates sediment samples were collected during both sampling events, however, no results were reported for sediment samples from the April/May 2021 sampling event. • Several other minor non-conformances were identified which are not considered to materially affect the outcomes of the GME including (but not limited to): <ul style="list-style-type: none"> ▪ Calibration certificate for WQM is attached – however the form appears to be missing important data re: the buffer solution conditions prior to calibrating and Final pH 4 value and initial pH 7 value. ▪ No field calibration record was available for the water quality meter used during the 20 May 2021 re-sampling of monitoring well MW02. • The sampling methodology indicates that sampling occurred when the drawdown and physico-chemical parameters had stabilised within the ranges presented in the NT Methodology for the Sampling of Ground Waters (2009) – however, this document could not be located to verify its currency or confirm the validity of this statement. • The appended field sheets indicate that monitoring wells MW01A and MW03 were purged dry with a bailer, however, this is not mentioned in the body of the report and Senversa notes that Section 7.2.3.1 of Schedule B2 of the NEPM stipulates that bailers are not considered appropriate for the sampling of VOCs or SVOCs. • Appended gauging sheets indicate MW04a was also gauged but has not been discussed in body of report or seemingly used in the interpretation of the movement of groundwater under the site. • Inconsistencies between information presented in the body of the report and appended result summary tables and/or laboratory reports. For example: <ul style="list-style-type: none"> ▪ Chemical concentrations listed in Table 8 do not always match appended tables. ▪ The report text suggests only locations SW03 and SW04 were sampled during the April 2021, however, the appended laboratory report indicates results are also available for sample SW2 (TRH and BTEXN not detected) and a sediment sample also appears to have been collected (SED2) but was not analysed.



7.8 Greencap (2021g) Surface Water and Sediment Sampling Report (February to September 2021)

Prepared prior to auditor engagement

Surface water and sediment sampling was completed by Greencap between February and September 2021 to support the groundwater monitoring program and to assess the potential migration of hydrocarbon impacts from the residual impacted material toward the marine ecological receptor. The specific objective of work was to identify whether the stockpile of diesel-impacted soils were impacting on surrounding parts of the site and adjacent surface water receptors and ecology.

The report notes that during the monitoring period, the stockpile was relocated approximately 150 m south of its original location – further from the site stormwater drains and Blessers Creek. The plastic cover on top of the stockpile was noted to have been removed during relocation, but surrounding silt fences and bunds maintained. Evidence of these measures is provided in appended photographs.

The scope, key outcomes and adequacy of the Greencap (2021g) report is summarised in the following table.

Table 13: Review of Greencap (2021g)

Aspect	Details
Scope	<p>The scope of works consisted of the following tasks:</p> <ul style="list-style-type: none"> • Weekly sediment and surface water inspections in portions of the site and drains near to an area where the previously excavated diesel impacted soils were being stored. • Collection of sediment and surface water samples from drains and the receiving marine environment (i.e., Blessers Creek) located downgradient of the spill site. <p>The locations where sediment and surface water sampling were (or was proposed to be) collected are shown in a figure in Appendix A.</p>
Outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none"> • A potential hydrocarbon sheen was identified in the drain (portion / location not specified) during the 5 February and 16 April 2021 monitoring events. • No visual or olfactory evidence of diesel-related contamination was noted within any of the sediment samples collected. • Several detections of hydrocarbons were identified in surface water during the multiple sampling events. However, the detections were considered either to be isolated, not attributable to the spill event (or impacted stockpile) and hydrocarbon concentrations were generally reported below the laboratory LOR at locations 3 and 4 – which were located downgradient of the residual soil contamination and impacted stockpile.
Adequacy and Compliance	<p>The auditor notes the following:</p> <ul style="list-style-type: none"> • The sampling locations, rationale and field sampling methods were considered generally appropriate. • The analytical schedule applied to the surface water and sediment samples was generally appropriate in the context of diesel impacts following the spill. • NATA accredited laboratories were used in sample testing.



Aspect Details

The following issues and uncertainties were identified by the auditor following review:

- Section 2:
 - Lacks detail in relation to when and where the visual assessments were completed. Further, there are few photographs supporting the observations reported in the text of the document.
 - Table 1 lists the four surface water and sediment sampling locations – however, one of the appended laboratory reports also indicates that samples SED5 to SED8 were also collected and analysis. The locations of these samples, and their relevance or significance, are not discussed.
 - Consistent with the GMMP methodology, sediment samples were to be collected during all sampling events, irrespective of whether surface water was present within the drain network – however, this does not appear to have occurred as indicated in point above.
 - Table 2 should include footnotes explaining what N/A denotes.
 - The results of the 19 March surface water sampling indicate the detected hydrocarbon concentrations at locations 1 and 2 may be associated with the remaining in-situ soil diesel impacts or stockpile. The report appears to infer that these detections were isolated as they were not reported in the receiving environment or during the subsequent monitoring round. However, this is incorrect as hydrocarbons were detected at downgradient locations 3 and/or 4 during subsequent monitoring events (as presented in Table 2).
 - Three hydrocarbon detections at locations SW02, SW03 and SW04 between March and July 2021 were indicated to be possibly due to natural degradation of organic matter and reference is made to the previous February silica gel cleanup testing – however this cannot be deduced without undertaking silica gel cleanup on the samples in question. The source of these detections is therefore uncertain and association with the spill event cannot be ruled out.
 - The fate of the sediment removed from the drain is uncertain.
 - No sediment duplicates appear to have been collected.
 - Equipment decontamination procedures are not discussed in the report.
 - In general, the relevant discussion of the results is poorly presented and unclear, therefore the source(s) of the detected hydrocarbons in sediment and/or surface water is at times uncertain and association with the spill event cannot be ruled out.
- Section 3, Conclusions:
 - Some of the conclusions are not supported based on the review comments above – specifically that some detections are inferred to be associated with sources other than the stockpiled soiled, but where there is insufficient supporting evidence.
- Attachments:
 - The sediment table appears to be incomplete – as minimal samples appear to have been collected (as proposed in the GMMP) and samples from down-gradient locations appear to be missing (e.g SED4 toward marine receptor). In addition, other TRH fraction results should be included for completeness.
 - The surface water result summary table indicates hydrocarbons were detected at location SW02 on 27 August 2021 (the highest detected to date) – however, no sampling results appear to be available downgradient of this location toward the marine receptor at this time.
 - A number of laboratory reports are missing (were not attached) – e.g 820390, 778025, 797042 and 798997.
 - The QC table indicates the number of QC samples analysed were less than recommended in the ASC NEPM.
 - The photographs indicate a dye test was undertaken – but the rationale and results are not discussed.
 - Laboratory report 772780 for sample SW05 collected on February 5 2021 reports the highest TRH C10-C36 or TRH C10-C40 concentrations to date (36,400 µg/L and 37,400 µg/L respectively). The location of this sample and its significance is not discussed in the report. A mangrove sample also appears to have been collected, but is not reported.
- In summary, the information in the report is poorly organising, data is missing or not discussed, and some conclusions are not able to be supported.



