Sandy Ridge Facility

Leachate Monitoring and Management Plan

2020

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Prepared for:
Department of Water and Environmental Regulation

Prepared by Tellus Holdings Ltd

TELLUS

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SANDY RIDGE FACILITY LEACHATE MONITORING AND MANAGEMENT PLAN

Final | May 2020

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Document Control

The signatures below certify that this management plan has been reviewed and accepted and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.

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Amendment Record

This management plan is reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or omissions is given below:

Section No.	Context	Version	Date
	Initial draft submission to DWER	A	20/11/2019
All	Restructure to meet DWER environmental management plan guidance document.	B	21/01/2020
All	Revised as per DWER Document Review Comments Sheet dated 10 February 2020. Added trigger and threshold criteria specific to leachate management.	C	05/03/2020
All	Revised as per DWER Document Review Comments Sheet dated 31 March 2020	D	24/04/2020
Various	Editorial fixes per feedback from L. Zheng DWER: Appendix A links, incorrect reference to Table 3-2, clarify mitigation actions for trigger exceedance, reword Appendix H2. Plus adjusted Appendix E.	E	07/05/2020

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ABBREVIATIONS

CAP	Compliance Assessment Plan
CAR	Compliance Assessment Report
CSM	Conceptual Site Model
CEO	Chief Executive Officer as defined in MS 1078
EPBC	*Environmental Protection and Biodiversity Conservation Act 1999*
HSECQ	Health Safety Environment Compliance and Quality
ICP	Institutional Control Period
ISO	International Standards Organisation
km	kilometres
LLW	Low Level Radioactive Waste
LMMP	Leachate Monitoring and Management Plan
m	metres
mbgl	metres below ground level
MS 1078	Ministerial Statement Number 1078
NORM	Naturally Occurring Radioactive Material
PCB	Polychlorinated biphenyls
PER	Public Environmental Review
PFAS	Per- and polyfluoroalkyl substances
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWL	Standing Water Level
WA	Western Australia
WAC	Waste Acceptance Criteria
WIP	Waste Immobilisation Plant

SUMMARY

Aspect	Summary
Title of Proposal	Sandy Ridge Facility
Proponent name	Tellus Holdings Ltd
Ministerial Statement reference	1078
Purpose of the document	Implementation condition requirement
Key environmental factor	Terrestrial environmental quality
Condition clauses	Conditions 9-1 to 9-6
Key provisions in the plan	The key provision and outcome for this Leachate Monitoring Management Plan is to establish site-based environmental trigger and threshold criteria for soil and groundwater chemistry. The criteria will be used to measure and manage through an adaptive management framework potential leachate associated with isolating Class IV and Class V waste in waste cells within a near-surface arid geological repository. The aim is to safeguard the long-term integrity of local and regional terrestrial environmental quality.

1 CONTEXT AND RATIONALE

1.1 Proposal

Tellus Holdings Ltd (the **Proponent**) is developing the Sandy Ridge Facility (the **Facility**). The Proponent has obtained the necessary environmental planning approvals[1] to develop and operate the Facility. It is located 75 kilometres (**km**) north east of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields Region of Western Australia (**WA**) (refer to Figure 1-1).

The Facility will develop a kaolin open cut mine and use the mine voids as a geological repository for the secure storage and isolation of Class IV and Class V intractable and low-level radioactive waste (**LLW**). These waste materials will be securely contained using best practice techniques support by several environmental management plans and a site-specific Safety Case[2]. Waste material destined for permanent isolation will be either solid dry waste or immobilised liquid waste before placed in a waste cell.

1.2 Purpose

The purpose of this Leachate Monitoring and Management Plan (**LMMP**) is to meet:

- Condition 9-2 of Ministerial Statement 1078 (**MS 1078**)
- The following environmental objective "*ensure that impacts to soil quality are minimised*".

The conditions of consent relevant to the LMMP are listed in Appendix A. The LMMP provides direction and guidance on environmental monitoring for soil and groundwater at the Facility during all phases of the project. The Proponent's minimum reporting requirements relevant to the LMMP are contained within APPENDIX B: Proponents Reporting Requirements.

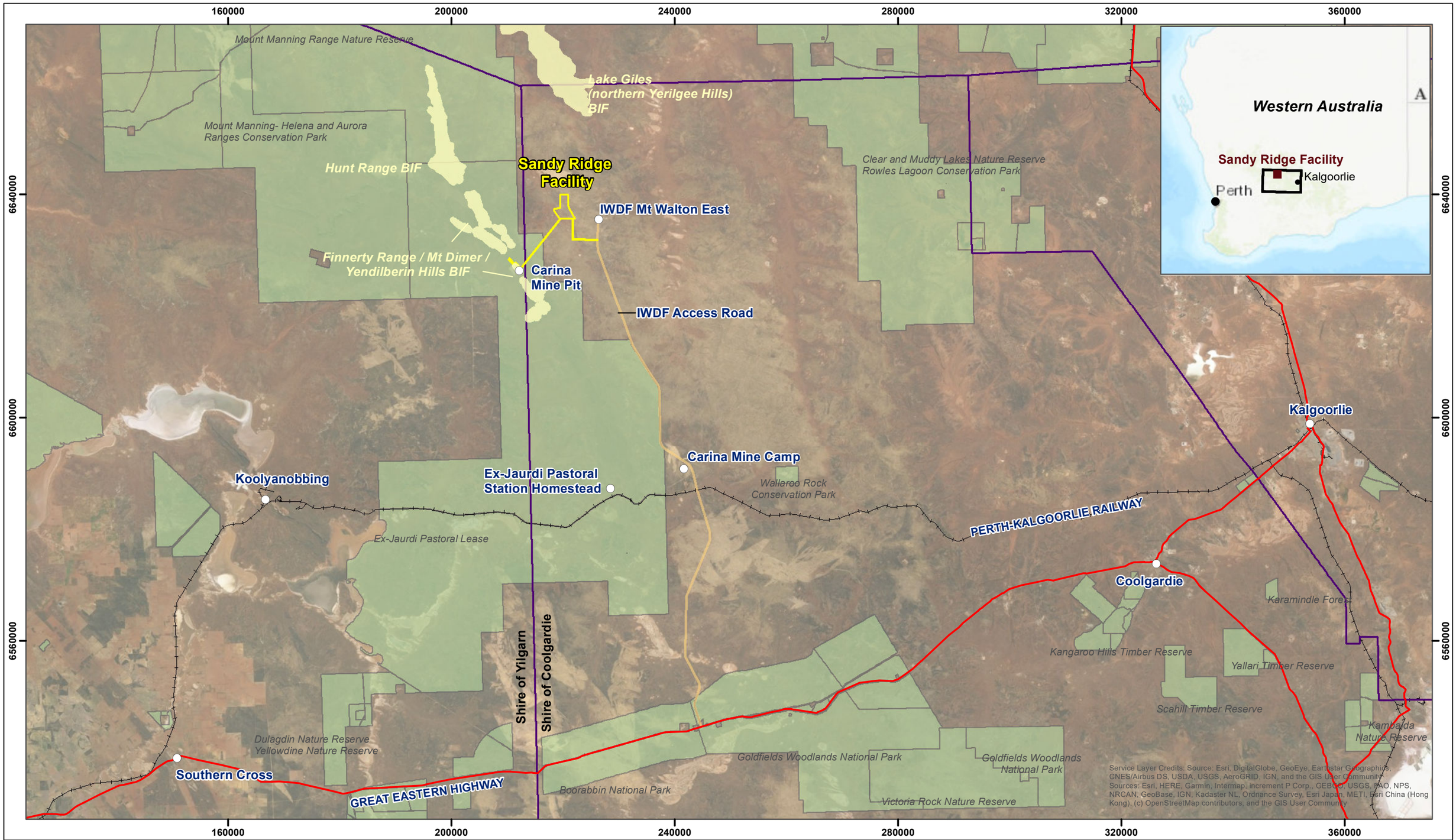
1.2.1 Objectives

The objectives of the LMMP are to:

- Ensure that impacts to soil are minimised, and
- Ensure that impacts to groundwater are minimised.

[1] The Facility received Ministerial Approval in June 2018 (Ministerial Statement 1078 [**MS 1078**]) and, was assessed under a bilateral agreement with the Australian Government Approval under the *Environmental Protection Biodiversity Conservation Act 1999* (**EPBC 1999**). The Australian Government approved the Facility in January 2019 (**EPBC 2015/7478**).

[2] Please note – the Facility will be supported by a LLW Safety Case which is a requirement of Site Registration under the WA *Radiation Safety Act 1975*.



N

10 5 0 10 Km

Coordinate System:
GDA 94 MGA Zone 51

Drawn by: DS
SP-ID:GL00-2017072102-788
TSR0426_LMMP_RegionalLocation.mxd

Legend

- IWDF Access Road
- Principal Road
- Railway
- Development Envelope
- Local Government Authority Boundaries
- Specified Ecosystems: Potentially Occuring Priority Ecological Communities

Data in this map is sourced from: © Commonwealth of Australia (Geoscience Australia) 2018 and © State of Western Australia (Department of Mines, Industry Regulation and Safety) 2018.

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Figure 1-1
Regional Location

SANDY RIDGE FACILITY
LMMP

TELLUS

Version: A
Date: 10/12/2019

1.2.2 Physical setting

Location and climate

The Facility is located in remote regional Western Australia, at an approximate palaeo-valley divide near the top of a surface water catchment between the Raeside and Rebecca palaeo-drainages. Important characteristics of this location with respect to the Facility include;

- It is in a semi-arid desert climate with low rainfall.
- Natural and extensive clay barrier within the deep weathering profile.
- No surface water receptors (as at top of surface water catchment).
- Flat topography with low rates of erosion.
- No regional aquifer, as near a groundwater divide between two palaeo-valleys.
- Remote location away from population centres.

The WA Environmental Protection Authority (**EPA**) considered that the above characteristics make the site suitable for detailed consideration as a near surface waste repository (EPA, 2017).

The low rainfall recharge implied by the lack of groundwater in the area is also supported by the prevailing local climatic conditions. The area is characterised as semi-arid, with annual average rainfall between 2015 and 2019 equalling 267.7 mm, and evaporation exceeding 2,400 mm/annum.

Under these conditions, the sporadic rainfall events (which may be intense) result in local runoff, and infiltration of rainfall into the thin aeolian surface sand. However, during subsequent dry periods, evaporation and evapotranspiration act to remove this rainfall infiltration from the top few metres of soil, which results in little if any net recharge (Cymod, 2016).

Site topography and drainage

The Development Envelope (as defined in MS 1078) has low relief that consists of flat to gently undulating plains and low rises. It is typical of landscapes in the WA Goldfields region which occur over deeply weathered granite rocks. The topography over the entire develop envelope ranges from about 460 metres (**m**) to 490 m above sea level. It rises gently from west to east.

Lithology and hydrogeology

The geological interfaces at the Facility are shown in Figure 1-2 and summarised below. The surface lithology (deep red and yellow sands) are homogenous in nature. By comparison, the surficial sediment and laterite layers are transitional in nature. The kaolin development is a deep and extensive weathering horizon on top of a 2.7-billion-year-old granite. The kaolin grades downwards from pure through declining percentages before it is classified as saprock, which in turn grades through degress of oxidation before it is classified as oxidized or moderately weathered granite.

There are no sharp interfaces between these layers in general, just gradual degrees of weathering before they are classified as a separate geological entity. This transitional nature makes it

challenging to define boundaries between the various classifications in what is essentially a weathered granite profile of varying intensity.

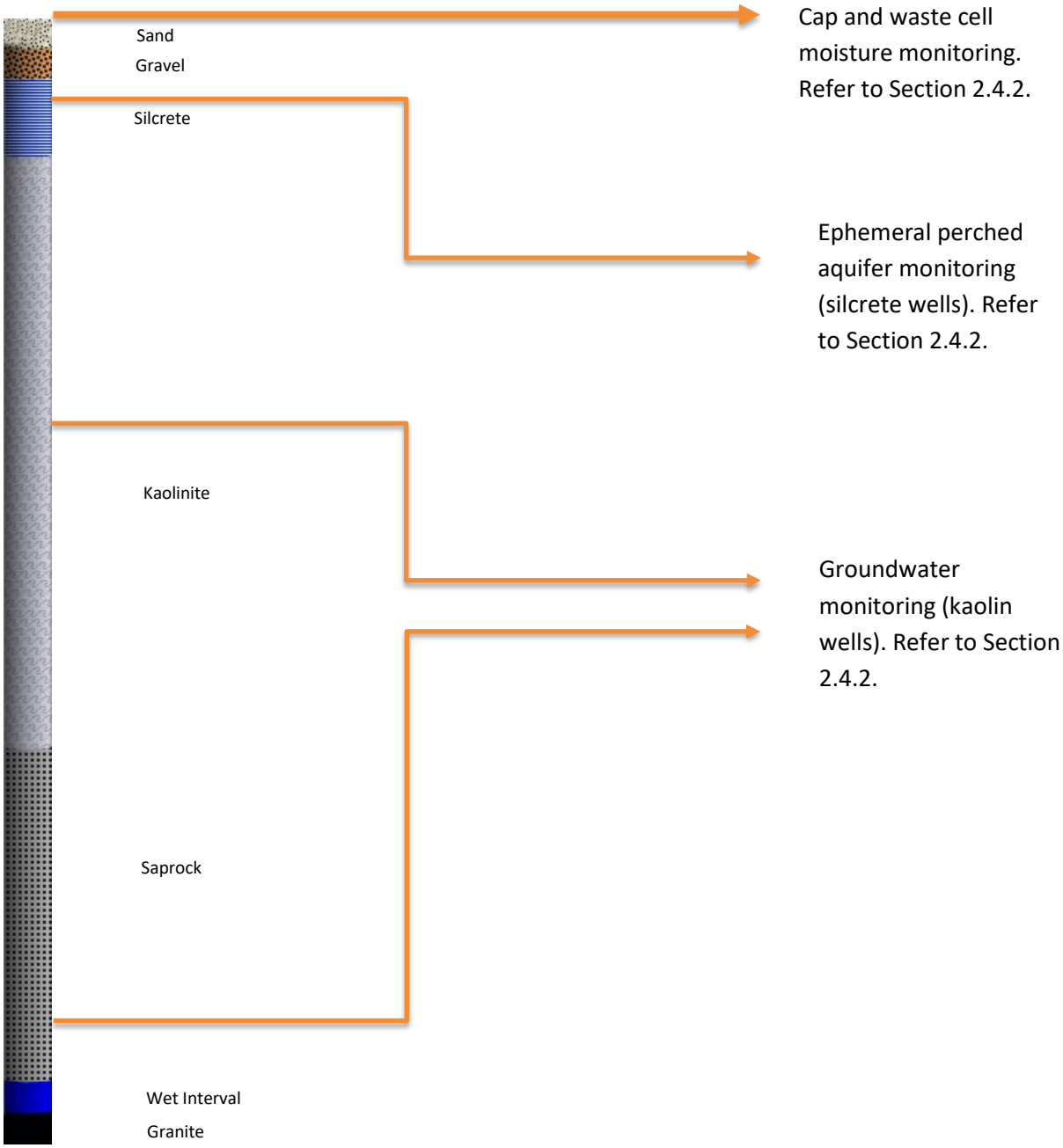


Figure 1-2 Typical lithology at the Sandy Ridge Facility.

The Facility does not occur within a groundwater area proclaimed under the WA *Rights in Water and Irrigation Act 1914*. Monitoring groundwater levels and for groundwater quality within the Development Envelope has been undertaken since 2015.

Where groundwater has been encountered, it occurs in natural traps at the deepest parts of the basement surface where the weathered granite (kaolin) and unweathered granite meet.

The sites groundwater well network is typically characterised by:

- Bottom of casing (base of well) ranging from approximately 20 to 50 metres below ground level (mbgl).
- Well casing diameters ranging from standard 50 mm uPVC to narrow 37 mm uPVC (piezometer wells).
- Water depths ranging from approximately 20 to 35 mbgl.
- Very low recharge rate.
- Water columns ranging from 0 m (dry) to 11 m.

Limited purging has resulted from some wells having a very shallow water column (i.e. less than 1 m), these wells typically have a high sediment content in the water column making sampling difficult.

As presented in the Public Environmental Review (PER), groundwater at Sandy Ridge was found to be relict water trapped more than 20 m below the ground surface in the undulations of unweathered bedrock (Rockwater 2015, Appendix A.11 to the PER).

Approximately 370 drill holes drilled in the area indicate the water is restricted to a pocket in the western portion of the site. Further, the groundwater is held in 70-million-year-old weathered kaolinised granite with an extremely low permeability like concrete (Cymod 2016, Appendix A.12 to the PER). Therefore, groundwater at Sandy Ridge is extremely unlikely to be affected by seasonality, change with time and, is not prone to moving its physical location.