7.9 Greencap (2022a) Sampling, Analytical and Quality Plan – February 2022

The auditor's review of the DSI (and other reports prepared by Greencap prior to commencement of the audit) identified several information gaps which were required to be addressed to:

- Inform the understanding of the nature and extent of remaining contamination and potential risks to human health and the environment associated with the spill.
- Develop and implement an appropriate remedial strategy for the remaining contamination.
- Address the NT EPA requirements for the audit program.

The SAQP was prepared by Greencap to describe the scope of works and methodology required to address the above and included the following:

- Site identification details, environmental setting information, a summary of the spill event and outcomes of the subsequent investigations and remedial works – including the nature and extent of known remaining contamination.
- Data gaps to be addressed through supplementary investigations.
- The scope of works, rationale and methodology for the supplementary investigations – prepared using the data quality objectives (DQOs) process and including the following:
 - Additional soil and groundwater sampling and analysis to assess for the presence of PAH and phenolic contamination associated with the spill.
 - Re-screening of all soil data against additional guidelines values (audit criteria).
 - The installation and sampling of three new monitoring wells placed down-hydraulic gradient of the spill site and immediately adjacent the marine receptor (mangroves).
 - Completing a gauging and sampling round of the entire groundwater monitoring well network to assess the nature and extent of groundwater contamination.
 - QA measures and QC sampling.
 - Groundwater fate and transport modelling using Bioscreen modelling software.
 - The preparation of an addendum DSI report documenting the outcomes of the above supplementary assessments (refer **Section 7.10** for auditor comments).

The SAQP was prepared in general accordance with the ASC NEPM and other relevant guidance – and included appropriate justification, rationale and assessment criteria to adequately address the above data gaps.



7.10 Greencap (2023b) Detailed Site Investigation Report – Addendum (March 2023)

Greencap prepared an addendum to the DSI report to document the outcomes of supplementary investigations completed in accordance with the SAQP detailed in **Section 7.9**, which included the following:

- Additional soil sampling and analysis to assess for the presence of PAH and phenolic compounds in the diesel-contaminated material.
- Re-screening of all soil data against additional audit criteria – to confirm the nature and extent of soil contamination.
- The installation and sampling of three new groundwater monitoring wells placed down-gradient of the spill site and immediately adjacent the marine receptor (mangroves).
- Completing gauging and sampling rounds of the entire groundwater monitoring well network to assess the nature and extent of groundwater contamination – including assessing for the presence of PAH and phenolic compounds in groundwater and adoption of additional screening criteria.
- Groundwater fate and transport modelling – to assess the extent in which contaminated groundwater could migrate towards (and impact upon) the down gradient receptor.

It is noted that the addendum DSI report included the September and December 2021 groundwater monitoring events report [Greencap (2023a)] as an appendix – which addressed the groundwater-related information gaps detailed above.

A summary of the scope, outcomes and adequacy of the Greencap (2023b) addendum DSI report is presented below in **Table 14**.

Table 14: Review of Greencap (2023b)

Aspect	Details
Scope	<p>The scope of the addendum DSI included the following:</p> <ul style="list-style-type: none"> • A soil investigation comprising the collection and analysis of samples from the stockpile of diesel contaminated soil (stockpiled more than 150 m away from the mangroves and surface drains and covered in plastic) to assess for the presence of PAH and phenolic compounds. • A groundwater investigation comprising: <ul style="list-style-type: none"> ▪ The installation and sampling of three new monitoring wells (MW09 to MW11) placed down-gradient of the spill site and immediately adjacent the marine receptor (mangroves). ▪ Completing two gauging and sampling events across the entire groundwater monitoring well network to assess the nature and extent of groundwater contamination – including assessing for the presence of PAH and phenolic compounds in groundwater (as documented in Senversa, 2023a). ▪ Completing groundwater fate and transport modelling to estimate the future migration and extent of diesel-related contamination toward the marine receptor. • Preparation of an addendum to the DSI report to document the outcomes of the above work – including consideration of additional soil and groundwater investigation and/or screening levels to: <ul style="list-style-type: none"> ▪ Confirm the nature and extent of contamination. ▪ Future management requirements. <p>The locations of the monitoring wells which were gauged and sampled are shown in a figure in Appendix A.</p>



Aspect	Details
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Outcomes	<p>The key investigation observations and outcomes included the following:</p> <p><u>Soil</u></p> <ul style="list-style-type: none"> • Residual soil contamination associated with the diesel spill remains at the site as follows: <ul style="list-style-type: none"> ▪ TRH F1 concentrations were reported greater than the adopted ASC NEPM commercial/industrial HSL-D criteria at the following locations and concentrations – the extent of which appears to be delineated and limited to two isolated areas: <ul style="list-style-type: none"> – BH13 to BH15 beneath the One Road Rail Line (immediately north of the spill location) ranging from 270 to 440 mg/kg greater than the adopted commercial/industrial HSL of 260 mg/kg and ecological screen level (ESL) of 215 mg/kg. – NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 590 mg/kg greater than the adopted commercial/industrial HSL of 370 mg/kg. ▪ TRH >C10-C16 concentrations were reported greater than the adopted commercial/industrial criteria at the following locations and concentrations – the extent of which appears to be limited to two isolated areas: <ul style="list-style-type: none"> – BH13 and BH15 beneath the One Road Rail Line (immediately north of the spill location) ranging from 24,000 mg/kg to 27,000 mg/kg – greater than the adopted commercial/industrial direct contact HSL of 20,000 mg/kg, ESL of 170 mg/kg and management limit (ML) of 1,000 mg/kg. – NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 31,000 mg/kg - greater than the adopted commercial/industrial direct contact HSL of 20,000 mg/kg, the ESL of 170 mg/kg and ML of 1,000 mg/kg. ▪ Concentrations of TRH >C10-C16 and/or TRH >C16-C34 were also greater than the respective ML of 1,000 mg/kg and 3,500 mg/kg in several soil samples collected from the base of the remediation area excavations. This is presented in further detail in Section 8.0 (Auditor CSM). ▪ The extent of remaining spill-related soil contamination is considered to have been adequately delineated. Excavation and removal of the limited remaining areas of soil contamination exceeding the human health audit criteria is considered impracticable – since it is immediately adjacent / potentially under active rail lines. <p><u>Groundwater</u></p> <ul style="list-style-type: none"> • Groundwater was generally saline, slightly acidic and oxidising. Groundwater movement is towards the north, with water levels varying up to 0.5 m due to the effects of the wet season (and associated infiltration and aquifer recharge). • Residual groundwater contamination inferred to be associated with the diesel spill remains at the site comprising TRH fractions C10-C16 (F2), >C16-C34 (F3) and >C10-C40 - with concentrations reported greater than the relevant marine aquatic ecosystems and primary contact and recreation assessment criteria. • The contamination appears to be limited and isolated to one monitoring well location (MW01), which is in the vicinity of the temporary recovery sump area within the western portion of the assessment area. Groundwater contamination associated with the spill was not reported at the down hydraulic gradient monitoring wells – located close the receiving environment (mangroves) of Blessers Creek. • No NAPL was observed in either of the monitoring events. A slight hydrocarbon odour was observed in monitoring well MW01 during both sampling events. • Bioscreen groundwater modelling suggests that the TRH contamination identified within groundwater is unlikely to migrate or pose a risk to the nearest sensitive receptors (i.e the mangroves immediately down-hydraulic gradient from the site and recreational users of Blessers Creek and broader Darwin Harbour area). <p>Based on the results and outcomes of soil remediation works, groundwater monitoring and predictive modelling, Greencap indicated that the reported concentrations of hydrocarbons within groundwater are unlikely to pose unacceptable risks to the sensitive receptors – however, additional groundwater sampling would be required to verify the predictive modelling results, which will be captured as part of the development and implementation of a GMP for the site (refer to Section 7.11).</p> <p>Manganese was also reported in groundwater greater than the audit criteria, and may in part be associated with background conditions and the presence of hydrocarbon contamination from the spill (which reduces the dissolved oxygen concentrations supporting potential dissolution of the manganese in the aquifer materials).</p>
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Aspect	Details
Adequacy and Compliance	<p>The auditor considers that the scope of supplementary works described within the addendum DSI was generally adequate and appropriate for the purpose of the audit and the auditor is satisfied that:</p> <ul style="list-style-type: none">• The scope of works and methodology were appropriate and consistent with the auditor-approved SAQP (refer to Section 7.9).• The nature and extent of contamination resulting from the diesel spill has been appropriately determined.• Remediation to the extent practicable (taking into consideration the presence of active rail lines) has been completed.• The modelling included realistic and representative input parameters and included sensitivity analysis.• Contamination from this spill does not appear to be impacting or threatening the receiving environment (based on the results of the groundwater monitoring and modelling), except in the most conservative (no degradation) conditions.• Residual contamination that remains can be reasonably and effectively managed to mitigate risks to human health and the environment – assuming appropriate management plans (EMP, GMMP) are developed and implemented.



7.11 Greencap (2023c) Groundwater Monitoring and Management Plan (July 2023)

Greencap prepared a GMMP to monitor and manage potential risks posed to off-site human and ecological receptors (with the mangroves of Blessers Creek) from the residual groundwater contamination present beneath the site.

The purpose of the GMMP was to outline the scope and approach to groundwater monitoring – including establishing criteria which trigger:

- contingent investigation or remediation actions; or
- allow for the cessation of ongoing groundwater monitoring.

The scope and content of the GMMP included:

- An introduction and background to the spill event – including relevant environmental legislation and requirements.
- The site identification details and environmental setting.
- A summary of the nature and extent of the residual soil and groundwater contamination – including relevant sources and pathways of exposure to relevant human (primary contact recreation) and ecological (marine aquatic) receptors from the groundwater contamination.
- Groundwater monitoring and management measures, comprising:
 - Roles and responsibilities.
 - The groundwater monitoring well network – including recommended monitoring well maintenance activities.
 - The proposed groundwater sampling locations, sampling methodologies (including QA/QC), analytical program, sampling frequencies and reporting requirements.
 - Contingency remedial or additional monitoring measures for situations where the trigger levels are exceeded.
 - Review and triggers for cessation of monitoring, including involvement of an auditor.

The auditor considers that the scope and content of the GMMP was developed in accordance with relevant guidance and contains adequate and appropriate information in the context of (and in response to) the spill event.

A separate environmental management plan (EMP) was prepared to mitigate potential risks to on-site workers and visitors posed by the remaining soil and groundwater contamination beneath the site (refer to **Section 7.12**).



7.12 Greencap (2023d) Environmental Management Plan (February 2024)

Greencap prepared an EMP in relation to the mitigation of potential risks posed to on-site occupants, intrusive workers and surrounding human and ecological receptors which may arise during disturbance of the residual soil and/or groundwater contamination (e.g., excavation, dewatering activities and/or development of occupied structures).