Geo 9 undertook further research in 2019 to characterise the Facility's lithology and hydrogeology. The report is contained within Appendix C and is summarised below:

- Desktop and field survey data was correlated against existing drill results to model the potential for groundwater occurrence and the potential for groundwater movement across the Facility.
- The resulting data has assisted in determining the transition from saprock to solid granite basement.
- There was excellent correlation between the survey data and the drillhole data.
- The granite basement is irregular, with ridges and depressions evident that naturally control the location (spatial distribution) of groundwater on the site.
- Groundwater is located only in the bottom of' basin like' basement lows where the weathered granite meets the unweathered granite.
- There is no evidence of significant aquifer development or groundwater recharge systems.

Figure 1-2 shows a 3D model representing relative / potential permeability data across the Development Envelope at the Facility. Data tubes modulate and are pseudo-coloured to represent the modelled relative / potential permeability values.

The wider the data trace (i.e. the tubes shown in Figure 1-2 and Figure 1-3) the more permeable the subsurface at the point indicated. The data traces are coloured to display the same relative values of permeability data to aid in distinguishing the data. The colours are on a pseudocolour spectrum with

the lowest values represented by blue then ranging through to the highest permeability values in red. Please note - the colour red still indicates low permeability (9.3 x 10 E+1).

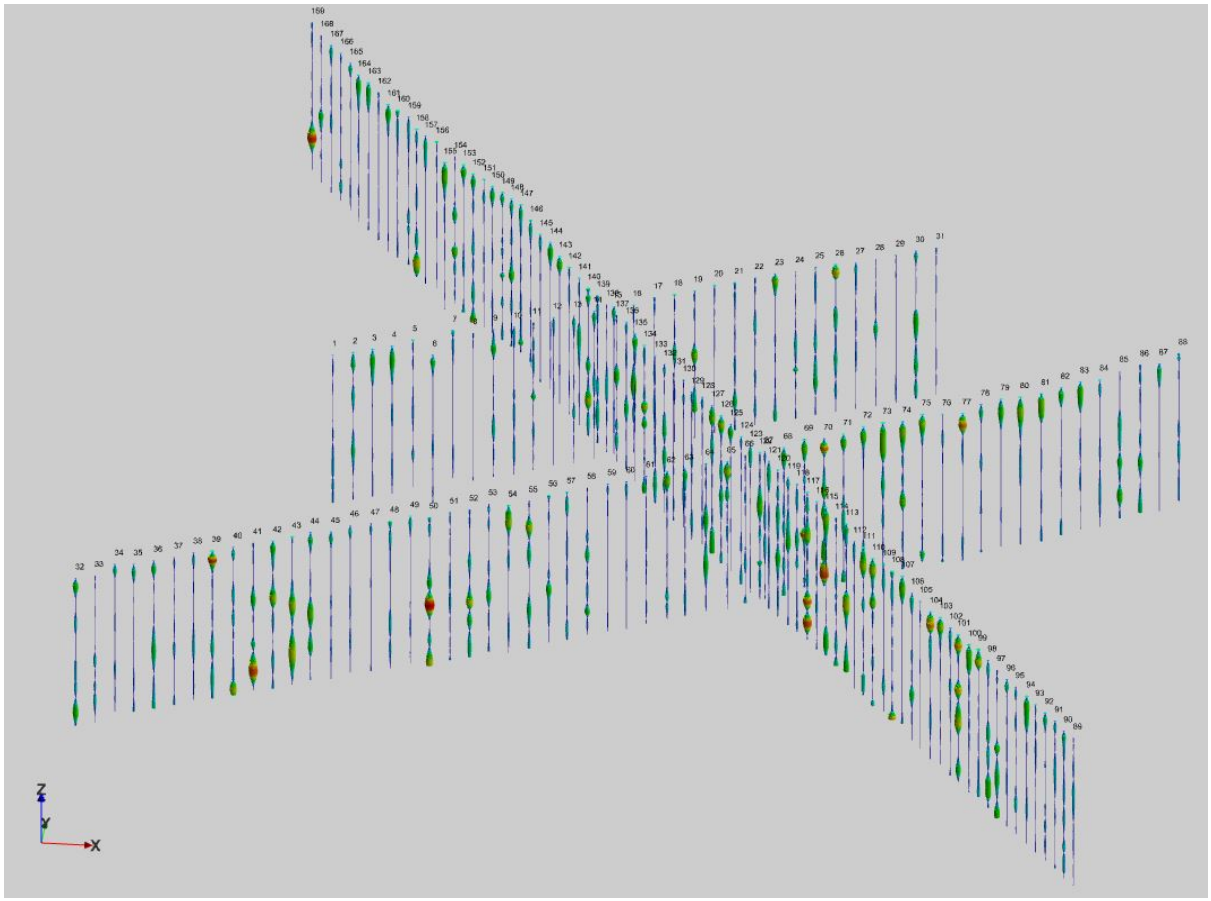


Figure 1-3 3D model showing potential hydraulic conductivity across Sandy Ridge.

The seismoelectric data in Figure 1-3 gives an indication of relative values of permeability in the middle of the development envelope. It indicates this section of the transect (points 117 to 136) contains low permeability throughout the drillhole lithology. The exception is at Point 117 which shows an increase relative permeability in the basement low.

When correlating the basement modelling with the drill results, it is observed that subsurface water is only encountered in basement lows where a natural basin structure has developed. The basement topography indicates that the water encountered appears to be sitting at the bottom of a natural sump. This matches the basement contours that were interpreted from the drilling data that are presented in

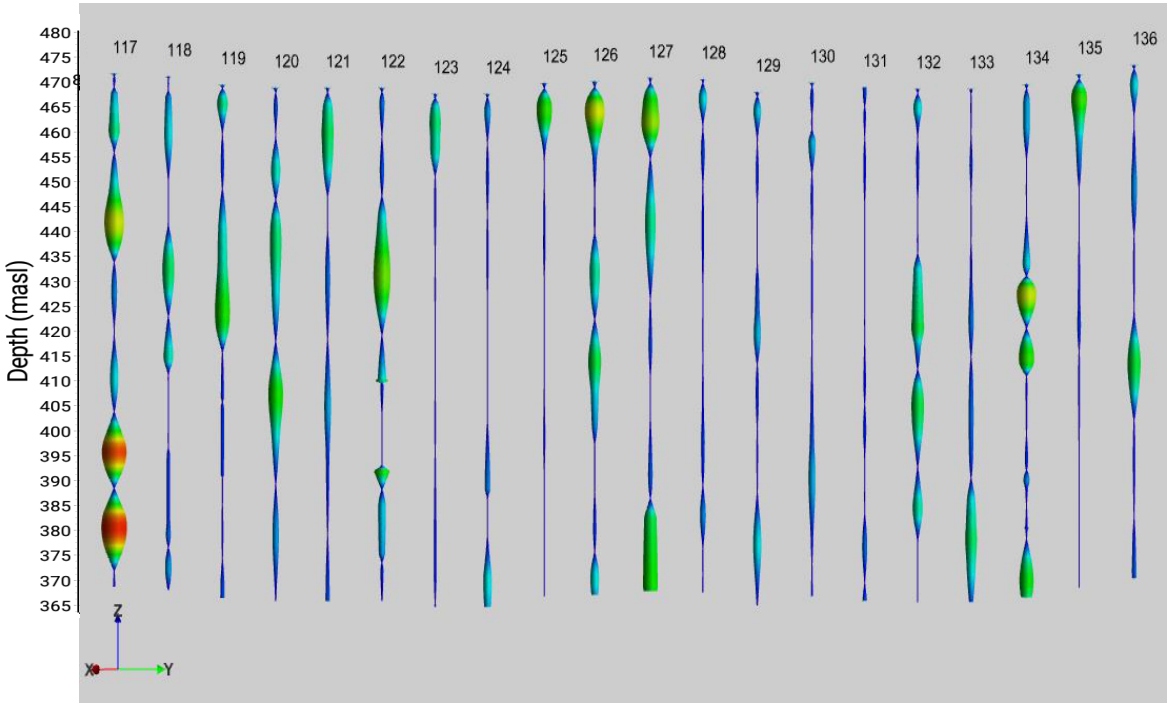


Figure 1-4 Data traces show relative permeability from the surface to end of drill holes (masl – metres above sea level).

1.2.3 Conceptual site model

The development of environmental baseline information between 2015 and 2019 allowed Tellus to prepare a conceptual site model (**CSM**) covering site operations and post closure. The CSM's are provided in Appendix D. The CSM's are drawn not to scale and illustrate the Facility layout and the location of groundwater monitoring wells in context to the Class IV and Class V waste Cells.

1.3 Key environmental factors

The key environmental factor relevant to the preparation and ongoing review of this LMMP is *terrestrial environmental quality*. Condition 9-1 of MS 1078 requires the Proponent to manage the implementation of the Facility to ensure that impacts to soil quality are minimised. As required by Condition 9-2 of MS 1078, this LMMP has been prepared to demonstrate the environmental objective in Condition 9 will be met.

EPA's environmental factor of Inland waters is indirectly related to terrestrial environmental quality, in that if soil quality were impacted by activities at the Facility, surface water and groundwater quality may be impacted as well, if there were a credible pathway.

For *terrestrial environmental quality*, activities which may affect this key environmental factor include the above-ground storage of waste, emplacement and permanent isolation of intractable Class IV and Class V waste into kaolinised granite.

The Facility has been designed to minimise the potential for discharge of contaminated water and thereby reducing the risk of contamination of soil. These aspects are regulated under Part V of the

EP Act. In addition, the site selection criteria included the absence of surface water bodies and a groundwater aquifer. Therefore, the potential for water and soil contamination from above-ground waste activities will not be discussed further.

This plan focusses on the potential for leachate generation from waste cells. Migration of groundwater or any free liquid at the Facility could potentially occur in a vertical or horizontal axis. This is described below.

1.3.1 Vertical migration pathways

The Geo 9 2019 study concluded the areas of highest potential permeability appear well below the kaolinite horizons in the solid granite basement. Relative permeability appears in mostly vertical structures, possibly where fracturing has been preserved in the granite.

The vertical pathway for contaminant migration in soil is severely limited by a thick layer of highly impermeable silcrete. The silcrete acts to limit vertical groundwater or infiltrating surface water. Further information on the properties of the silcrete are contained in the PER.

The silcrete layer is underlain by the low permeability kaolinised granite. The silcrete is sufficiently impermeable to delay the infiltration of any rainwater for long enough and close enough to the surface, such that the available atmospheric energy and capillary action removes by evaporation, any rainfall which may have infiltrated the surficial soils.

Each waste cell will be capped with a 3 m thick layer of compacted kaolinised granite overlain by 4 m of compacted kaolinised granite and silcrete, which is capped with a nominal 2 m thick compacted kaolinised granite dome upon closure of the waste cell. After a subsidence monitoring period has been completed, each waste cell is covered with a layer of subsoil and topsoil. This is completed to minimise pathway for vertical migration of meteoric water from the surface into the waste cell and to provide a media for plant growth.

1.3.2 Horizontal migration pathways

Figure 1-2 and Figure 1-3 show there are very few areas of high relative permeability observed across the entire site. Where they are, they appear isolated with no real horizontal connectivity to suggest any likelihood of potential aquifer development.

Geo9 (2019) reports there is no evidence of any significant aquifer development in the area as the zones of relatively high permeability are isolated with little to no interconnection between them evident. Where connection is seen in the permeability data, it tends to be in a vertical direction below the transition to solid granite, possibly related to vertical fracturing preserved in the fresh rock.

Accordingly, horizontal migration of free liquid below the silcrete is unlikely. Extensive research undertaken between 2015 and 2020 indicates that the limited amount of groundwater present in some areas of the site sits in confined basement lows, with no evidence of horizontal migration and limited opportunity for horizontal migration to the existing geological topography of the

unweathered granite. In addition, the very low permeability kaolinised granite will further inhibit any potential horizontal migration of liquid.

In accordance with the Proponent's Waste Acceptance Criteria (**WAC**) (refer to Section 1.4.1 for more information), all wastes to be disposed in cell will be dry solid wastes or immobilised wastes. The WAC is in place to eliminate free liquid being generated in a waste cell that may migrate horizontally or vertically from the waste mass. Horizontal migration of free liquid above the silcrete is also unlikely. The region is subject to significant evaporation (i.e. up to 10 times higher than annual average rainfall) meaning:

- The potential for rainfall or leachate to vertically infiltrate on top of the silcrete layer is limited.
- If it did, it is unlikely to pool above the silcrete for any length of time because, there does not appear to be any significant hydraulic conductivity response developed horizontally in the survey orientations completed in 2019 by Geo9, other than within the confines of the basement lows which appear to act as groundwater traps.
- There does not appear to be any surface recharge of groundwater in the survey area with a significant horizon of low permeability indicated in the kaolinite and saprock horizons. High permeability response in the surface overburden is not seen extending through the kaolinite horizon at any point (Geo9, 2019).

Tellus has measured soil moisture and temperature in-situ since 2016. This data is being assessed against the on-site automatic weather station to determine whether there is evidence of ephemeral perched aquifer occurring. Future revisions of the LMMP will include an overview of baseline soil moisture and temperature data and what it means against the objectives of this Plan.

1.4 Condition requirements

A detailed table of MS 1078 condition requirements is presented in APPENDIX A: Conditions of Ministerial Statement 1078.

1.5 Rationale and approach

1.5.1 Waste acceptance

The Facility's WAC permits the acceptance and temporary surface storage of solid and liquid wastes. However, in line with the Facility's WAC and Waste Acceptance Procedure (**WAP**), liquid wastes will be immobilised using a Waste Immobilisation Plant (**WIP**) before they are placed inside a waste cell for permanent isolation. Combined, the WAC and WAP only permit solid and immobilised liquid waste for permanent isolation at the Facility.

Based on the Proponent's WAC, WAP and several risk assessments, the potential for leachate generation inside a waste cell over the life of the project, even beyond the 100-year Institutional Control Period (**ICP**), is considered rare. Accordingly, risks to the receiving environment as a result of potential leachate generation, are also considered rare.

1.5.2 Environmental baseline studies

Between 2015 and 2019, numerous site surveys and studies have been undertaken to qualitatively and quantitatively assess, analyse and describe baseline soil and groundwater quality. Various desktop and field studies and monitoring confirm that groundwater does not exist where Class IV and Class V waste materials will be permanently isolated. The same studies confirm there is no true aquifer bearing zone within the Development Envelope. However, the same studies have confirmed isolated pockets of groundwater do exist to the west and northwest of the mining/cells area. In 2019, Geo 9 state "*these areas of isolated groundwater have limited opportunity for horizontal or vertical migration of water due to the unweathered granite acting as an aquiclude and, by the natural undulating geological topography across the site*".

Detailed baseline soil studies completed in 2015 and 2019 were undertaken by the Proponent to establish background levels of metals and ions, inorganics, radionuclides, Per- and polyfluoroalkyl substances (**PFAS**) and asbestos. Results of the studies were compared against National Environment Protection (Assessment of Site Contamination) Measure (2011) and Health Investigation Levels. Results concluded background soil levels are below threshold values for human health-based and ecological soil criteria (refer to Appendix E).

These studies and any future soil and groundwater sampling within the Development Envelope will be used to establish site-based trigger and threshold criteria. More information regarding site-based triggers and actions are contained within Sections 2 and 3 of this LMMP.

1.5.3 Environmental and engineering risks

Various environmental risk assessments, environmental management planning and leachability studies based on cell design were undertaken between 2015 and 2019. These risk assessments were completed to support the preparation of the environmental impact assessment and this LMMP.

Ongoing risk and design assessments will be undertaken by the Proponent to determine:

- The WAC and WAP are acceptable to risk.
- Potential for leachate generation.
- The rationale for well hole monitoring locations.
- Expected landform evolution (i.e. rates of change to the receiving environment).
- The potential for future land use.
- The timeframes and costs for mitigation and/or remediation to take place and effect.

1.5.4 Desired environmental outcomes

To safeguard local soils and groundwater and conserve the Facility's terrestrial environmental quality, the Proponent's desired outcome for the Facility and this LMMP is to demonstrate there are no significant changes to environmental baseline conditions.

2 ENVIRONMENTAL MANAGEMENT PLAN PROVISIONS

2.1 Introduction

The commitment to environmental monitoring and management provisions for the LMMP are summarised in Table 2-1. The rationale for leachate monitoring provisions in the LMMP include the:

- Location of monitoring sites including reference or control sites.
- Parameters to be established for site-based trigger criteria.
- Frequency, timing and methodologies for data collection and analysis.

2.2 Leachate generating scenarios

Leachate could be generated through:

1. Direct precipitation into a cell during operations.
2. Surface water inflow to a cell.
3. Cell cap failure.
4. Liquid waste being placed into the cell.
5. External recharge.
6. Surface water runoff from above-ground waste handling and storage.

The potential for leachate generation for each of the above scenarios is explained in Section 2.2.1 to 2.2.6.

To eliminate leachate generation, site operational procedures and key infrastructure at the Facility will avoid and minimise leachate generation scenarios listed above by implementing this LMMP supported by several operational procedures.

If in the unlikely event leachate is generated, this LMMP has outlined measures that will be taken to demonstrate the nature and extent of leachate generation and, how it will be managed and reported.

Table 2-1 Provisions of the LMMP

Management Actions	Management Targets	Monitoring	Reporting
Condition 9-1 MS 1078 **The proponent shall manage the implementation of the proposal to meet the following environmental objective:** **(1) ensure that impacts to soil quality are minimised**			

Implement the following management and mitigation actions:
• Follow the strict Waste Acceptance Criteria (**WAC**) to prevent the generation of leachate ensuring that no wastes containing free liquids (such as a sludge or liquid waste inside drums), no putrescible waste that may decompose into a liquid state, and no wastes that when compacted will release moisture, will be deposited. Refer to for more information.
• Erect a canopy over the cell to prevent the entry of stormwater either through direct precipitation into the cell or through surface water inflow.
• Control localised drainage around the cell to prevent ingress of water into the void during mining and waste operations.
• Ensure each waste cell is fully enclosed at all stages of excavation and backfilling by the canopy structure.
• Ensure the waste cell cap design is engineered to:
  ○ Resist water ingress by promoting run-off.
  ○ Resist water ingress using low permeability barriers.
  ○ Resist water ingress using a store-and-release barrier.
  ○ Resist erosion.
  ○ Maintain integrity whilst allowing for some settlement of the waste cell content
	• Wastes that do not meet the WAC are transported offsite to an appropriately licensed facility.
	• No liquid wastes to be placed in cell without first being immobilised.
	• No water ingress into the cell during operations.
	• Publish internal groundwater procedure outlined in Appendix F.
	• Waste cell caps designed and installed as stipulated in the Sandy Ridge Waste Facility Decommissioning and Closure Plan (refer to Appendix G).
		• Monthly groundwater monitoring to be undertaken during the construction of the Facility (12 sampling events) to establish baseline site-based trigger criteria. Method for data collection and analysis is addressed in section 2.3. Once site-based criteria are established, the Proponent will undertake bi-annual sampling against a range of parameters contained in APPENDIX H1 and Appendix H2. The suite of analyses for operational bi-annual monitoring may be refined based on the future top-10 wastes to be accepted at the Facility. These wastes may form Key Indicators in future leachate monitoring at the Facility.
		• Groundwater monitoring will be undertaken as per the procedure outlined in Appendix F.
		• Ephemeral perched aquifer will be monitored during operations as outlined in Section 2.4.5.
		• Refer to Figure 2-1 for the locations of groundwater monitoring sites.
		• Waste cell cap monitoring in accordance with the Sandy Ridge WFDCP summarised in APPENDIX G.
		• A compliance report is prepared for each new cell to ensure compliance with the relevant management actions.
			The proponent will prepare and submit an annual Compliance Assessment Report (**CAR**) that includes the following;
			• Annual reporting of monitoring results and trends against management targets.
			• Reporting of any exceedance of management targets in accordance with the approved MS 1078 Compliance Assessment Plan (**CAP**).
			• Reporting on the review and revision of management actions.
			• Submission of compliance reports of new cells.

Condition 9-2 MS 1078 **Prior to the commencement of waste receival, the proponent shall prepare and submit a Leachate Monitoring and Management Plan to the Chief Executive Officer (CEO), to demonstrate that the environmental objective in condition 9-1 will be met.**			
Submit the LMMP to the CEO prior to commencement of waste receival at Sandy Ridge.	LMMP received and approved by the CEO prior to any waste acceptance at Sandy Ridge.	Weighbridge and waste acceptance records as recorded by the Tellus Waste Management System.	The proponent will prepare and submit an annual CAR that includes the following; • A report on the type of wastes, tonnages of wastes and the dates wastes were received between at Sandy Ridge.
Condition 9-3 MS 1078 **The Leachate Monitoring and Management Plan shall specify:**			

Management Actions	Management Targets	Monitoring	Reporting
(1) Monitoring procedures and protocols, including monitoring location points and frequency of monitoring (minimum every six (6) months)			
• Tellus has developed a Groundwater Monitoring Procedure which identifies the appropriate procedures and protocols to be undertaken. The procedure is presented in Appendix F. • Tellus has developed a groundwater monitoring plan, detailed in Section 2.4. Existing groundwater wells will be sampled 8 times prior to waste acceptance onsite to develop statistically sound baseline groundwater quality and trigger criteria. Each event will be conducted at least 2 weeks apart. • Once an appropriate number of monitoring events have been undertaken and the baseline criteria developed, groundwater monitoring will shift to a bi-annual program throughout operations. • Twenty existing wells will be monitored, as well as future wells adjacent to each new cell as shown in Figure 2-1. • Monitoring points downstream of the Infrastructure Area will be installed to check for presence of ephemeral perched aquifer in the event of extreme rainfall events. • Monitoring of cell cap moisture and subsidence is described in Section 2.4.3 and will be managed under the Sandy Ridge Waste Facility Decommissioning and Closure Plan.	• Conformance with the Groundwater Monitoring Procedure. • Monitoring of groundwater wells prior to waste acceptance and post waste acceptance onsite is conducted at least 6-monthly. • Subsidence will be monitored for 10 years in each cell cap. • Cap moisture will be monitored in cells 1- 3 for the life of moisture probes (estimated to be 10 years).	• An internal audit of field staff conducting monitoring against the monitoring procedures is to occur at least annually • Samples will be analysed against the suite listed in Appendix H1 and H2.	• Conformance and performance of monitoring protocols and procedures is to be included in the MS 1078 CAR submitted to DWER. • The LMMP will be revised to include baseline criteria and resubmitted to DWER for approval once the background sampling events have been completed.
(2) Mitigation and management measures;			
The Proponent will implement the following management and mitigation actions to prevent the generation of leachate: • Follow the strict WAC to prevent the generation of leachate ensuring that no wastes containing free liquids (such as a sludge or liquid waste inside drums), no putrescible waste that may decompose into a liquid state, and no wastes that when compacted will release moisture, will be deposited. • Erect an air dome over the cell to prevent the entry of stormwater either through direct precipitation into the cell or through surface water inflow. • Control localised drainage around the cell is also required to prevent ingress of water into the void during waste operations. • Ensure each waste cell will be fully enclosed at all stages of excavation and backfilling by the air-dome structure. • Manage water introduced to the cell for aiding compaction and for dust control in the cell, to avoid ponding or saturated ground. • Manage the waste immobilisation procedure to ensure quality control. • Ensure the waste cell cap design is engineered to: ○ Resist water ingress by promoting run-off.	• Wastes that do not meet the WAC are transported offsite to an appropriate facility. • No liquid wastes to enter the cell without first being immobilised. • No cells mined or back filled with waste without an operational air dome. • No uncontrolled water ingress into the cell during operations. • Use of water to aid compaction and dust control will be conducted in accordance with a documented procedure. • Waste immobilisation will be conducted in accordance with documented procedures that include QA/QC testing. • Waste cell cap performs as required under the Sandy Ridge Waste Facility and Decommissioning Plan.	• Monthly groundwater monitoring to be undertaken during the construction of the Facility to establish background site-based trigger criteria. Method for data collection and analysis is addressed in Section 2.3. Once site-based criteria are established, the Proponent will undertake 6 monthly sampling against a range of parameters contained in Appendix H1 and Appendix H2. The suite of analysis for both the background monitoring and operational biannual monitoring are identical. • Soil moisture monitoring to be conducted in waste cell to provide early warning of potential leachate generation. • Groundwater monitoring will be undertaken as per the procedure outlined in Appendix F. • Refer to Figure 2-1 for the locations of groundwater monitoring sites. • Waste cell cap monitoring in accordance with the Sandy Ridge	The Proponent will prepare and submit an annual environmental management report that includes the following; • Annual reporting of monitoring results and trends against management targets. • Reporting of any exceedance of management targets in accordance with the approved MS 1078 CAP. • Reporting on the review and revision of management actions.

Management Actions	Management Targets	Monitoring	Reporting
○ Resist water ingress using low permeability barriers. ○ Resist water ingress using a store-and-release barrier. ○ Resist erosion. ○ Maintain integrity whilst allowing for some settlement of the waste cell content		Waste Facility Decommissioning and Closure Plan summarised in Section 2.4 of Appendix G.	
(3) An adaptive management framework, including trigger criteria, monitoring design and methodologies, and trigger management actions			
A two-tiered adaptive leachate management and monitoring framework will be implemented at the Facility. It will be comprised of trigger levels and threshold criteria for groundwater levels and quality and cell cap performance. • Investigation levels are developed as an early indication that results are outside the trigger criteria and/or threshold criteria for the types of samples and analyses performed. Exceedance of trigger criteria will prompt an internal investigation to resolve the reason of increased levels. • Threshold criteria are set at a level of concern where corrective actions may be required to minimise the risk of environmental impacts. Due to natural background variation and possible analytical difficulties, samples exceeding a trigger criteria or threshold criteria are not necessarily conclusive of a serious issue. This will be especially true for heavy metals for they may have local / site-based background values higher than applied groundwater standards.	The Proponent has proposed trigger and threshold criteria as early response indicators (see Section 3.1). These will be refined upon completion of baseline monitoring as follows: • Trigger criteria, threshold criteria and actions for presence of liquid in a well previously dry. • Trigger criteria and threshold criteria for radionuclides (refer to Appendix H2). • Trigger and threshold criteria and actions for cell cap subsidence and moisture levels.	• Groundwater monitoring will be undertaken as per the methodology outlined in Appendix F. • Refer to Figure 2 1 for the locations of groundwater monitoring sites. • Waste cell cap monitoring in accordance with the Sandy Ridge Waste Facility Decommissioning and Closure Plan summarised in Section 2.4 (see also APPENDIX G. • Further monitoring may be required if a trigger or threshold criterion is exceeded. This will be discussed with and ultimately approved by DWER.	The Proponent will prepare and submit an annual environmental management report that includes the following; • Annual reporting of monitoring results and trends against management targets. • Reporting of non-compliances will be done in accordance with the approved MS 1078 CAP. In relation to reporting to DWER: - A Trigger criteria exceedance is considered to constitute a “potential non-compliance” as per the CAP. - A Threshold criteria exceedance is considered to constitute a “noncompliance” as per the CAP.
(4) Incident reporting			
The Proponent’s EMS records accidents and incidents at the Facility in the form of: • Occupational Health and Safety Management System (4801:2002 / ISO 45001 compliant) – records on impacts to workers or the public and data on exposure to radiation will be retained in this system. • Environmental Management System (ISO 14001 complaint) – records on impacts to the environment, environmental and area data will be retained in this system. The Proponent will implement its Quality Management System (ISO 9001 compliant) during the operation of the Facility to ensure consistent documentation, record keeping and business processes.	• Maintenance of the ISO 4801:2002 / ISO 45001 and 14001 accreditations.	• Annual audit and recertification of the accreditations through an ISO accredited certifier.	• The Proponent will prepare and submit an annual environmental management report that includes a copy of its current and valid ISO certifications. • Reporting of non-compliances (including incidents) will be done in accordance with the approved MS 1078 CAP. In relation to reporting to DWER: - Tellus considers a Trigger criteria exceedance to constitute a “potential non-compliance” as per the CAP. - Tellus considers a Threshold criteria exceedance to constitute a “noncompliance” as per the CAP.
(5) Review periods; and			

Management Actions	Management Targets	Monitoring	Reporting
• The Proponent will revise leachate monitoring and management aspects no less than every three years. Any changes to the LMMP will require approval by the Chief Executive Officer (CEO) of DWER. Where and if required, the Proponent will review and revise the LMMP as and when directed by the CEO.	• Submission of the revised LMMP to the CEO of DWER no less than every three years. • Review of the LMMP to include the findings of any incidents or changes to applicable standards.	• The Proponent will utilise the software package InForm to monitor the review schedule of the LMMP.	The proponent will prepare and submit an annual environmental management report that includes the review status and any changes, whether proposed or actual, to the LMMP.
(6) Implementation reporting and auditing			
The proponent will prepare and submit an annual environmental management report that includes the following • Annual reporting of monitoring results and trends against management targets as described in LMMP. • Reporting of any exceedance of management targets in accordance with the approved MS 1078 CAP. • Reporting on the review and revision of management actions	• Submission of all reports on schedule.	• The Proponent will utilise the software package InForm to monitor the schedule of the annual report. • The Proponent will monitor the management target of submission of all reports on schedule through the MS 1078 Compliance Assessment Plan.	• The proponent will prepare and submit an annual environmental management report that includes the review status and any changes, whether proposed or actual, to the LMMP. • The proponent will include its performance of reporting on schedule in the MS 1078 CAR.
Condition 9-4 MS 1078 **After receiving notice in writing from the CEO that the Leachate Monitoring and Management Plan satisfies the requirements of condition 9-1, the proponent shall** (1) Implement the LMMP, or any subsequent revisions as approved by the CEO; and (2) Continue to implement the Leachate Monitoring and Management Plan, or any subsequent revisions as approved by the CEO, until the CEO has confirmed by notice in writing that the proponent has demonstrated the objective specified in condition 9-1 has been met and therefore the implementation of the management plan is no longer required.			
The proponent will implement the LMMP as approved by the CEO and ensure an approved copy is available on the proponent's intranet. The proponent will audit compliance to the LMMP on an annual period.	Implementation of the LMMP and adherence to all obligations and conditions of the LMMP	Annual audit of compliance against the LMMP	The proponent will prepare and submit an annual environmental management report that includes the results of an annual audit of compliance against the LMMP.
Condition 9-5 MS 1078 **The proponent may review and revise the Leachate Monitoring and Management Plan or any subsequently revisions as approved by the CEO**			
The proponent will submit any revisions made to the LMMP to the CEO for approval prior to implementation.	Submission of any revisions made to the LMMP to the CEO prior to implementation	The proponent will monitor the revision history, submission date and approval dates of the LMMP through	The proponent will prepare and submit an annual environmental management report that includes the review status and any changes, whether proposed or actual, to the LMMP, when/if the changes were made and when they were implemented.
Condition 9-6 MS 1078 **The proponent shall review and revise the Leachate Monitoring and Management Plan or any subsequently approved revisions, as and when directed by the CEO**			
The proponent shall review and revise the Leachate Monitoring and Management Plan or any subsequently approved revisions, as and when directed by the CEO	Revision and resubmission of the LMMP within 60 days of a request by the CEO.	The proponent will monitor the management target of revision and resubmission of the LMMP through the MS 1078 Compliance Assessment Plan.	The proponent will include its performance of revising the LMMP on schedule in the MS 1078 CAR.

2.2.1 Direct precipitation

Direct precipitation may generate leachate if it were to fall directly into an active waste cell where waste was present at the surface, through taking some waste material into solution and generate a contaminated leachate.

2.2.2 Surface water inflow to cell

Surface water flow generated from a large rain event where water flows across the surface of the ground or through the ground at a near surface depth, into an active cell where waste present at the surface, could generate leachate through taking some waste material into solution and generate a contaminated leachate.

2.2.3 Surface water from above-ground waste management

Surface water flow generated from a large rain event where water flows across the surface of the ground where waste is handled or stored at the surface, could contaminate surface water through taking some waste material into solution.

If that contaminated surface-water were released to the environment, it is regarded as unlikely for reasons explained in the PER and in the most recent research conducted by Geo 9. However, this LMMP has considered the unlikely possibility of surface water seeping into the soil profile and generating a pool of contaminated leachate at the silcrete layer.

In this unlikely event, surface leachate could contaminate the perched aquifer and travel horizontally above the silcrete.

2.2.4 Cap failure

Failure of the cap of a waste cell could generate leachate through allowing a pathway for water ingress into a cell, in turn saturating waste materials and generating a contaminated leachate. The cap of each waste cell is the key containment mechanism to prevent free liquid entering the cell and interacting with waste.

2.2.5 Liquids placed or generated in the Cell

Leachate could be generated in cells from free liquids introduced to aid compaction, dust management and/or generated from materials placed into the cell with potential to generate a contaminated leachate.

2.2.6 External recharge

Entry of water into the waste cells from external sources (i.e., not through any mechanism described above) is not considered a credible risk for the following reasons.

- **Control of ground penetrations**. All activities on the project site are managed to reduce the opportunity for surface water to infiltrate to the koalinised granite, or if they do, they are of limited duration and are actively managed. For example, drill-holes are both of small

diameter (<100 mm), are backfilled upon completion and any other excavations into the silcrete are lined or designed to only contain limited quantities of water for a short period of time.

- **Mining of the silcrete**. Silcrete mining within a waste cell is done with a surface miner machine rather than drill and blast, to eliminate the chance of fracturing of the silcrete or kaolin.
- **Incompatible land uses nearby will be managed**. The Sandy Ridge site is already within the FNA 275 and FNA 668 buffer zones for the IWDF and it is intended that similar FNA buffer zones will be established for Sandy Ridge in time. These FNAs restrict and provide for Government review of proposed land uses in neighbouring areas which could be incompatible with an intractable waste facility.