The EMP includes:

- An introduction and background to the spill event, objective of the EMP and relevant environmental legislation and requirements.
- The site identification details and environmental setting.
- A summary of the nature and extent of the residual soil and groundwater contamination.
- A summary of potential human and ecological receptors and exposure pathways to the residual contamination in the context of continued use of the site a freight rail facility.
- Roles and responsibilities for the implementation of the EMP.
- An environmental risk management strategy – in relation to management controls, performance measures and monitoring record requirements in the event the following could be or are realised:
 - Exposure to contaminated soil, sediment, surface water and/or groundwater.
 - Waste materials are generated which require management and/or disposal (e.g water from dewatering activities, excess/surplus soil).
 - Air quality issues are possible or are encountered (e.g excess dust generated).
- A summary of training and reporting requirements for any staff and sub-contractors who will be undertaking works in the subject area – including contingencies in the event an environmental objective or performance criterion is not being achieved (e.g incident or non-conformance occurs).

Greencap also note that the GMMP should be read in conjunction with the EMP if excavations deeper than 2.5 m bgl are planned within the subject area.

The auditor considers that the EMP has been prepared in general accordance with relevant guidance – and is considered to be a reasonable and appropriate document to effectively mitigate risks to human health and the environment associated with potential disturbance of the remaining soil and groundwater contamination under the site.



7.13 Agon Environmental (2024a), Sampling, Analytical and Quality Plan (6 November 2024)

Agon prepared a SAQP for assessing the quality of backfill materials used to fill in the remedial excavations on-site. The auditor's review of the DSI (Greencap, 2021c; and other reports prepared by Greencap prior to commencement of the audit) identified that the source of the backfill materials was unknown – including its chemical and physical characteristics.

The auditor requested that a SAQP be prepared to sample and assess the quality of the backfill material used – to confirm its suitability in the context of the current land use as a freight rail terminal facility.

The SAQP described the scope of works and methodology required to address the above and included the following:

- Site identification details and a summary of previous investigations.
- A preliminary conceptual site model – in the context of the importation / use of backfill materials of unknown quality as the potentially contaminating activity. This included identifying the areas of the site where the backfilling had occurred and likely backfill volumes to inform sample locations and frequencies.
- The scope of works, rationale and methodology for a supplementary soil investigation – prepared using the data quality objectives (DQOs) process and including the following:
 - Detailed soil sampling methodologies and broad screen laboratory analysis to assess the quality of the backfill materials.
 - QA measures and QC sampling.
 - Reporting details – comprising the preparation of a soil investigation report documenting the outcomes of the above supplementary assessment (refer **Section 7.14** for auditor comments).

The SAQP was prepared in general accordance with the ASC NEPM and other relevant guidance – and included field screening, sample locations and frequencies, laboratory analysis and assessment criteria considered adequate to assess the quality and suitability of the backfill materials. The soil investigation was subsequently undertaken, with the outcomes of which are discussed in **Section 7.14**.



7.14 Agon Environmental (2024b); Soil Investigation Report (6 November 2024)

Soil sampling was completed by Agon in accordance with SAQP dated 6 November 2024 (Agon, 2024a; **Section 7.13**) to assess the physical and chemical quality of the backfill material used and confirm its suitability in the context of the current land use as a freight rail terminal facility.

The scope, key outcomes and adequacy of the Agon (2024a) report is summarised in the following table.

Table 15: Review of Agon (2024b)

Aspect	Details
Scope	<p>The scope of work comprised a targeted soil investigation within each of the three backfilled remediation areas (Area 1 to Area 3), comprising:</p> <ul style="list-style-type: none"> • The drilling and sampling from five soil boreholes within Area 1 (A1_SB01 to A1_SB05). • The excavation and sampling from eight test pits within Area 2 (A2_TP01 to A2_TP08). • The excavation and sampling from eight test pits within Area 3 (A3_TP01 to A3_TP08). <p>The test pit and soil borehole locations are shown in a figure in Appendix A and were advanced to depths to intersect the full thickness of the back fill profile.</p>
Outcomes	<p>Key investigation outcomes were as follows:</p> <ul style="list-style-type: none"> • The backfill material comprised a road base silty sand material with asphalt inclusions – considered by Agon to be likely recovered/repurposed road base material which is understood to have been previously stored on-site. • No visual or olfactory evidence of diesel-related contamination was noted within any of the soil samples collected from the backfill material – and no asbestos containing material (ACM) was identified. • TRH concentrations were detected above the laboratory LOR from the majority of soil samples collected – however, TRH concentrations from only one surface sample location (A3_TP07_0) were reported above the adopted ESLs. All other COI concentrations were either below the relevant laboratory LOR or the adopted investigation and/or screening levels. • The TRH contamination identified at location A3_TP07_0 was not considered by Agon to present an unacceptable risk to ecological or human health receptors in the context of the existing use of the site as an operating rail freight terminal – with the shallow soils of the area having minimal ecological value with regards to terrestrial flora and fauna.
Adequacy and Compliance	<p>The auditor considers that the soil sampling completed generally provides an adequate understanding of the backfill material to assess its physical and chemical quality; given:</p> <ul style="list-style-type: none"> • The sampling locations, rationale and field sampling methods were considered generally appropriate, consistent with the SAQP (Agon, 2024a). • The analytical schedule applied to the soil samples was consistent with that proposed in the SAQP (Agon, 2024a). • Relevant deviations to the SAQP were appropriately justified and not considered to impact on the outcomes of the investigation. • NATA accredited laboratories were used for analytical testing. <p>The auditor considers the backfill material to be suitable to remain onsite in the context of the current land use as a rail freight facility. The identified TRH concentrations are considered likely to be attributed to the asphalt inclusions present throughout the material and unlikely to present an unacceptable ongoing risk to human health, or ecological receptors on-site in the context of its use as an operating rail freight facility.</p>

8.0 Conceptual Site Model and Risk Assessment

8.1 Auditor CSM

The following presents the auditor’s CSM for the audit site – which is based on a review of the information provided in the reports and documents reviewed in **Section 7.0** and relates only to residual contamination associated of the diesel spill event which occurred on 30 May 2020.

Table 16: Auditor Conceptual Site Model

CSM Element	Detail
Sources	<p>The sources of the contamination relate to the following – which remain following soil remediation (excavation) works which occurred immediately following the diesel spill event on 30 May 2020)</p> <ul style="list-style-type: none"> • Residual (in-situ) soil contamination which remains (following remediation): <ul style="list-style-type: none"> ▪ Under, and in the near vicinity of, the One Road, Auxiliary Road and Ramp Road rail lines adjacent the spill area to depths of approximately 0.5 m below the surface – and at/below the interface with groundwater (where soil remediation could not practicably be completed). ▪ In the base of backfilled excavations which extended to the interface with groundwater in, and in the immediate vicinity of, the location of the temporary sump. • Groundwater contamination which remains downgradient of the spill area with the highest concentrations in the vicinity of monitoring well MW01 (where LNAPL was previously observed)¹⁴. <p>The locations of the residual soil contamination are shown in Figures 4b, 5b and 6b attached to Appendix A. The inferred extent of detectable hydrocarbons in groundwater is also presented in Appendix A.</p> <p>As indicated in Section 7.0, a stockpile of contaminated material from the remediation excavation areas also remains on-site and is proposed to be bioremediated. The stockpiled material is currently stored on and covered by plastic and located more than 150 m away from the remediation areas, the adjacent mangroves and surface water drains. Future management of this material forms a recommendation of the audit as discussed in Section 9.4.</p>
Receptors	<p>Based on the continued commercial / industrial land use for the audit site and the relevant environmental values of groundwater, the following are considered to represent potential receptors of contamination:</p> <p>Human:</p> <ul style="list-style-type: none"> • Current and future commercial workers and on-site visitors (on-site). • Future intrusive maintenance workers (on-site). • Recreational users of Blesers Creek and broader Darwin Harbour (off-site). <p>Ecology:</p> <ul style="list-style-type: none"> • Marine ecosystem and mangrove community (off-site Blesers Creek and broader Darwin Harbour). <p>Aesthetics and Built Environments:</p> <ul style="list-style-type: none"> • Exposed soil and groundwater. • Building foundations and footings.

¹⁴ NAPL was previously observed in the October 2020 to May 2021 monitoring events – noting NAPL was not observed in the most recent September and December 2021 monitoring events.

CSM Element	Detail
Affected media and Contamination Extent	<p data-bbox="437 286 1286 338">Residual contamination associated with the diesel spill event at audit site is present in the following media:</p> <p data-bbox="437 344 496 367">Soils:</p> <ul data-bbox="437 376 1366 1346" style="list-style-type: none"> <li data-bbox="437 376 1366 450">• Investigation locations where the residual soil contamination remains is described below, in Figures presented in Appendix A and within a tabulated summary presented in Table 1 attached: <ul data-bbox="485 459 1366 1346" style="list-style-type: none"> <li data-bbox="485 459 1366 539">▪ TRH F1 concentrations were reported greater than the adopted ASC NEPM commercial/industrial HSL-D criteria at the following locations and concentrations – the extent of which appears to be delineated and limited to two isolated areas: <ul data-bbox="533 548 1366 712" style="list-style-type: none"> <li data-bbox="533 548 1366 629">– BH13 to BH15 beneath the One Road Rail Line (immediately north of the spill location) ranging from 270 to 440 mg/kg greater than the adopted commercial/industrial HSL of 260 mg/kg. <li data-bbox="533 638 1366 712">– NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 590 mg/kg greater than the adopted commercial/industrial HSL of 370 mg/kg. <li data-bbox="485 721 1366 801">▪ TRH C10-C16 concentrations were reported greater than the adopted CRC Care commercial/industrial direct contact HSL-D criteria at the following locations and concentrations – the extent of which appears to be limited to two isolated areas: <ul data-bbox="533 810 1366 996" style="list-style-type: none"> <li data-bbox="533 810 1366 913">– BH13 and BH15 beneath the One Road Rail Line (immediately north of the spill location) at concentrations of 24,000 mg/kg and 27,000 mg/kg respectively – greater than the adopted commercial/industrial direct contact HSL of 20,000 mg/kg. <li data-bbox="533 922 1366 996">– NDTP07 within remediation Area 2a (south of a temporary recovery trench) with a concentration of 31,000 mg/kg greater than the adopted commercial/industrial HSL of 20,000 mg/kg. <li data-bbox="485 1005 1366 1191">▪ TRH F1, F2, F3 and/or F4 concentrations were reported greater than the adopted commercial/industrial ESL criteria at a number of locations beneath the One Road, Ramp Road and Auxiliary Rail lines – including within remediation areas 2a, 2b, 2c and 3. The auditor acknowledges that some of the ESL contamination which remains within remediation area 3 has not been delineated further south and were considered likely to be indicative of historical impacts resulting from the use of the site as a rail terminal and not related to the diesel spill event. <li data-bbox="485 1200 1366 1346">▪ TRH C10-C16 and TRH F3 concentrations were reported greater than the adopted commercial/industrial MLs at a number of locations beneath the One Road, Ramp Road and Auxiliary Rail lines – including within remediation areas 2a, 2b, 2c and 3. The extent of the remaining contamination appears to be delineated and limited to areas in the vicinity of the original spill location and the temporary recovery sump within the western portion of the assessment area. <p data-bbox="437 1355 576 1377">Groundwater:</p> <ul data-bbox="437 1386 1366 1720" style="list-style-type: none"> <li data-bbox="437 1386 1366 1467">• Groundwater is contaminated with TRH fractions C10-C16, F2, F3, sum of TRH C10-C34 and TRH C10-C40 – where TRH concentrations were reported greater than the relevant marine aquatic ecosystems and primary contact and recreation assessment criteria. <li data-bbox="437 1476 1366 1556">• The contamination appears to be limited and isolated to one monitoring well location (MW01) in the vicinity of the temporary recovery sump area within the western portion of the assessment area. <li data-bbox="437 1565 1366 1668">• Groundwater modelling suggests that the TRH contamination identified within groundwater is unlikely to present unacceptable risks to the nearest sensitive receptors (i.e the mangroves immediately down-hydraulic gradient from the site and recreational users of Blesers Creek and broader Darwin Harbour area) – see Section 7.10. <li data-bbox="437 1677 1366 1720">• The remaining groundwater contamination is presented in the appended Table 2 and the inferred extent where TRH remains in groundwater is presented in Appendix A. <p data-bbox="437 1729 735 1751">Surface Water and Sediment:</p> <ul data-bbox="437 1760 1366 1861" style="list-style-type: none"> <li data-bbox="437 1760 1366 1861">• Whilst there was some evidence of impacts to surface water and sediment on-site immediately following the spill and remedial excavation activities, subsequent remediation, sampling and soil management tasks indicate that contamination is unlikely to be present or migrating into the off-site marine aquatic ecosystem of Blesers Creek.