2.3 Management based provisions

Monitoring for impacts to soil quality will be undertaken to measure performance against the Proponent's desired environmental outcome. The ongoing monitoring of soil and groundwater quality will assist in determining whether the Proponent's trigger or threshold contingency actions should be implemented.

2.3.1 Objective

Consistent with Condition 9-1 of MS 1078, the environmental objective of this LMMP for terrestrial environmental quality is to "*ensure that the impacts to soil quality are minimised*".

In this version of the LMMP, the short-term objective is to continue baseline water quality monitoring to allow Tellus to develop site-based environmental criteria and performance indicators for groundwater to safeguard the long term terrestrial environmental quality.

2.3.2 Management actions

Management actions that will be implemented to meet the environmental objective (refer Section 2.3.1), management targets, monitoring and reporting are summarised in Table 2-1. Management actions that will be implemented to minimise the risk of generating leachate are listed by priority below:

- Site selection criteria – the site lacks groundwater and surface water bodies, low annual average rainfall, and evaporation rates 10 times higher than annual average rainfall (refer to Section 1.2.2).
- Implementing strict WAC - the WAC prevents the opportunity to generate leachate ensuring that no wastes containing free liquids (such as a sludge or liquid waste inside drums), no putrescible waste that may decompose into a liquid state, and no wastes that when compacted will release moisture, will be deposited.
- Covering cells with an air dome to exclude rainfall or surface water ingress during mining and backfilling with wastes will create a dry operational environment.
- Installing bunds and diversion channels around cells to exclude surface water from entering the cell during mining or waste operations.
- Manage water introduced to the cell for compaction and for dust control, to avoid ponding or saturated ground. Water application procedures will address machine operator training,

application flow rates, defining the application area, supervision and post-application measurements (e.g. CBR and moisture).

- Install civil-engineered cells caps designed (refer to Appendix C) to minimise ingress of rainwater to closed waste cells by:
    - Resisting water ingress by promoting run-off.
    - Resisting water ingress using low permeability barriers.
    - Resisting water ingress using a store-and-release barrier.
    - Resisting erosion.
    - Maintaining integrity whilst allowing for some settlement of the waste cell content.
- Construct active waste handling areas (waste inspection bays, liquid waste dispensing area, waste immobilisation plant) with concrete-bunded floors with self-contained drainage with capacity for 1 in 100 year 72-hour storm event (described in detail in the application for works approvals W6308/2019/1).
- Construct above-ground waste storage areas with low-permeability paved surfaces that drain to HDPE-lined stormwater retention pond with capacity for 1 in 100 year 72-hour storm event (described in detail in the applications for works approvals W6243/2019/1 and W6308/2019/1).
- Operate WIP in accordance with operational procedures that include:
    - Immobilisation formulations using kaolin and or cement to immobilise or chemically bind liquid and sludge waste.
    - free-liquid testing in accordance with Tellus' geotechnical trials and formulation development works to ensure that free liquids are not generated once the immobilised waste is encapsulated.

Monitoring that will be implemented to verify that these management actions are effective are provided in Section 2.4.

2.3.3 Management targets

The management targets for leachate management at Sandy Ridge are:

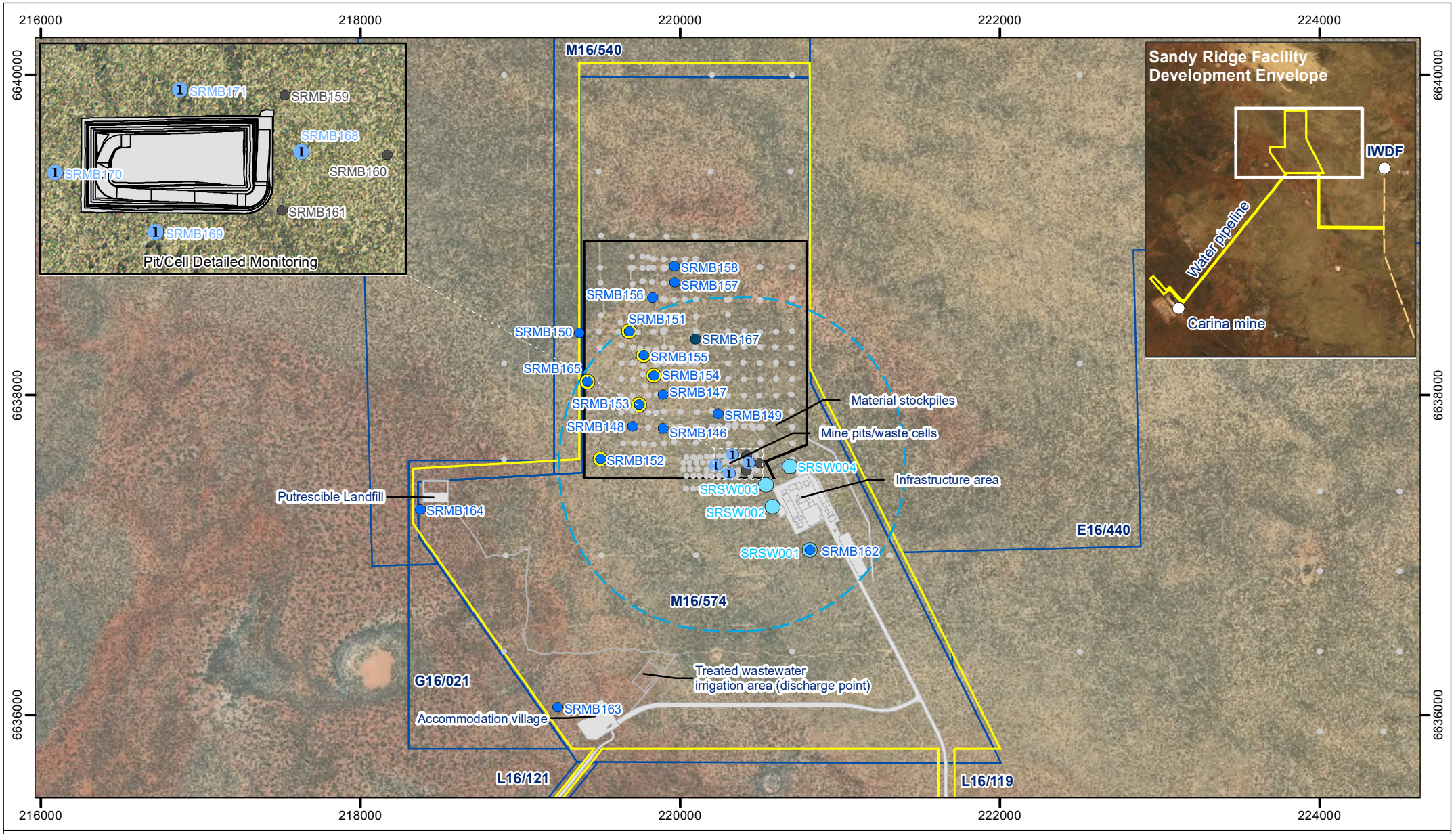
- No increase in groundwater levels above baseline levels (once established).
- No decrease in groundwater quality above baseline levels (once established).

2.4 Monitoring

2.4.1 Historical soil and groundwater monitoring

Environmental monitoring for soil and groundwater across the Development Envelope has been conducted since 2015. An overview of soil baseline monitoring is summarised below and detailed in Appendix E. A brief summary of groundwater monitoring undertaken since 2015 is also provided below. Groundwater wells that have been drilled, sampled thus far and to be sampled during operation of the Facility are shown in Figure 2-1.

A schedule outlining the approval of the LMMP and its implementation is illustrated in Figure 2-2.



N

0 175 350 700 m

Coordinate System:
GDA94 MGA Zone 51

Drawn by: DS
TSR0451_LMMP_MonitoringBores.mxd

Legend

- Monitoring well – kaolin
- Monitoring well – kaolin (cell 1)
- Monitoring well – granite (deep)[1]
- Monitoring well – silcrete (shallow)
- Monitoring well – kaolin (decommissioned)[2]
- Groundwater wells (kaolin): wells within 1km of cell 1 and typically with sufficient water to sample
- Exploration drillholes
- Extent of groundwater well (kaolin) sampling and analysis programme – 1km radius from cell 1
- IWDF access road
- Development envelope
- Live tenement
- Mining area
- Infrastructure area

[1] Monitoring/Management Programme detailed in Deep Groundwater Monitoring and Management Plan

[2] Decommissioned due to being located within the Cell 1 construction footprint. However, replaced with Cell 1 Groundwater Wells (SRMB168-171)

Figure 2-1
Location of Monitoring Wells

SANDY RIDGE FACILITY
Leachate Monitoring and Management Plan

TELLUS

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Date: 24/04/2020

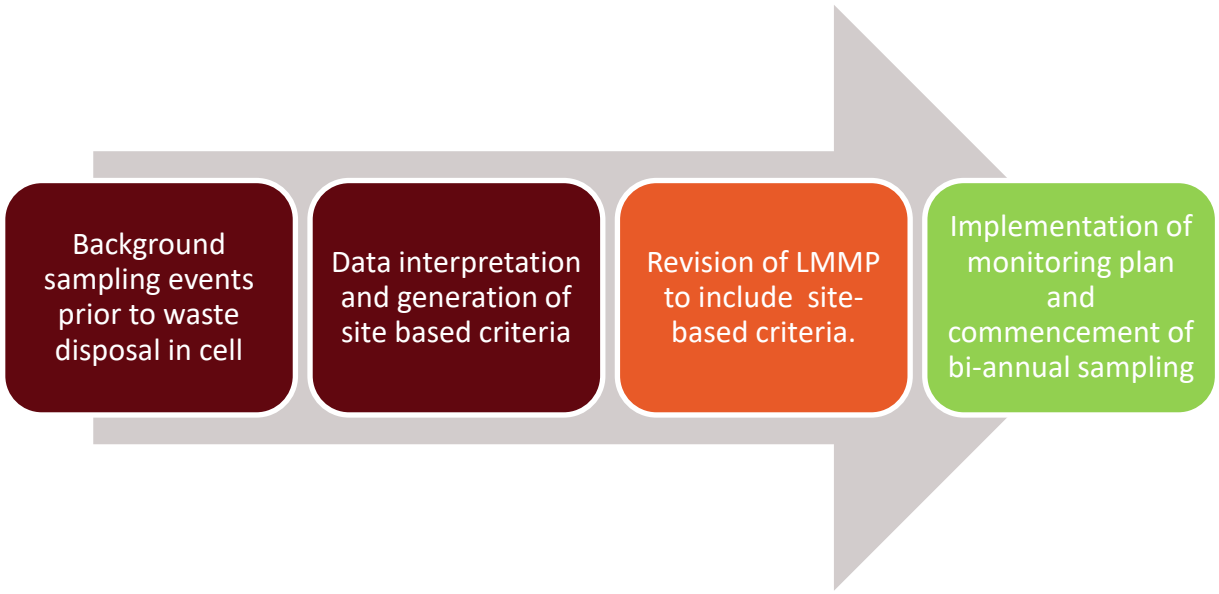

Figure 2-2 Schedule for approving and implementing the LMMP

Soils

Since the publication of the Sandy Ridge PER in 2015, Tellus has commissioned two further soil baseline sampling programs:

1. Soil sampling in the MS 1078 Development Envelope in 2019.
2. Soil sampling of the Mount Walton Road and Sandy Ridge Access Road in 2020.

Approximately 210 samples were collected in 2019 across the development envelopment and were analysed for environmental heavy metals, radionuclides and asbestos. The analyses results were compared against the NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater Health Indicator Levels (HILs) and Ecological Investigation Levels (EILs) listed in Table 2-2. The results are provided in Appendix E, except for radionuclides in 2020 due to pending laboratory results at the time of writing.

The 2019 soil sampling program indicates no HIL exceedances. There were records of elevated background Chromium and Nickel results when compared against the EIL-1 guidelines. This is likely to represent the natural variability of the weathered geology. No results exceeded commercial/industrial EILs or Urban residential and public open space EILs.

In 2020 the Proponent commissioned baseline soil sampling of the access roads in compliance with terms of the Crown Lease. Approximately 50 sites were sampled and were/are being analysed for environmental heavy metals, inorganics, radionuclides, PFAS, Polychlorinated biphenyls (PCB) and asbestos. The combined results of the two sampling programs will be presented in a single report from Landloch Environmental Consultants. An interim baseline report is provided in Appendix E.

Baseline soil quality data will be compared against future targeted soil quality monitoring (every three years) to assess whether the Facility has adversely impacted soil quality and therefore requires

remediation. Surface soil quality is an indicator of the potential for contamination by above-ground waste management activities. Leaching through contaminated soils in turn could contaminate ephemeral perched aquifers above the silcrete layer. Soil quality data is likely a poor indicator of the potential for leachate generation from waste deposited in cells.

This is because surface soils are separated from subsoils by a very impermeable natural silcrete layer. Further this same geology of a thick layer of kaolinised granite overlain by impermeable silcrete, means that if leachate from waste cells were to be generated, it is highly unlikely the leachate would permeate to surface soils. Therefore, groundwater is the better early response indicator for leachate management. More detail on monitoring of soil quality during operations and on closure is contained within the WFDCP (Appendix G).

Groundwater

Pre-construction groundwater monitoring from 2015 (i.e. detection monitoring) was undertaken to detect and characterise the presence or absence of groundwater. This 'detection phase' allowed Tellus understand what risks and hazardous may adversely impact on terrestrial environmental quality.

Importantly, monitoring wells during this detect phase were established down gradient of the Facility. Tellus is still in the 'detection phase' of monitoring for groundwaters at the Facility. Where groundwater samples have been taken, they will be compared to up-gradient wells. These samples will be analysed to determine if a statistically significant increase (SSI) in the levels of any of the monitored parameters has occurred. Refer to Section

Twenty groundwater monitoring wells have been installed at Sandy Ridge, in the active cell area and the surrounding area. Desktop and field hydrogeological studies that have been supported by several drilling campaigns within the Development Envelope undertaken since 2015 confirm that there is no aquifer within the mining/cells area at Sandy Ridge.

Fourteen wells at Sandy Ridge detected moisture or water. Tellus has sporadically been able to recover sample volumes suitable for laboratory analyses from six wells; in 2016, 2019 and in February 2020. The depth to "water" at Sandy Ridge ranges from 22 m to 42 mbgl. A record of standing water levels recorded to date is presented in Appendix E and bore logs are contained within Appendix I.

Table 2-2 NEPM standards use for baseline soil assessment.

	Analytes							
	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
PQL	5	0.1	1	1	0.02	1	1	1
Method	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403	ARL No. 406	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403
	Guideline Levels							
HIL-A	100	20	100*	6000	10#	400	300	7400
HIL-B	500	150	500*	30000	30#	1200	1200	60000
HIL-C	300	90	300*	17000	13#	1200	600	30000
HIL-D	3000	900	3600*	240000	180#	6000	1500	400000
EIL-1	40	-	60[1]	20[2]	-	5[2]	470[3]	15[2]
EIL-2	100	-	190[1]	60[2]	-	30[2]	1100[3]	70[2]
EIL-3	160	-	310[1]	85[2]	-	55[2]	1800[3]	110[2]

** denotes limit for hexavalent chromium*
 # denotes limit for methyl mercury
[1] SS ACL Cr - Soil-specific (added contaminant limit) for ecological investigation limit (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater). Based on Cr III and the lowest value has been used as a precaution
[2] SS ACL - Soil-specific (added contaminant limit) for ecological investigation limit (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater). The lowest value has been used as a precaution.
[3] ACL Pb - Generic added contaminant limits for lead in soils irrespective of their physicochemical properties
- Denotes no NEPM guidelines available

2.4.2 Leachate monitoring

The proposed leachate monitoring program described in this section is based upon the Facility's specific geology. Future wastes to be permanently isolated and their characteristics was also considered.

Despite a low likelihood of leachate generation at the Facility, Tellus has adopted a source, pathway, receptor risk management model to its leachate monitoring and adaptive management plan.

Accordingly, existing and future groundwater monitoring involves:

- Baseline monitoring (to establish site-specific trigger and threshold criteria to establish a 95% confidence interval); and
- Operational monitoring to be assessed against the site-specific trigger and threshold criteria for adaptive management during operations.

Table 2-3 summarises the proposed leachate monitoring measures at Sandy Ridge. It lists early and long-term detection systems, control measures and responses based on the establishment of site- based trigger criteria and threshold criteria. In addition, cell cap subsidence and cell cap moisture will be monitored as early detectors of for potential pathways of leachate generation in a closed cell.

Table 2-3 Overview of Sandy Ridge leachate monitoring program.