CSM Element	Detail
Exposure pathways	<p data-bbox="437 286 517 309">Human:</p> <ul style="list-style-type: none"> <li data-bbox="437 320 1362 622"> <ul style="list-style-type: none"> <li data-bbox="485 320 1362 342">• Current and future commercial workers and on-site visitors (on-site): <ul style="list-style-type: none"> <li data-bbox="533 353 1362 432">▪ Soils – direct contact, ingestion and inhalation of dusts associated with residual soil contamination, although exposure risk considered to be low in the context of completed remediation works. <li data-bbox="533 443 1362 521">▪ Groundwater – not applicable – due to the absence of registered groundwater bores in the area and the groundwater quality beneath the spill area being highly saline and unlikely to be used for any extractive purpose. <li data-bbox="533 533 1362 622">▪ Vapour – possible vapour intrusion exposure pathway if future occupied structures were to be constructed over the assessment area (where residual soil and groundwater contamination is present - e.g above the One Road rail line where TRH F1 concentrations were reported greater than the adopted vapour intrusion HSL-D criteria). <li data-bbox="437 633 1362 723"> <ul style="list-style-type: none"> <li data-bbox="485 633 1362 656">• Future intrusive maintenance workers (on-site): <ul style="list-style-type: none"> <li data-bbox="533 667 1362 689">▪ Soils - direct contact, ingestion and inhalation of residual contaminated soils. <li data-bbox="533 701 1362 723">▪ Groundwater – direct incidental contact and ingestion. <li data-bbox="437 734 1362 1059"> <ul style="list-style-type: none"> <li data-bbox="485 734 1362 757">• Recreational users of Blesers Creek and broader Darwin Harbour (off-site): <ul style="list-style-type: none"> <li data-bbox="533 768 1362 790">▪ Soil – not applicable as the residual soil contamination is confined to on-site areas. <li data-bbox="533 801 1362 925">▪ Groundwater - not applicable based on the outcomes of the groundwater monitoring events and fate and transport modelling work completed. However, modelling requires future verification events to confirm the validity of these modelling outcomes – and therefore an assessment of risk to this receptor will be undertaken as part of ongoing groundwater monitoring. <li data-bbox="533 936 1362 1059">▪ Surface water - direct incidental contact and ingestion in the event contaminated groundwater (or soil) is brought to the surface during intrusive maintenance activities which subsequently migrates to the receptors – however, this exposure risk is considered to be unlikely in the context of completed remediation works and with implementation of effective EMP controls. <p data-bbox="437 1070 517 1093">Ecology:</p> <ul style="list-style-type: none"> <li data-bbox="437 1104 1362 1462"> <ul style="list-style-type: none"> <li data-bbox="485 1104 1362 1149">• Marine ecosystem and mangrove community (offsite Blesers Creek and broader Darwin Harbour): <ul style="list-style-type: none"> <li data-bbox="533 1160 1362 1182">▪ Soil – not applicable as residual soil contamination is confined to on-site areas. <li data-bbox="533 1193 1362 1317">▪ Groundwater – not applicable based on the outcomes of the groundwater monitoring events and fate and transport modelling work completed. However, modelling requires future verification events to confirm the validity of these modelling outcomes – and therefore an assessment of risk to this receptor will be undertaken at a later stage as part of ongoing groundwater monitoring. <li data-bbox="533 1328 1362 1462">▪ Surface water – potential exposure to the marine receptor in the event contaminated groundwater (or soil) is brought to the surface during intrusive maintenance activities which subsequently migrates to the marine receptor – however, this exposure risk is considered to be unlikely in the context of completed remediation works and with implementation of effective EMP controls. <p data-bbox="437 1473 794 1496">Aesthetics and Built Environments:</p> <ul style="list-style-type: none"> <li data-bbox="437 1507 1362 1753"> <ul style="list-style-type: none"> <li data-bbox="485 1507 1362 1529">• Aesthetics: <ul style="list-style-type: none"> <li data-bbox="533 1541 1362 1608">▪ Soil – the potential for stained and/or odorous soils to impact on the aesthetic aspects of the site is considered low in the context of completed remediation works, except in areas where TRH concentrations greater than the MLs were reported. <li data-bbox="533 1619 1362 1753">▪ Groundwater – the potential for odorous groundwater and/or groundwater displaying hydrocarbon sheens to impact on the aesthetic aspects of the site is considered low since extraction and use of groundwater at the audit site is unlikely and any groundwater brought to the surface during any future intrusive maintenance activities would be effectively managed under the EMP. <li data-bbox="437 1765 1362 1944"> <ul style="list-style-type: none"> <li data-bbox="485 1765 1362 1787">• Built structures: <ul style="list-style-type: none"> <li data-bbox="533 1798 1362 1865">▪ Soil - some of the residual contamination contains TRH concentrations which are reported greater than the MLs. There is the potential for this residual contamination to impact on built structures if constructed within this material in the future. <li data-bbox="533 1877 1362 1944">▪ Groundwater –although not specifically assessed by Greencap, the low residual concentrations of TRH in groundwater are not considered likely to represent a risk to built structures.

CSM Element	Detail
Evaluation of data gaps	<p>The following information gap has been identified in the CSM for contamination on and under the audit site:</p> <ul style="list-style-type: none"> • Groundwater – the predictive modelling indicates that the remaining TRH contamination identified within groundwater is unlikely to migrate to, and therefore unlikely to present unacceptable risks to, the nearest sensitive receptors (i.e the mangroves immediately down-hydraulic gradient from the site and recreational users of Bleesers Creek and broader Darwin Harbour area). However, the modelling predictions (and assessment of risks to relevant receptors) require verification through ongoing monitoring as per the requirements of the GMMP (as detailed in Section 7.11).

8.2 Auditor Risk Assessment

The following table presents the auditor’s qualitative risk assessment for the audit site – which is based on the auditor’s CSM (refer to **Section 8.1**) and only relates to residual contamination present on and under the site following (and only associated with) the diesel spill event. Potential risks to human health, ecology and aesthetic aspects are detailed below. Mitigation of risks are also identified.

Table 17: Auditor Risk Assessment

Contaminated Media	Risk Assessment
Soil	<p>Residual soil contamination from the spill event has the potential to pose a risk to the following receptor groups at the audit site:</p> <ul style="list-style-type: none"> • Human: <ul style="list-style-type: none"> ▪ Construction and maintenance workers who may come into direct contact with the contaminated soils during intrusive works. ▪ Current and future commercial workers (and on-site visitors) if contaminated soils are brought to the surface during future intrusive maintenance works. • Ecological: <ul style="list-style-type: none"> ▪ Off-site aquatic ecology of Bleesers Creek in the event that contaminated soils are brought to the surface during future intrusive maintenance works and are eroded and transported off-site. • Aesthetic and built structures – aesthetic impacts to surface soil quality in the event the contaminated soils are brought to the surface during future intrusive maintenance works. Some areas of residual soil contamination may also pose a risk to built structures. <p>The auditor considers that the above potential risks from the residual contamination can be effectively mitigated through the appropriate implementation of the measures described in the EMP (Greencap, 2023d).</p> <p>Whilst residual soil contamination from the spill event also exceeds the ESLs in some areas, these exceedances are considered to have limited relevance (and are unlikely to present a risk) in the context of the use and form of the site – which consists of paved surfaces and railway ballast and rail lines. The auditor considers that the contaminated soil excavated during remedial excavations is unlikely to pose a risk to human health or the environment based on:</p> <ul style="list-style-type: none"> • The distance to nearby receptors (the material is not stockpiled near buildings or waterways). • It is covered and underlain by black plastic to prevent erosion and leaching of contaminated soil. <p>Notwithstanding the above, the ongoing management of the excavated and stockpiled material forms a recommendation of this SAR (refer to Section 9.4).</p>

Contaminated Risk Assessment Media

- Groundwater** The residual groundwater contamination from the spill event has the potential to present risk to the following receptor groups at the audit site:
- On-site:
 - Human – construction and maintenance workers who may come into direct contact with the contaminated groundwater during intrusive works.
 - Aesthetics – aesthetic impacts to groundwater quality given groundwater contamination (and associated hydrocarbon odours) remain, most notably in the vicinity of monitoring well MW01. However, since extraction and use of groundwater at the site is considered unlikely, these aesthetic impacts are unlikely to be realised.
 - Off-site:
 - Human – the modelling indicates risks posed by groundwater discharge to recreational users of the downgradient Blesers Creek / mangroves is low. This conclusion requires verification through further groundwater sampling.
 - Ecology – the modelling indicates risks posed by groundwater discharge to marine aquatic ecology of the downgradient Blesers Creek / mangroves is low. This conclusion requires verification through further groundwater sampling.

The auditor considers that:

- The above potential risks to human health, aesthetics and aquatic ecology from the residual groundwater contamination can be effectively mitigated through the appropriate implementation of the measures described in the EMP (Greencap, 2023d) and GMMP (Greencap, 2023c).

-
- Surface Water** The auditor considers the risk of surface water contamination from residual soil and groundwater contamination present at the site (caused by the spill event) impacting human health, ecology or aesthetics is likely to be low given:
- The residual soil contamination is present at depth following remediation works (e.g at the groundwater interface beneath the former temporary sump location) or beneath surface ballast and/or infrastructure in inaccessible areas (e.g. beneath rail lines).
 - The measures presented in the EMP (Greencap, 2023d) are considered sufficient to prevent contamination of surface water during works which may disturb contaminated residual soil and groundwater.

-
- Vapour** Risks to human health from soil vapour contamination resulting from the spill event is considered unlikely to exist under the current layout and use of the site. However, a potential risk to human health could occur if commercial buildings are constructed over, or in the near vicinity of, the areas where some of the residual soil contamination remains (e.g above the One Road rail line where TRH F1 concentrations were reported greater than the adopted vapour intrusion HSL-D criteria). These potential risks are identified in the EMP (Greencap, 2023d), with a soil vapour assessment recommended if occupied structures are proposed in the relevant parts of the site.
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9.0 Audit Determination, Conditions and Recommendations

9.1 General

The following sections detail the audit determinations, conditions and recommendations. These are made in the context of the following:

- Audit purposes (refer to **Section 1.1**).
- Relevant regulation imposed by the NT EPA in response to the spill event (refer to **Section 1.3**).
- The continued commercial / industrial use of the site as a rail freight terminal.
- The environmental values of groundwater.
- Only contamination associated with the 30 May 2020 diesel spill event subject to the regulation issued by NT EPA (7 July 2021).