	Early Detection		Longer term detection	
	Surface Infrastructure	**In Cell**	**Cell Early Detection**	**Monitoring wells**
	Silcrete	**In cell moisture probes**	**Water depths**	**Water quality**
Trigger	Silcrete ports 3 around higher risk areas and area greatest risk of overflowing If water present but unable to sample (i.e. ~<0.5m), internal investigation on possible source incl review of processes and rainfall, integrity checking of pads etc.	Trigger: Cell cap probes detect moisture **Action:** Internal investigation cause: - Non-intrusive permeability surveys. - Anomalous result. - Continual improvements. - Review cell design for future cell improvements.	0.5m Some action	TBD Internal investigation
Threshold	Silcrete ports Water (>0.5m) Sample + do actions as per ANZECC Short Term and/or control port. If results suspected contamination investigate as per 3.1.4	Threshold: In cell probes detect moisture **Actions:** - As per 3.1.4 WA *Contaminated Sites Act 2003* (CS Act). - Notify DWER within 7 days. - Begin a compliance monitoring program.	1m As per 3.1.4 CS Act	TBD As per 3.1.4 CS Act

Ephemeral perched aquifer monitoring (silcrete wells)

As per section 2.2.3, there is a possibility that surface water contamination could filter vertically to the shallow silcrete layer (location approximately 2-4 mbgl). On advice from DWER, Tellus will implement a monitoring program to check for presence of ephemeral perched water on the silcrete layer following extreme rainfall events or, following an uncontrolled event.

Four silcrete wells (monitoring locations) will be established adjacent to the Infrastructure Area as control points (Figure 2-1) to assess for the presence of an ephemeral perched aquifer above the silcrete layer. Three of the four locations will be adjacent to potential water infiltration/contamination sources, namely stormwater sumps and a mid-point between them. The fourth well will be located south of the Infrastructure Area in a location considered to be "upstream". It is upstream (i.e. a "control" point) due to the civil earthworks design of the Infrastructure Area directing drainage toward the north/north-west (see Figure 2-1).

In addition, the in-situ soil monitoring location (shown in Figure 2-1) will continue to be monitored.

During operations, the silcrete wells will be dipped after rainfall events generating 40 mm or above within a 24-hour rainfall event. If monitoring records free liquid within a silcrete well, a grab sample will be collected and analysed in accordance with the monitoring suite described in Appendix H1 and Appendix H2.

Silcrete wells will be monitored daily for a minimum of five days or until water is no longer present, whichever is later, following the event described above

Cap and cell embedded moisture monitoring

Soil moisture and temperature monitors were installed in 2016 in two locations at Sandy Ridge, at depths of 2 m, 1.75 m, 1.5 m, 1.25 m, 1 m, 0.75 m, 0.5 m and 0.25 m. This data is currently being collated use to establish the in situ seasonal soil moisture profiles and to validate the hydrological modelling (Cymod, 2016) used to estimate infiltration rates.

To verify the performance of cell caps and further calibrate the hydrological model for the site, Tellus will embed digital soil moisture and temperature monitors with continuous data monitoring within the first three cell caps.

In the first cell, moisture probes will be installed in three locations of the cap. In each of the three locations, probes will be installed at a range of depths corresponding with the engineered cap layers (e.g., at the base of upper clay cap layer, at the base of the silcrete/laterite layer, as well as the base of the lower clay cap). The probes will be connected by cables to a data collection device. Monitoring of this first cell will provide detailed data on the performance of the cell cap design and construction.

In the second and third cells, moisture probes will be installed in one location. The location and depths of probes will be informed by the monitoring results from the first cell.

Moisture data will be collected at 10-minute increments 24 hours a day, and manually backed up every 3 months.

Based on Cymod (2016) modelling, the Proponent assumes that moisture levels in newly constructed cell caps will be higher than in-situ regolith moisture levels because water will be used during construction and compaction of the cell caps. As time passes, cell caps will dry due to the very high evaporation rate compared to low rainfall rate. It is assumed that moisture levels will equilibrate back to the regional in-situ soil moisture levels over time.

Cell cap moisture levels increasing over time (instead of decreasing) could indicate leachate generation and/or failure of the cell cap design or construction. A trend of increasing moisture levels will trigger response actions (see Section 3.1) an investigation into the possible cause. Investigation methods could include compaction testing using nuclear density gauge and Lidar survey.

Cap subsidence monitoring

The cell and its cap are designed with some tolerance of subsidence post-closure. Acceptable subsidence of waste cells and the cell caps is detailed in the Sandy Ridge WFDCP (refer Appendix G) which is incorporated into trigger and threshold criteria in Section 3. Localised subsidence or a sharp step between larger areas subsiding at different rates are both worthy of further investigation and potential remedial works.

Subsidence itself does not automatically result in water ingress and generation of leachate. The cap is constructed of natural granular materials which do not catastrophically 'break' or tear in the event of differential movement within the cap.

Greater than expected subsidence or localised subsidence would be monitored and if need be assessed by a hydrologist / hydrogeologist. Time should be a consideration as localised subsidence may be short-lived and remedial works may be as simple as placing some additional compacted fill to remove a low point which may act to pool water. Care will be taken not to carry out such work until any subsidence has completed its movement.

Therefore, each cell will be closed with a thick final capping layer to seal in the waste and limit the infiltration of rainwater, as shown in the Conceptual Site Model. The final capped surface of the cell is to be covered with soil material and vegetated with shallow rooted native plant species that will not affect the structural integrity of the capping.

For the first 10 years of the cell cap being in place (without topsoil or vegetation), it will be monitored for subsidence. This would be evident by:

- Slumping of the cap.
- Cracking or unusual deformation of the cap.
- Ponding of water on the domed cap or development of preferential pathways leading to erosion or rilling.

The 10-year monitoring period for cap stability was selected based on information on the exposed clay caps at the adjacent IWDF, where only one clay cap exhibited minor and localised subsidence, and this occurred within 5 years of capping.

For conservatism, Tellus has adopted a subsidence monitoring period of 10 years. In addition, advice from Douglas Partners (geotechnical engineers) indicates that over the 10-year period, it is expected that more than 95% of residual settlement will have occurred providing a high degree of confidence that the structure of the waste body is unlikely to undergo any further significant vertical deformation.

Indicative completion criteria for the geotechnical stability of cells are contained in the WFDCP (refer Appendix G). Monitoring to confirm that the completion criteria can be met will include:

- Survey cell cap slopes.
- Compaction testing carried out using a nuclear density gauge in accordance with AS 1289.5.8.1.
- Annual subsidence monitoring topographical survey (or other acceptable survey method, e.g. drone survey) for 10 years.
- Annual cap inspections for erosion. Location and number of scours (if present), will be recorded along with depth measurements.

Early response criteria and threshold criteria and actions for subsidence are provided in Section 3. Once the site has been decommissioned, an annual visual inspection of each cap will be undertaken for the following 20 years as per the Sandy Ridge Waste Facility Decommissioning and Closure Plan.

Groundwater Monitoring (Kaolin wells)

Groundwater monitoring wells have been appropriately designed and installed at the Facility. Consistent sampling and analytical procedures will be implemented to ensure accurate and representative samples are taken. The sampling requirements and procedures (including frequency of sampling) are specified in Appendix F.

During operations, the twenty existing monitoring wells (shown in Figure 2-1) plus future wells at each cell will be dipped six-monthly using a calibrated water level indicator by appropriately trained personnel. If free liquid is encountered in the monitoring wells located within 1 km of Cell 1 initially (wells SRMB151, SRMB152, SRMB153, SRMB154, SRMB155 and SRMB165), a sample will be collected and analysed in accordance with the suite provided in Appendix H1 and Appendix H2. As the LMMP is a live document, the list of monitoring wells will alter as more cells are developed.

New monitoring wells will be installed immediately adjacent to the cells and around the perimeter of the mining infrastructure area (as indicated on Figure 2-1) will be monitored for standing water level and groundwater quality. The final location of future monitoring wells will be determined by the arrangement of the cells. All new monitoring wells will be constructed to the technical specification presented in Appendix I.

During operations, the groundwater quality parameters to be monitored as part of this LMMP will be determined based on baseline monitoring results (see above) and:

- The identification of contaminants of potential concern or key indicators (i.e. Facility top 10 waste types).
- What activities associated with isolating Class IV and Class V intractable wastes carry the most risk to the receiving environment.

Major anions and cations will be monitored across wells that contain any groundwater within 1 km of the active Class IV and Class V waste handling areas. A kilometre radius has been selected based on the very low propensity for subsurface water movement due to the natural geology as described in the PER and in Section 1.2.2. Groundwater monitoring data (specifically major anions and cations) will allow the ionic signature to be compared between wells. This will assist in identifying whether the monitoring wells are chemically comparable.

To achieve monitoring well comparability, the recommended considerations involved in the analysis of groundwater quality monitoring data are:

- Determine summary statistics for each monitoring well for all parameters / indicators.
- Compare the ionic composition of each well.
- Graph the data for each well.
- Adjust the dataset to reflect a 95 % confidence level (where required).

Available groundwater quality data for all monitoring wells including the dates of sampling, number of samples, and range of indicators will be presented and considered in addition to summary statistics (e.g. 95% confidence level). If appropriate, outliers and trends in the data will be identified noting an outlier may be due to variability in the measurement or, it may indicate measurement error. This data will be investigated further regarding quality assurance and quality control and, environmental conditions at the time of groundwater sampling.

If major cation and anion data are available, a piper diagram (or an equivalent means of representing ion composition) will be provided. The data from each monitoring well will be plotted as time series plots, box and whisker plots, for example. Box plots provide a graphical summary of data distribution and give an indication of spatial and temporal variability across multiple well locations by presenting the central tendency, dispersion and unequal variances in the data at each well. This type of statistical reporting will be important for the Facility over the license period. The demonstration that the Facility is operating safely and not having adverse impacts on terrestrial environmental quality will be linked to closure objectives in the WFDCP and, project financial assurance and insurance.

Priority sampling

In the event Tellus is unable to extract enough groundwater for completing both chemical and radionuclide laboratory analysis (i.e. a minimum of five litres), Tellus will complete adaptive sampling and analysis based on a prioritisation of analytical suites (refer to Table 2-4).

Table 2-4 Groundwater adaptive sampling and analysis

Testing Priority [1]	Expected Top 10 Wastes	Analytical Suite	Planned Min Nº Monitoring Events	Groundwater Monitoring: Possible Sample Scenarios																					
				Scenario 1 - Sample Water Volume: High									Scenario 2 - Sample Water Volume: Medium									Scenario 3 - Sample Water Volume: Low								
				1	2	3	4	5	6	7	8	8+	1	2	3	4	5	6	7	8	8+	1	2	3	4	5	6	7	8	8+
High	Likely	**Metals**	≥8									Review statistical data against top 10 wastes[1]									Review statistical data against top 10 wastes[1]									Further Assessment likely [2]
High	Likely	**PFAS**	≥8																											
High	Likely	**Field Parameters: pH**	≥8																											
High	Likely	**Radionuclides (natural)**	≥8																											
High	Likely	**Radionuclides (other)**	≥1																											
Med	Less Likely	**OC/OPs**	≥8																		Further Assessment likely [2]									
Med	Less Likely	**PCBs**	≥8																											
Med	Less Likely	**TRH/BETX**	≥8																											
Med	Less Likely	**PAHs**	≥8																											
Low	Unlikely	**Other (i.e. nutrients)**	≥8																											
Low	Unlikely	**Field Parameters: Other**	≥8																											
Low	Unlikely	**Major Cations and Anions**	≥8																											

[1] *Based on what wastes are most likely to be accepted in the short term (i.e. <5yrs)* [2] *For example; monitoring, statistical analysis, etc. maybe required*

	Sampled/Analysed - Full LMMP Suite
	Sampled/Analysed - Reduced LMMP Suite
	Insufficient sampleable water

Analysis of quantitative baseline data

Tellus has developed a monitoring program for groundwater that will establish site-based trigger and threshold criteria. The groundwater monitoring program will be based on a minimum of 12 groundwater sampling events that will undergo statistical analysis to establish a 95 % confidence interval and to determine if a statistically significant increase (SSI) in the levels of any of the monitored parameters has occurred. If a SSI is detected, the Facility will enact trigger criteria reporting and management (refer to Table 2-3).

The proportions of the major cations and anions within different monitoring wells can provide an indication to the degree of connectivity between groundwater wells. Baseline water samples will be analysed for the suite listed in Appendix H1 and Appendix H2.

Trigger and threshold criteria values will be the benchmark to minimise impacts to terrestrial environmental quality from the effects of leachate generation from waste cells.

Trigger and threshold criteria can often be developed based on relevant published guidelines. Water quality guidelines[3] give recommended values for indicators and are intended to ensure that values for inland waters at the Facility are protected. However, there is limited guidance available that is relevant to the unique hydrogeology and environment at Sandy Ridge. Therefore, the Proponent will adopt a conservative framework for establishing site-based soil and water quality triggers.

Identifying site-specific groundwater quality values

Site-based groundwater quality triggers are the numerical criteria that, if exceeded, provide an alert of a change in water quality that warrants further investigation. Conversely, water quality limits (also known as a threshold criteria in this LMMP) in an environmental approval (i.e. an Operational Licence) are typically the maximum allowable concentration of a contaminant that should be measured and not be exceeded.

Trigger criteria at the Facility must be fit for purpose and conservative enough so when they are applied, they will provide early warning of emerging or potential leachate. The time to detect and respond to exceedances of trigger criteria should be considered to ensure compliance and/or remediation action is possible before groundwater is contaminated. Therefore, the monitoring frequency may vary depending on the contaminant of concern.

In the absence of published applicable groundwater trigger values for a near surface geological repository, the Proponent is committed to determining site-based triggers.

[3] *Australian and New Zealand Guidelines for Fresh and Marine Water Quality for the protection of freshwater aquatic ecosystems or stock drinking water (ANZECC, 2000); Australian Drinking Water Quality Guidelines (NHMRC, 2011).*

The highest level of environmental protection to the Facility will be given due to it being previously undisturbed by anthropogenic factors or influences including cultural values of the region. Accordingly, to derive site-based trigger criteria for high environmental values, a 95 % confidence interval will be required for all groundwater analytical data.

A 95% confidence interval is a range of values that you can be 95% certain contains the true mean of the sample data population.

The 95% confidence interval adjusted groundwater analytical data will be used to form the basis of the site-based trigger and threshold criteria. Importantly, the site-specific derived groundwater quality trigger and threshold should be assessed to determine if they meet their intended purpose. This will be applied on a well by well basis. By applying this method, the following four steps will be reviewed to determine appropriate groundwater quality trigger and threshold criteria over the Facility's operating license period.

Step 1 – Examine current understanding

- Identify which wells at Sandy Ridge have enough monitoring data to calculate statistically robust trigger criteria.
- Sample monitoring wells to obtain 12 sampling events.
- Identify any outliers and / or trends in the data.
- Outliers that are identified will be investigated and removed from the data set used to determine the 95 % confidence interval.

Step 2 – Assess site-based data

- Box plots and time series plots to be prepared.
- Where different trends in the concentrations of different indicators across the monitoring wells exist, a brief discussion will be provided for each trend over time.

Step 3 – Agree suite of site-specific parameters

The baseline analytical suite will be revised for appropriateness at the completion baseline monitoring and review of baseline analytical results. Depending on the review outcome, the analytical suite maybe be refined (in consultation with DWER) to reflect 'key groundwater condition indicators' which will be monitored during the operational biannual monitoring programme.

Step 4 – Define site-based trigger and threshold values

To determine site specific groundwater quality trigger and threshold criteria, assess:

- The total number of samples collected.
- The number and percentage of individual samples or;
- The rolling median of the most recent eight samples.

If steps one to four above reveal that monitored parameters have exceeded threshold triggers, compliance monitoring will be actioned. This will involve the verification that any samples have

exceeded the trigger values and, will determine the number of occasions samples have exceed values across the entire historical dataset.

In line with Tellus' Environmental Management System, exceedances of threshold criteria will trigger notification to the appropriate regulator within seven days. The notification will be supported by an outline corrective action program. Compliance monitoring will continue during this period.

Limitations on groundwater sampling

Extracting enough groundwater to complete chemical and radionuclide laboratory analysis has been a limiting factor at the Facility. This has been an unsurprising result given the site was originally selected for having a distinct absence of a groundwater and/or a defined groundwater table or aquifer.

Since 2015, attempts to purge aquifers and obtain a worthy sample for laboratory analysis have been in vain. Tellus has recently purchased more sophisticated equipment in the hope of extracting enough groundwater to test against a broad suite of chemical and radionuclide parameters. In some cases, purging a single well for a groundwater sample has taken several hours resulting in insufficient water volumes for laboratory analysis.

Approximately five litres of groundwater are needed for conducting accredited laboratory testing for a range of radionuclides. With the physical and hydrogeological limitations at the Facility in mind, Tellus propose to sample in accordance with the Radiation Addendum (see Appendix H2) and over a 'reasonable period of time'. This reasonable period of time could be up to five consecutive days. If inadequate volumes of groundwater are abstracted during that reasonable period of time, the supporting chain of custody documentation will accurately reflect and record the sampling event.

3 ADAPTIVE MANAGEMENT FRAMEWORK

A two-tiered adaptive leachate management and monitoring framework will be implemented at the Facility. It will be comprised of early response trigger criteria with actions and threshold criteria and actions as summarised in Table 3-1. The framework described in this section of the LMMP will be adopted by the Proponent to avoid compromising the desired environmental objective linked to Condition 9-1 of MS 1078.

The Proponent intends that the environmental criteria and performance indicators to be established for groundwater at the Facility be:

- Measurable.
- Effective for tracking potential changes to recorded background / baseline conditions.
- Scientifically credible through rigorous sampling procedures, laboratory analysis and quality assurance and control linked to International Organization for Standardisation (**ISO**) 9001 and ISO 140001.
- Unambiguous and easily understood.
- Consistent with best practice techniques across Australia.
- Repeatable and easily monitored over the operational licence and ICP.

A framework of trigger criteria and trigger exceedance actions and threshold criteria and threshold criteria exceedance actions is summarised in Table 3-1. These are explained further in this section.

Table 3-1 LMMP trigger and threshold criteria and actions

Parameter	Trigger criterion	Early response actions	Threshold criterion	Threshold contingency actions
Groundwater level	Nominated 0.5m, pending completion of baseline water level monitoring.	Investigate measurement to find potential source of exceedance, including: • check monitoring equipment, • re-sample and/or increase sampling frequency, • Compare with results from neighbouring wells. • Report to DWER in Annual Compliance Assessment Report.	Nominated 1.0m, pending completion of baseline water level monitoring.	• Report to DWER in accordance with MS 1078 condition 4-5. • Analyse water from affected well(s) for contaminants. • Increase monitoring frequency in affected well(s) to monthly. • Install new well(s) and abstract groundwater (if possible) then analyse water for contaminants of potential concern.
Groundwater quality - Chemical	Pending completion of baseline water quality monitoring	As above	Pending completion of baseline water quality monitoring	• Report to DWER in accordance with MS 1078 condition 4-5. • Install new well(s) and abstract groundwater if possible. • Increase monitoring frequency in affected well(s) to monthly.
Groundwater quality - Radiation	Pending completion of baseline water quality monitoring: Proposed 2 x site-specific baseline levels of Radium 226 and Radium 228 measured in wells adjacent to waste cells.	• Conduct internal investigation into the event. As a minimum, the following steps will be undertaken by the Proponent: - Assess the quality of the sample location. - Review the sampling procedure with the on-site sampler to check for possible sampling errors. - Assess the quality of the laboratory analysis and certify there is a quality control and quality assurance procedure in place.	Pending completion of baseline water quality monitoring: Proposed 2 x site-specific baseline levels of Radium 226 and Radium 228 measured in wells adjacent to (inside) MS 1078 Development Envelope boundary.	• Report to DWER in accordance with MS 1078 condition 4-5. • Conduct contamination investigation in alignment with the *Contaminated Sites Act 2003* (WA) and where required as determined by the investigation, a remediation action plan will be prepared. The Proponent will develop the scope and timeline of such an investigation and remediation action plan with Radiological Council. The remediation action plan may include the following items:

Parameter	Trigger criterion	Early response actions	Threshold criterion	Threshold contingency actions
		- Assess local environmental variation that may have occurred (e.g. climatic). - Repeat sample to confirm the original result and check QA/QC procedures. • Increase the frequency of sampling may be considered and a brief report will be completed and filed within the Proponent's EMS and provided to DWER in the MS 1078 Compliance Assessment Report. • Consult with Radiological Council to develop an action plan to determine the extent of potential leachate contamination. This may include installation of monitoring points adjacent to but inside the approved MS 1078 Development Envelope.		- Installation of new groundwater wells to determine the extent of contamination - Installation of groundwater extraction infrastructure, such as a series of interception wells with pneumatic pumps installed to remove contaminants and minimise the extent of contamination beyond the Cell. • Post-corrective action monitoring will be done to demonstrate the effectiveness of the corrective action, and a risk assessment of the situation will be done that includes suitable risk mitigation controls and procedures.
Cell Cap Moisture	A trend of increasing moisture measured in a cell cap moisture probe over six successive months.	• Inspect cell cap integrity (erosion, scours) and check subsidence survey records. • Check surroundings for potential sources of water ingress. • Inspect monitoring equipment for signs of deterioration (moisture probe life is estimated to be 10 years). • Compare results with other cell cap moisture monitors. • Check meteorological records for correlations.	A trend of increasing moisture measured in a cell cap moisture probe over 12 successive months.	• Report to DWER in accordance with MS 1078 condition 4-5. • Conduct assessment of cell cap surface and sub-surface layers, which may include: - Ground-penetrating radar. - Shallow drilling investigation. • If moisture is indicated by the above, develop an action plan and report to DWER.

Parameter	Trigger criterion	Early response actions	Threshold criterion	Threshold contingency actions
		• Report to DWER within Annual Compliance Assessment Report.		
Cell Cap Subsidence	Surveyed subsidence of more than 5% in a cell cap measured.	• Check cell cap construction specifications (thicknesses of layers, compaction measurements and as-constructed surveyed levels). • Inspect cap for erosion. • Measure compaction levels and compare with as-constructed measurements. • Report to DWER in Annual Compliance Assessment Report.	Surveyed subsidence of more than 10% in a cell cap measured.	• Report to DWER in accordance with MS 1078 condition 4-5. • Apply and compact layer of kaolinised granite to cell cap to re -instate water-shedding design. • Increase cell cap monitoring frequency to bi-annually until results are return to below trigger criteria.

3.1 Early Response Indicators

This Plan adopts two aspects of early response indicators for managing potential impacts to terrestrial environmental quality:

1. **Indicators of water ingress to closed cells**: moisture levels in cell caps of cells 1-3 to verify cell cap design.
2. **Indicators of leachate being released from waste cells**: groundwater level and groundwater quality.

3.1.1 Early response trigger criteria

Early response trigger criteria (trigger criteria) are developed as an early indication that results are outside the agreed criteria for the types of samples and analyses performed. Exceedance of trigger criteria will prompt an internal investigation to resolve the reason of increased levels. Four early response trigger criteria to alert for the potential for leachate generation from waste cells are proposed:

1. Trigger and threshold criteria for groundwater levels.
2. Trigger criteria for groundwater quality will be established in late 2020 following analysis of continuous groundwater sampling events. Tellus is committed to sampling no less than 8 and up to 12 events to establish 95% confidence intervals for trigger criteria and threshold criteria.
3. A trend of increasing moisture measured in an in-cell moisture probe over three successive months.
4. A trend of increasing moisture measured in a cell cap moisture probe over six successive months.
5. Subsidence of more than 5 % in a cell cap.

Standing water levels

Trigger and threshold criteria for groundwater standing water levels (**SWL**) will be based on the natural variation observed in monitoring completed to date and in future monitoring. Several measurements of standing water level in monitored wells at Sandy Ridge are outliers and presumed to be sampling errors. Once these errors are excluded from the dataset, standing water levels were measured within a 0.5 m range. Therefore, an increase of greater than 0.5 m above the average SWL is nominated as a trigger criterion and an increase of greater than 1.0 m above the average is nominated as a threshold criterion.

Chemical and radionuclide parameters

Trigger and threshold criteria for chemical and radionuclide parameters will be refined following Tellus achieving a minimum of eight (8) sampling events with a view to extend to 12 events. The trigger and threshold criteria will be developed using the baseline data, which will be adjusted to a 95 % confidence level.

Cell moisture

Trigger criteria for in-cell and cell cap moisture will be applied to cells 1 to 3 in which soil moisture probes will be installed to verify the integrity of the operational controls and engineered cell cap design.

This LMMP will be amended to confirm the trigger and threshold using the baseline data adjusted to a 95 % confidence interval.

3.1.2 Early response actions

Trigger management actions are the actions that will be implemented if trigger criteria are exceeded, to minimise the potential for environmental impacts. An exceedance of a trigger criteria will trigger an internal investigation into the event. As a minimum, the following steps will be undertaken by the Proponent:

- Assess the quality of the sample location.
- Review the sampling procedure with the on-site sampler to check for possible sampling errors.
- Assess the quality of the laboratory analysis and certify there is a quality control and quality assurance procedure in place.
- Assess environmental (e.g. climatic) variation that may have occurred.
- Repeat sample to confirm the original result.

Following these steps, increasing the frequency of sampling may be considered and/or additional mitigation actions. A brief report will be completed and filed within the Proponent's EMS and provided to DWER in the MS 1078 Compliance Assessment Report.

3.1.3 Threshold criteria

Threshold criteria represent the limit of acceptable impact beyond which there is likely to be a significant effect on the environment (EPA Instruction: Environmental Management Plans, 2020).

The Sandy Ridge Facility site was selected and approved for development of a geological repository due to the unique geology and lack of sensitive receptors. This means that if a cell were to fail to perform as predicted by the scientific studies and modelling, there remains the natural passive barriers to that failure resulting in pollution or environmental harm. Therefore, it is difficult to set true threshold criteria above which "a significant environmental impact on the environment" is predicted.

Therefore, this Plan nominates "preventative threshold criteria" to minimise the risk of failure of waste cells due to their design and/or construction, and "performance threshold criteria" for groundwater levels in monitoring wells:

1. Threshold criteria for groundwater levels (thickness).
2. Threshold criteria for groundwater quality will be established in late 2020 following analysis of 12 continuous groundwater sampling events.

3. A trend of increasing moisture measured in an in-cell moisture probe over three successive months.
4. A trend of increasing moisture measured in a cell cap moisture probe over 12 successive months.
5. Subsidence of more than 10% in a cell cap.

Radiation in groundwater

Most of the radioactive waste proposed to be accepted at Sandy Ridge is Naturally Occurring Radioactive Material (**NORM**). This differs from disused sealed radioactive sources which will be contained within multiple layers of containment before being placed in a cell.

Tellus proposes to monitor groundwater for radionuclides associated with NORM as an early indicator that the cell design is not performing as expected.

The threshold criterion for radiation levels in groundwater is proposed to be twice baseline measurements of radionuclides listed in Appendix H2 measured in monitoring wells adjacent to but inside the MS 1078 Development Envelope.

Disused radioactive sealed sources are therefore a much lower risk of causing contamination beyond a cell. Therefore, Tellus proposes to monitor groundwater for parameters associated with NORM as an early indicator that the cell design is not performing as expected, as listed in Appendix H2.

The trigger criterion for radiation levels in groundwater is proposed to be above baseline measurements of radionuclide indicators of potential NORM contamination measured in monitoring wells adjacent to waste cells. This strategy has been developed following consultation with WA Department of Radiation Health (refer to Appendix H2).

3.1.4 Threshold contingency actions

Threshold contingency actions are decisive actions that will be implemented to bring the impact back below the trigger criteria quickly.

A threshold criterion exceedance will be reported to DWER, in the timeframes conditioned in MS 1078. The significance of the observed values will be evaluated. Further actions may include increased sampling, as well as mitigating activities on a case by case basis.

Exceedance of a threshold criterion in in-cell moisture, groundwater level or groundwater quality will trigger a contamination investigation in alignment with the *Contaminated Sites Act 2003* (WA). Where required as determined by the investigation, a remediation action plan will be prepared. The Proponent will develop the scope and timeline of such an investigation and remediation action plan with DWER. The remediation action plan may include the following items:

- Installation of new groundwater wells to determine the extent of contamination.
- Installation of groundwater extraction infrastructure, such as a series of interception wells with pneumatic pumps installed to remove contaminants and minimise the extent of contamination beyond the Cell.

Post-corrective action monitoring will be done to demonstrate the effectiveness of the corrective action, and a risk assessment of the situation will be done that includes suitable risk mitigation controls and procedures.

3.2 Implementation, reporting and auditing

As per Condition 9-4 of MS 1078, this LMMP will be implemented immediately after receiving notice in writing from the CEO it satisfies Condition 9-1.

As per Condition 9-4 (1) of MS 1078, the Proponent will continue to implement this LMMP, or any subsequent revisions as approved by the CEO. As per Condition 9-4 (2) of MS 1078, the Proponent will no longer implement the LMMP if it has received notice in writing from the CEO that it has demonstrated the objective specified in Condition 9-1 has been met.

The proponent will prepare and submit an annual environmental management report that includes the following:

- Annual reporting of monitoring results and trends against management targets.
- Reporting of any exceedance of threshold criteria within 7 days of identification of exceedance.
- Reporting on the review and revision of management actions.

3.3 Incident reporting

The Proponent's EMS records accidents and incidents at the Facility in the form of:

- Occupational Health and Safety Management System (4801:2002 / ISO 45001 compliant) – records on impacts to workers or the public and data on exposure to radiation will be retained in this system.
- Environmental Management System (ISO 14001 complaint) – records on impacts to the environment, environmental and area data will be retained in this system.

The Proponent will implement its Quality Management System (ISO 9001 compliant) during the operation of the Facility to ensure consistent documentation, record keeping and business processes.

As per condition 4-5 of MS 1078 the proponent will notify DWER of any potential non-compliance within 7 days of becoming aware of the non-compliance. The Proponent will report all incidents and near misses occurring at Sandy Ridge to DWER in accordance with condition 4-2(4) of MS 1078 as outlined in the Compliance Assessment Plan approved by the CEO.

Compliance against the provisions of this Plan will be reported in the Compliance Assessment Report in accordance with condition 4-6 of MS 1078 and monitoring data provided in an electronic format (or suitable digital file alternative).

3.4 Continuous improvement

The Proponent will revise leachate monitoring and management plan no less than every three years. Any changes to the LMMP will require approval by the Chief Executive Officer (**CEO**) of DWER.

Where and if required, the Proponent will review and revise the LMMP as and when directed by the CEO.

Continuous improvement of this LMMP will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets to identify opportunities for improvement. The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

3.5 Change management

Further refinements to the LMMP may result from detailed design refinement or changes identified during construction and operation of the Facility. Any design changes or changes in the scope of works will be managed using the Proponent's Change Management Procedure (DOCID-88105952-697).

Future revision of the Plan will include details of additional monitoring wells installed, including the supporting well construction logs.

Future revisions of the Plan will be resubmitted to the Chief Executive Officer of DWER for approval as per condition 9-5 of MS1078.

3.6 Responsibilities of key staff

3.6.1 General Manager – Health Safety Environment Compliance and Quality (HSECQ)

The General Manager for HSECQ has the following responsibilities:

- The LMMP always meets the requirements set out in Condition 9 of MS 1078.
- Maintain the Proponent's EMS to ISO 14001:2004.
- Provide resources to certify compliance is achieved with this LMMP.
- Mandate and certify that environmental protection remains an integral element of all activities during construction and operation.

3.6.2 Environment Manager – HSECQ (Perth)

The Environment Manager has the following responsibilities during the construction and operation of the Facility:

- Ensure that this LMMP is effectively implemented by the contractor.
- Provide direction and guidance on the implementation of this LMMP.

- Verify that an appropriate environmental induction and training program is developed such that personnel are aware of their environmental responsibilities under relevant legislation and their contract including the requirements associated with this LMMP.
- Coordinate ongoing training in environmental awareness for all levels of staff, as required, to implement this LMMP.
- Participate in regular inspections to ensure compliance with this LMMP.
- Certify that the required monitoring and reporting, including environmental auditing, is undertaken and reported to Tellus General Manager – HSECQ.
- Provide notification/information where environmental incidents/events have occurred liaising with Tellus General Manager – HSECQ.
- Ensure the timely review and assessment of environmental monitoring, auditing and inspection outcomes to ensure identification and implementation of continual improvement with regards to this LMMP.
- Overall reporting of the environmental performance of the Facility.

3.6.3 Facility Manager

The Facility Manager has the following responsibilities in line with the LMMP:

- Conduct environmental mitigation/management inductions.
- Daily interaction and coordination with contractors to ensure their environmental management requirements are implemented.
- Inspection and monitoring (daily and monthly) to ensure environmental mitigation/management requirements are implemented.
- Report on compliance with environmental mitigation/management requirements, results of inspections and monitoring, and any improvement opportunities and non-conformances. Liaise directly with the HSECQ Environment Manager.

3.6.4 Contractors

Contractors have the following responsibilities during the construction and operation of the Facility:

- Identify resources required for the implementation of this LMMP.
- Verify that personnel receive appropriate induction training, including details of the environmental obligations.
- Verify suppliers and subcontractors comply with requirements regarding leachate monitoring and management.
- Undertake weekly inspections, ensuring works comply with relevant regulatory and other requirements.
- Provide other information as required from time to time to demonstrate that environmental management requirements are being met by the contractor.
- Program toolbox talks and daily pre-start meetings to include any relevant leachate monitoring and management requirements
- Report any activity that has resulted, or has the potential to result, in an environmental incident immediately to Sandy Ridge Site Technician or Tellus Perth Manager – HSECQ.
- Stop activities where there is an actual or immediate risk of harm to the environment and advise Sandy Ridge Site Technician or Tellus Perth Manager – HSECQ.
- Verify steps are taken to rectify and prevent future incidents from occurring in consultation with Sandy Ridge Site Technician or Tellus Perth Manager – HSECQ.