9.2 Audit Determinations

The audit determinations have been based on the requirements and guidance set out in the following:

- *Notice to Carry Out Environmental Audit Program (NT EPA, 7 July 2021) (Notice)* (attached as **Appendix B**).
- *Northern Territory Contaminated Land Guideline (NT EPA, 2017)*.
- *Guidelines for the NSW site auditor scheme (3rd Ed.) (NSW EPA, 2017)*.

In the context of the above, the determinations consist of the following:

- The nature and extent of any contamination of the land – which addresses item (i) and item 9 (a) of Attachment B of the Notice.
- The appropriateness of a remediation / management plan – which addresses item (ii) and item 9 (b) of Attachment B of the Notice.

9.2.1 Nature and Extent of Contamination

The nature and extent of contamination in soil and groundwater on and under the audit site is considered to have been adequately determined, and consists of the following – which is based on the intended future commercial / industrial use of the site as a rail freight terminal and environmental values of groundwater:

- **Soil** TRH contamination greater than the relevant human health, ecological and management limit guideline values remains in areas which could not be practicably remediated / removed at the following locations:
 - Under and immediately adjacent to the One Road, Auxiliary Road and Ramp Road rail lines to depths of approximately 0.5m below the surface.
 - In the base of backfilled excavations which extended to the interface with groundwater in, and in the immediate vicinity of, the location of the temporary sump.
- **Groundwater** – Groundwater contamination remains downgradient of the spill area in the vicinity of monitoring well MW01 (where LNAPL was previously observed).

Contamination has not been identified to extend off-site.

9.2.2 Appropriateness of Remediation / Management Plan

The GMMP (Greencap, 2023c) and EMP (Greencap, 2023d) documents have been prepared to monitor, manage and/or mitigate potential risks to human health and ecological receptors which may arise during disturbance of the residual soil and/or groundwater contamination.

The auditor considers the GMMP and EMP documents to be reasonable and appropriate documents for the following reasons:

- The documents were prepared in a manner generally consistent with relevant national and NT guidelines endorsed by the NT EPA.
- The nature and extent of contamination which remains in soil and groundwater under the site has been appropriately determined and documented – and appropriate provisions are made for:
 - Mitigating potential risks to relevant receptor group through reasonable and appropriate management controls – including:
 - How the effectiveness of the management controls will be verified (through monitoring).
 - How frequently the monitoring will be completed and the verification criterion.
 - Ongoing monitoring of groundwater quality; including:
 - Contingent investigation or remediation actions (in the event a groundwater trigger level is exceeded).
 - Allowing for the cessation of ongoing groundwater monitoring.

With respect to the ongoing groundwater monitoring, a decision to cease or reduce monitoring must be subject to review/approval by the engaged auditor and the NT EPA.

As indicated in **Section 7.0**, a stockpile of contaminated material generated from the excavated remediation areas remains onsite and is being bioremediated. The auditor understands these works are ongoing. The stockpiled material is currently stored on (and covered by) an impermeable plastic and located more than 150 m away from the Bleasers Creek and away from occupied areas of the site – and thus is considered unlikely to pose a risk to surrounding human and ecological receptors.

9.3 Audit Conditions

Mitigation of the potential risks posed by residual contamination in soil and groundwater from the diesel spill event of 30 May 2024 requires effective implementation of the GMMP (Greencap, 2023c) and EMP (Greencap, 2023d). Accordingly, implementation of these management plans forms a condition of this SAR.

Cessation of groundwater quality monitoring under the GMMP requires auditor and NT EPA review and approval.

9.4 Audit Recommendations

As required by item 9 (c) of Attachment B of the Notice, the auditor makes the following recommendations in relation to management of the excavated contaminated soils¹⁵ currently being bioremediated by Aurizon:

- If the material is proposed to be disposed off-site to a licensed landfill facility, it should be assessed and classified by a suitably experienced and qualified environmental consultant.
- If the material is proposed for re-use on-site or off-site, it should be assessed and classified by a suitably experienced and qualified environmental consultant. If reuse on-site is proposed, this should take into consideration the following:
 - The soil criteria applied in the addendum DSI (Greencap, 2023b) which are considered appropriate values to assess suitability for reuse on-site.
 - The management measures described in the EMP (Greencap, 2023d).
- Verification by a suitably experienced and qualified environmental consultant that contaminated soil does remain beneath the former stockpile location. This should be addressed by supplementary soil sampling.

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¹⁵ Which the auditor understands emanated from the remediated excavations and is currently stored on (and covered by) an impermeable plastic located more than 150 m away from the remediation areas, the adjacent mangroves and existing surface water drains.

10.0 Other Relevant Information

This site audit was conducted for Aurizon for the purposes of determining the following:

- The nature and extent of contamination.
- Appropriateness of a remediation / management plan.
- Recommendations for further investigation or remediation.

The SAR, its determinations, conditions and recommendations only relate to contaminations caused from the diesel spill event at the site on 30 May 2020. It does not consider any other contamination that could have been caused by other events or sources which have occurred prior to or following the spill event.

This SAR is not suitable for any other purpose. Assessment of risk implications from any changes to the land use must be made by an EPA Accredited Auditor.

The appointed consultants (Greencap and Agon) included limitations in its reports. The audit must also be subject to those limitations. The auditor has prepared this SAR in accordance with the *Guidelines for the NSW Site Auditor Scheme (3rd Edition) (EPA, 2017)*, utilising other guidance made or endorsed by EPA and by applying professional judgement. However, the auditor is unable to certify or warrant works over which the auditor had no control or was unable to check (e.g works completed prior to auditor engagement / involvement).

In drawing conclusions, the auditor used reasonable care to avoid reliance upon data and information that may be inaccurate, however a degree of uncertainty is inherent in all subsurface investigations and there remains the possibility that variations may occur between sample locations. The audit and this report are limited by and rely upon the scope of the review, and the information provided by Aurizon and its consultants and representatives through documents provided to the auditor. The auditor's conclusions presented in this report are therefore based on the information made available to them and arising from their own observations conducted during the audit. If the auditor is unable to rely on any of those documents, the conclusions of the audit could change.

It is not possible in a SAR to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

11.0 References

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