4 STAKEHOLDER CONSULTATION

The Proponent recognises the importance of engaging with stakeholders to achieve acceptable environmental outcomes, manage stakeholder expectations and eliminate or minimise potential risks associated with closure.

The Proponent's Corporate Stakeholder and Communications Management Plan:

1. Continuously identify of stakeholders and interested parties.
2. Ensures key stakeholders are consulted throughout the life of the Facility.
3. Ensures a targeted communication strategy to reflect the needs of the stakeholder groups and interested parties.
4. Ensures adequate resources are allocated to the engagement process.
5. Commits it to working with local communities to manage the potential impacts of Facility closure.

4.1 Stakeholder engagement strategy

Where required, Tellus will use single or multiple methods to communicate with key stakeholders regarding the LMMP. The methods adopted by Tellus are listed in Table 4-1.

Table 4-1 Communication methods

Purpose	Method
Inform	Information booths, media releases, newsletters, brochures, mail out programs, websites and hotlines.
Consult	Public meetings, discussion groups, polls, surveys and focus groups.
Involve and collaborate	Workshops and discussion groups, learning circles, interviews, reference groups and community consultative committees.
Empowerment	Site visits, direct phone calls and electronic mail.

Table 4-2 lists future consultation activities and topics associated with implementing and operating the LMMP.

Table 4-2 Future consultation associated with the LMMP

Stakeholder	Topic	Timing
DWER	Multiple departments covering all phases of the project inclusive of Phase I of the ICP.	As required. At the completion of decommissioning each cell.
DPLH	Transition into ICP	As required.
DMIRS	Decommissioning of waste infrastructure (work health and safety).	As required.
DBCA	Progressive rehabilitation of waste Cells	As required.
RHU[4]	Post closure radiation and radon monitoring	ICP
Shire of Coolgardie	Transition into closure	Ongoing and once closure dates are announced.
Indigenous groups	Cultural heritage	Ongoing.
DAWE	Operation, decommissioning and closure	As required.

As the Project progresses, future consultation with the above DMA and other stakeholders will be recorded in the Proponent's online consultation database and management system.

4.2 Stakeholder feedback to date

During 2019 and 2020, the preparation of the Sandy Ridge Crown Lease and this Plan involved Tellus having several meetings with the following key Decision-Making Authorities within the WA government. A summary of those communications is provided in Table 4-3.

[4] *The Responsibility for the Radiation Safety Act lies with the Radiological Council, the independent statutory authority appointed under section 13 of the Act. The Council advises and is responsible to the Minister for Health.*

Daily administration of the Act is handled by personnel of the Radiation Health acting through the Secretary of the Council. Radiation Health is part of the Environmental Health Directorate of the Department of Health, Western Australia. The Unit has separate responsibilities to the Department of Health and is under the direction of the Managing Health Physicist.

RADIOLOGICAL COUNCIL. 2020. Radiation Health Unit. [ONLINE] Available at: http://www.radiologicalcouncil.wa.gov.au/Pages/contact_us.html. [Accessed 18 February 2020).

Table 4-3 Stakeholder engagement during development of the LMMP

Stakeholder	Topic	Outcome
Department of Agriculture, Water and the Environment (formerly DoEE)	In relation to development of a Deep Groundwater Monitoring and Management Plan: • Extent of existing network of monitoring wells. • Nature of groundwater recorded – standing water levels and quality. • Potential for a groundwater aquifer in the unweathered granite. • Installation of a deep well into unweathered granite (bedrock). • Development and logic for establishing site-based trigger and threshold criteria.	Tellus submitted Deep Groundwater Monitoring and Management Plan in December 2019 and again in January 2020. Based on the information provided to DoEE on collected parameters since 2015, DoEE provided in principle support for the location of the deep well and, the establishment of site-based trigger and threshold criteria over a clearly defined monitoring network. The Plan is currently under assessment.
Department of Water and Environmental Regulation	LMMP version 1 submitted in January 2020. DWER provided review comments.	This version addresses DWER comments.
Department of Water and Environmental Regulation	Waste Facility Decommissioning and Closure Plan (submitted October 2019) required by Condition 12 of MS 1078 includes completion criteria for cell caps. DWER provided review comments on the Plan querying baseline data upon which completion criteria can be developed.	Tellus revised Waste Facility Decommissioning and Closure Plan to show how baseline data is being gathered during construction. Indicative completion criteria will be refined as more monitoring data is collected. The Plan is currently under assessment by DWER.
Department of Planning, Lands and Heritage	Various topics relating to aspects of the Crown Lease, whole of project assurance framework and, closure and post-closure activities and costs.	Crown Lease granted under the WA *Land Administration Act 1997* on 26 November 2019.
Department of Planning, Lands and Heritage	In relation to terms of the Crown Lease for Sandy Ridge Facility: Baseline surface soils quality at Sandy Ridge were measured in 2015 and 2019. DPLH required similar sampling to be conducted along the Mount Walton East Intractable Waste Disposal Facility Access Road as a condition of consent on the grant of approval.	Tellus conducted baseline radiation measurements along the Mt Walton Access Road and commissioned a third party to conduct soil sampling.
Department of Mines, Industry	In relation to developing the Mine Closure Plan submitted with Mining Proposal Reg ID 75521:	Sandy Ridge Mine Closure Plan includes indicative completion criteria.

Stakeholder	Topic	Outcome
Regulation and Safety	Completion criteria for closure can be semi-quantitative in current Mine Closure Plan and can be refined as the Project progresses.	DMIRS approved Mining Proposal Reg ID 75521 and its accompanying Mine Closure Plan in June 2019.
Radiation Health (supporting Radiological Council)	Discussed appropriate groundwater monitoring parameters and frequencies for inclusion in the LMMP. Advised Tellus that the radionuclide concentration limits in the Radiation Safety Regulations are probably not applicable to the situation at Sandy Ridge.	The Proponent provided the draft LMMP to Radiation Health. Advice provided by Radiation Health (D. Surin pers. comm. 3 March 2020) has been considered in the proposed radiological monitoring of groundwater in this Plan.

5 REFERENCES

CyMod Systems Pty Ltd, 2016. The Assessment of Long-term Recharge to Encapsulated Waste Isolation cells Sandy Ridge Project. Appendix A.12 of the Sandy Ridge Facility Pubic Environmental Review, Tellus Holdings Ltd, December 2016.

Geo9, 2019. *Sandy Ridge Project Seismoelectric and Electrotelluric Survey Report*. Report prepared by Michael Cook, Chief Groundwater Exploration Geologist.

Rockwater Hydrogeological and Environmental Consultants, 2016. *Sandy Ridge Kaolinite Project. Surface Water Assessment and Management Plan*. Report No. 454/0/15/01a for Tellus Holdings Ltd. January 2016. Appendix A.11 of the Sandy Ridge Facility Pubic Environmental Review, Tellus Holdings Ltd, December 2016.

APPENDIX A: CONDITIONS OF MINISTERIAL STATEMENT 1078

Condition No.	Condition	Document reference
9-1	The proponent shall manage the implementation of the proposal to meet the following environmental objective - *Ensure that impacts to soil quality are minimised*	*This management Plan.*
9-2	*Prior to the commencement of waste receival, the proponent shall prepare and submit a LMMP to the CEO, to demonstrate that the environmental objective in Condition 9-1 will be met.*	*This management Plan.*
9-3	The Leachate Monitoring and Management Plan shall specify	
9-3 (1)	*Monitoring procedures and protocols, including monitoring location points and frequency of monitoring (minimum every six (6) months)*	*Protocols (including frequency) – Section 2.4.2* *Location – Figure 2-1*
9-3 (2)	*Mitigation and management measures;*	*Section 3.1.2* *Section 3.1.4*
9-3 (3)	*An adaptive management framework, including trigger criteria, monitoring design and methodologies, and trigger management actions*	*Section 3*
9-3 (4)	*Incident reporting*	*Section 3.3*
9-3 (5)	*Review periods; and*	*Section 3.4*
9-3 (6)	*Implementation reporting and auditing*	*Section 3.4* *Section 3.5*
9-4	After receiving notice in writing from the CEO that the Leachate Monitoring and Management Plan satisfies the requirements of condition 9- 1, the proponent shall	
9-4 (1)	*Implement the Leachate Monitoring and Management Plan, or any subsequent revisions as approved by the CEO; and*	*Noted*
9-4 (2)	*Continue to implement the Leachate Monitoring and Management Plan, or any subsequent revisions as approved by the CEO, until the CEO has confirmed by notice in writing that the proponent has demonstrated the objective specified in condition 9-1 has been met and therefore the implementation of the management plan is no longer required*	*Noted*
9-5	The proponent may review and revise the Leachate Monitoring and Management Plan or any subsequently revisions as approved by the CEO	*Noted*
9-6	The proponent shall review and revise the Leachate Monitoring and Management Plan or any subsequently approved revisions, as and when directed by the CEO	*Noted*

APPENDIX B: OWNERS REPORTING REQUIREMENTS

Minimum requirement	Objective
A	The Owner shall develop, implement and maintain a LMMP.
B	The Owner shall implement a Water Management Plan that includes a groundwater monitoring program.
C	It shall be the responsibility of the Owner to have appropriate spill response measures in place with supporting management plans and procedures.
D	The Contractor shall maintain a register documenting all relevant information, recording monitoring dates, inspection dates, names of personnel performing the monitoring and inspections, corrective actions. The register shall include: i. The location and description of all monitoring wells. ii. The time and date on which monitoring wells are sampled and results obtained. iii. Photographs of all monitoring wells. iv. The signature of the person making each entry.
E	No runoff from any part of the Facility shall be discharged into a waste Cell.

APPENDIX C: GEO 9 SEISMOELECTRIC AND ELECTROTELLURIC REPORT

Sandy Ridge Project

Seismoelectric and Electrotelluric Survey Report

For Tellus Holdings Ltd
Suite 2, Level 10
151 Castlereagh Street
Sydney NSW 2000

July 2019

Geo9 Project97A
Project Final Report

Report prepared by:
Michael Cook
Chief Groundwater Exploration Geologist

Overview of findings

- Seismoelectric (ES) and electrotelluric (ET) surveying was conducted on the Sandy Ridge Project site between the 9th – 14th of May 2019 with three survey lines completed. Line 1 (31 points) and Line 2 (57 points) were oriented WSW – ENE (065°) across the site. A longer NNW -ESE (150°) 80-point traverse (Line 3) was then completed approximately perpendicular to the initial two traverses. Survey location is shown in Figure 1 with a more detailed view in Figure 2.

- The survey was designed to investigate the potential location of any groundwater on the site and identify any potential groundwater movement pathways away to the surrounding area.

- Survey data has been correlated with existing drill results to model the groundwater occurrence and potential controls on groundwater movement on the Sandy Ridge site.

- The ET data has worked very well in determining the transition from saprock to solid granite basement. There is excellent correlation between the survey data and the drillhole data.

- The granite basement is irregular, with ridges and depressions evident that control the location of groundwater on the site. Groundwater is located only in the bottom of basin like basement lows.

- There is no evidence of significant aquifer development or groundwater recharge systems evident, just isolated zones of elevated permeability that may contain groundwater in structural lows.

- Structural lows in the basement are related to areas of high ES response, with evidence of permeability extending to depth beneath them, possibly indicating fracturing and/or faulting control on the basement topography and the development of secondary permeability.

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1. Introduction

This report presents the findings of the electroseismic (ES) and electrotelluric (ET) aquifer mapping survey undertaken on the Sandy Ridge Kaolin Project during May 2019 (Figure 1).

Based on discussions with Richie Phillips from Tellus, a survey strategy of 3 traverses across the Sandy Ridge site was designed to investigate the potential location of any groundwater on the site and identify any potential movement pathways away to the surrounding area.

In total, 171 survey points were recorded, consisting of 3 survey lines and 2 additional survey points at piezometer locations. Point spacing was 50 m along each of the survey traverses. Survey data has been processed to a depth of 100m. Survey line 1 extends for 1500 m, oriented 065° and consists of 31 points. Survey line 2 extends for 2800 m and consists of 57 points, parallel to line 1, located 850m to the south. Survey line 3 extends for 4 km, perpendicular to the first 2 survey lines. Line 3 was located to pass through the centre of the area where water has been encountered at depth during the prior drilling programs. An overview of the layout of the three survey lines and their location within the exploration licence is shown in Figure 1 and a detailed survey layout in Figure 2.

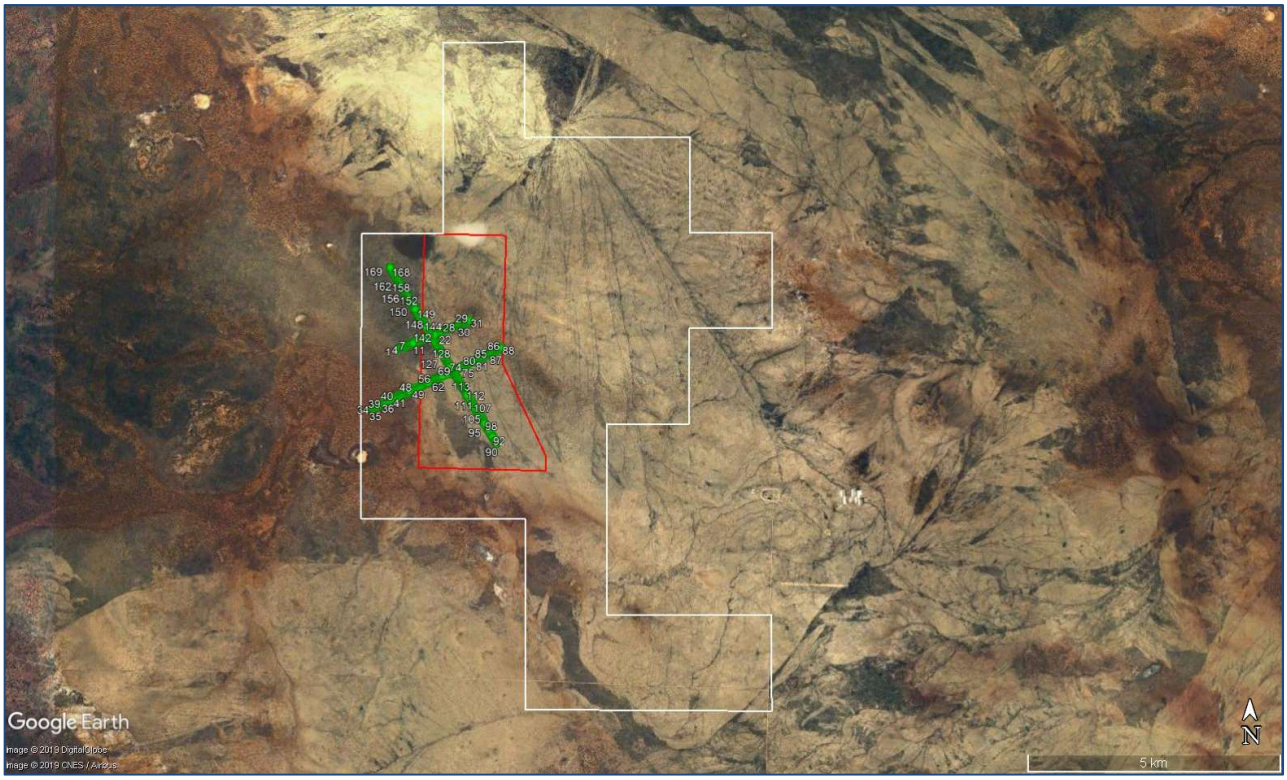

Figure 1. Survey location with individual survey points shown in green. Project boundary (red line) is shown within the larger EL area (white line).

The aim of the project is to incorporate the seismoelectric and electrotelluric survey results into the existing geological models from prior drilling programs and the geophysical and geological information collected during the Stage 1 Preliminary Assessment, to produce a detailed conceptual hydrogeological site model. The location of previous drillholes are shown in Figure 3.

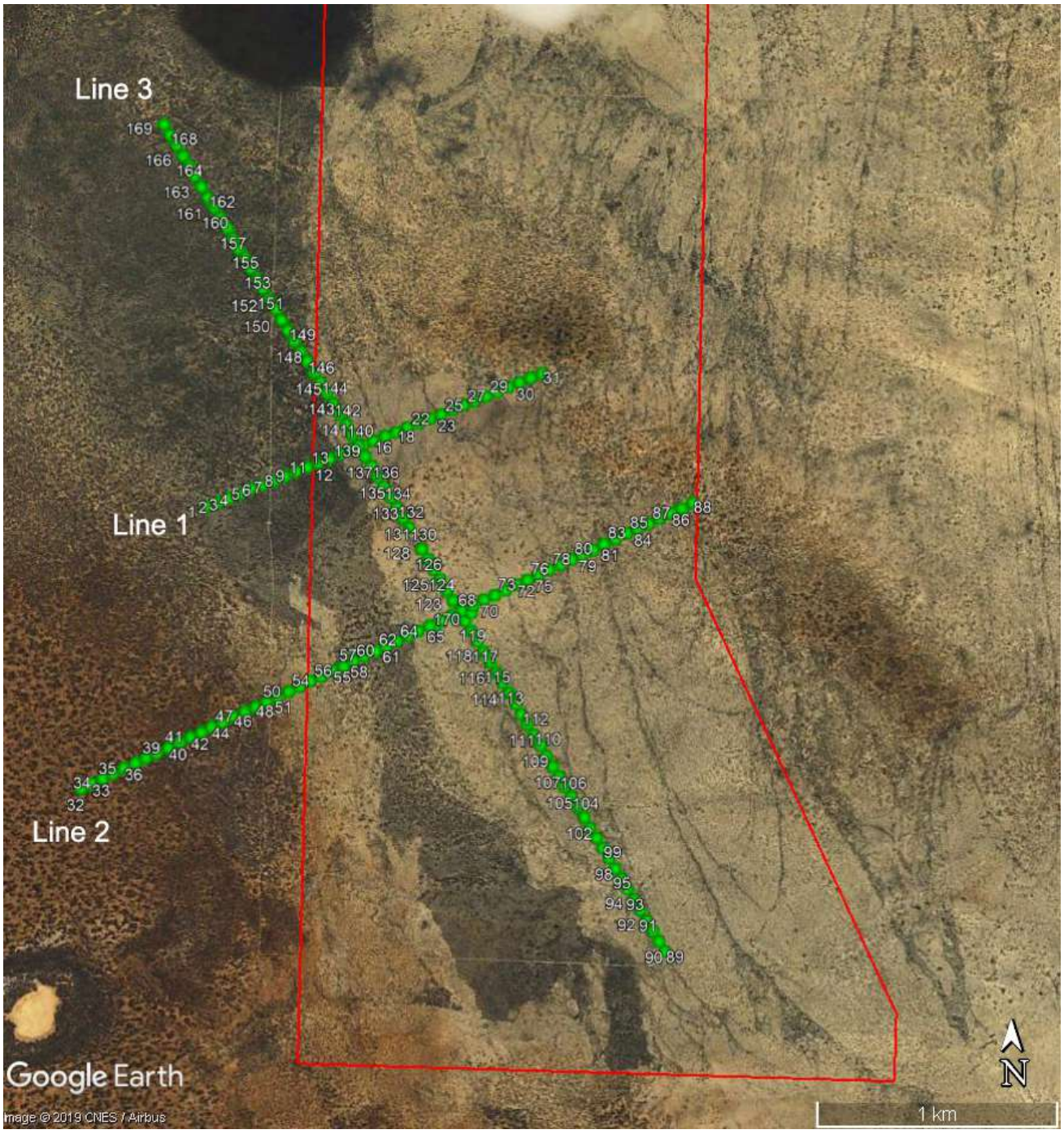

Figure 2. Location of Survey Lines within Sandy Ridge Project tenement.

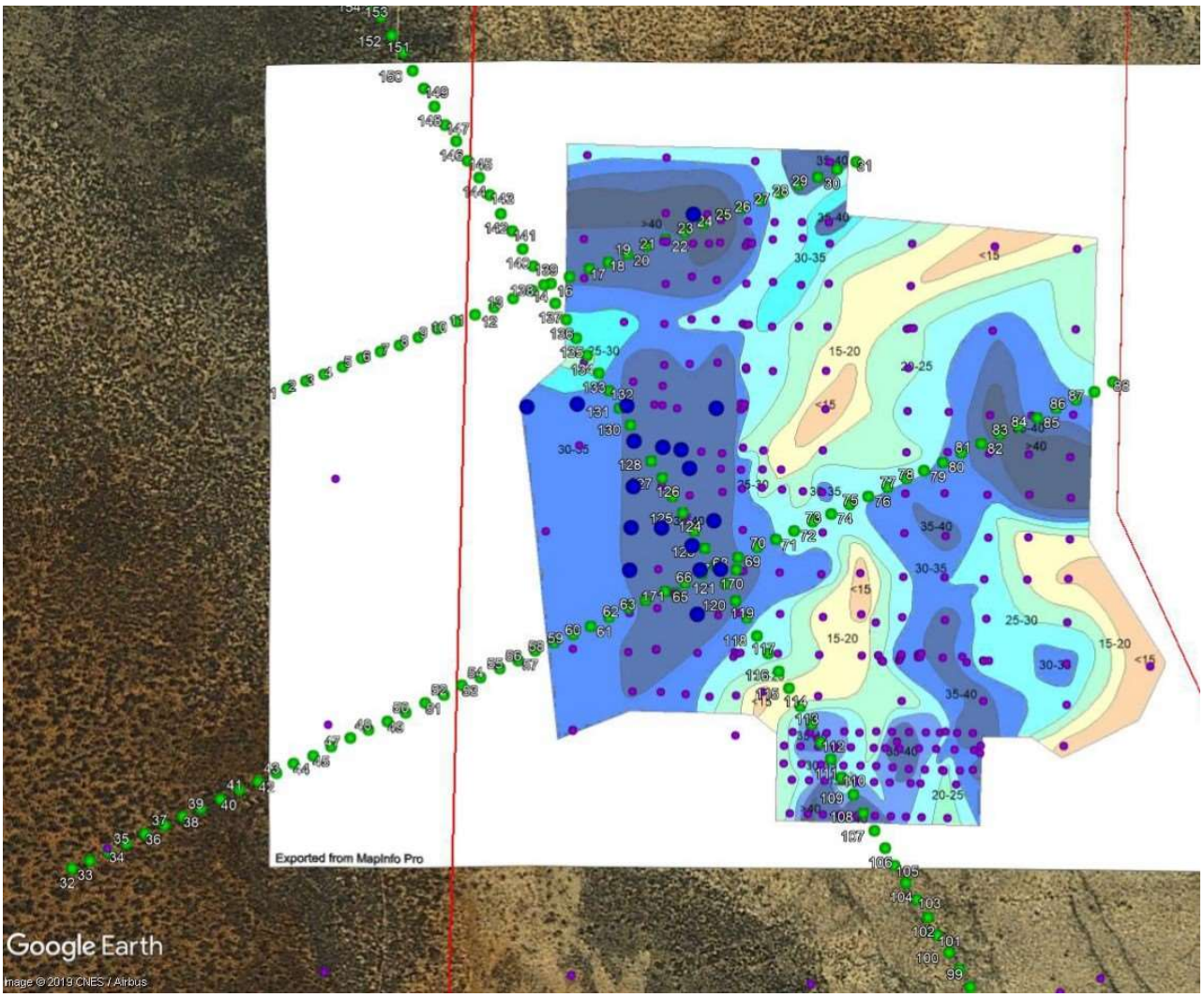

Figure 3. Survey Location in relation to previous drilling programs with drillholes marked in purple. Holes where water was encountered are marked in blue. Overlay showing previously interpreted basement contours show the strong correlation between depth to basement and groundwater occurrence.

Survey data was then built into a 3D model alongside the previous drilling data to correlate between the two data sets. An overview of the 3D dataset is shown in Figure 4. Drilling and survey data was initially used to interpret the likely basement depth across the survey lines which was then incorporated into the hydrogeological interpretation.

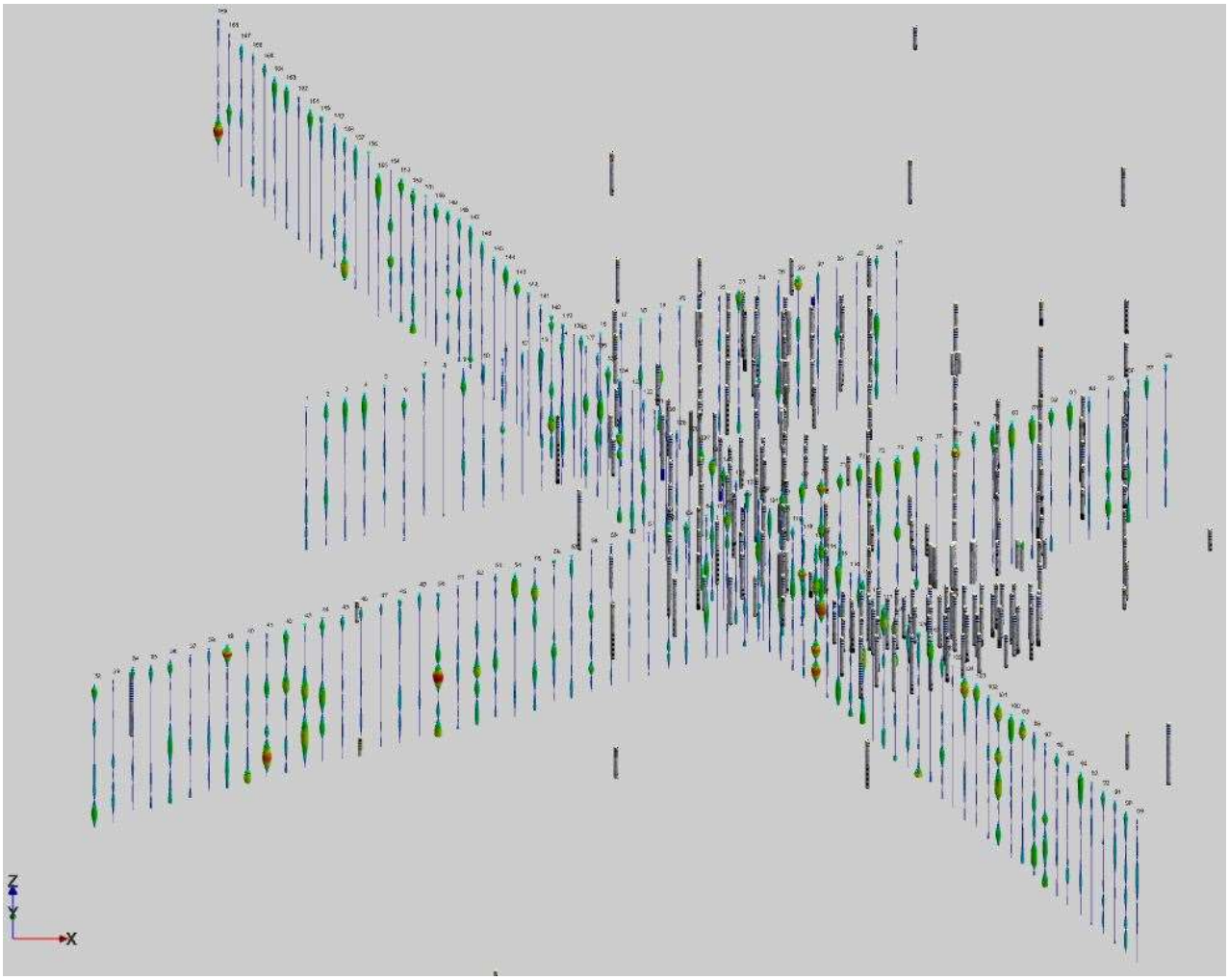

Figure 4. 3D model showing survey data in the form of drill traces alongside lithology tubes representing the prior drilling results. An explanation of the data representation is presented in Figure 5. A lithology key for the drillhole data is shown in Figure 6. Detailed breakdown of the model by survey line will be discussed in later sections.

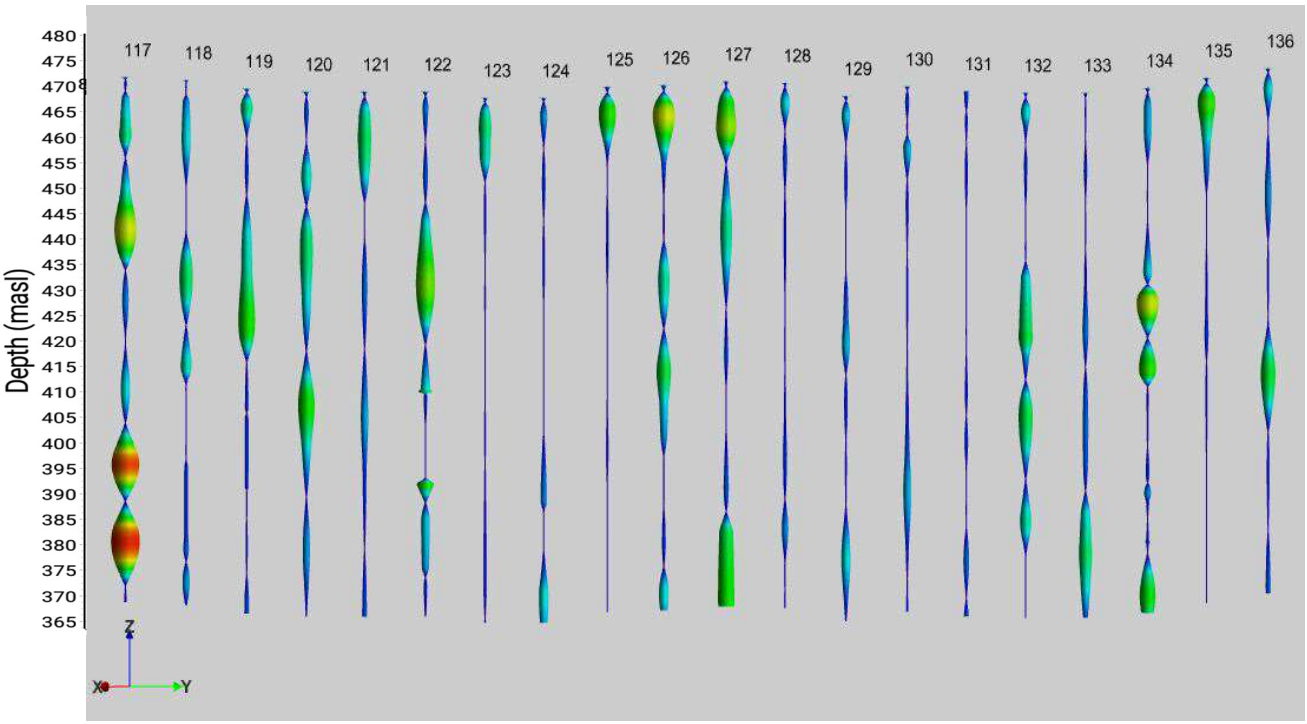

Figure 5. Data traces for Points 117-136 along Line 3. The seismoelectric data shows the relative values of potential hydraulic conductivity. The thickness of the drill tube modulates to give an indication of **relative** values of permeability (ie. potential hydraulic conductivity). The wider the data trace the more permeable the subsurface at the point indicated. The data traces are coloured to display the same ESKT data to aid in distinguishing the data. The colours are on a pseudocolour spectrum with the lowest values in blue ranging through to the highest values in red.

Figure 6. Example drillhole lithology from Hole SRAC309.

2. Seismoelectric / Electrotelluric Survey

2.1 Survey Design and Data Processing

Electroseismic surveying was conducted on the Sandy Ridge Project between the 9th – 14th of May 2019. The survey was aimed at mapping areas of potential groundwater storage and movement pathways in the subsurface and to identify the geological controls on groundwater occurrence on the project site.

Survey details are summarised in Table 1. A 171 point survey along the three survey lines was completed, covering an area of 4000 x 2800m at its widest extents. ES data was collected using a sledgehammer and steel plate. Two additional points were collected at the sites of two piezometers on site (SRMB 147 and SRMB 153). Survey point coordinate details are provided in Appendix 1.

Survey data has been processed and modelled to a depth of 100 m.

In general, the quality of the data collected is considered good. Due to the deep, sandy soils on the site, seismoelectric response was expected to be lower than ideal. In sandy horizons, electrode connectivity may be low due to the sandy soils pushing up the electrode contact resistance. To combat this a 14lb sledge hammer was used (normally 10lb). Recorded signal responses were in the low range but with the very low electromagnetic noise on site, the observed signal to noise ratios were more than acceptable. Seismoelectric response signals are still clearly defined in the data recordings.

Survey details	
Survey Lines	3
Points per Line	31 / 57 / 81
Survey Depth	100m
Survey Point/Line spacing	50m
Survey Orientation	Line 1 and 2 @ 065° / Line 3 @ 330°
Electroseismic recorded	Yes
Electrotelluric recorded	Yes

Table 1. Geo9 geophysical survey details

3. Interface Modelling

The geological interfaces below surface at Sandy Ridge are transitional in nature below the surficial sediment and laterite layers. The kaolin development is a deep and extensive weathering horizon on top of a 2.7 billion year-old granite. In general, the kaolin grades downwards from pure through declining percentages before it is classified as saprock, which in turn grades through degress of oxidation before it is classified as oxidized or moderately weathered granite. There are no sharp interfaces between these layers in general, just gradual degrees of weathering before they are classified as a separate geological entity. This transitional nature makes it challenging to define boundaries between the various classifications in what is essentially a weathered granite profile of varying intensity.

Detailed analysis of the various seismoelectric and electrotelluric datasets, in combination with the existing drill results has allowed an approximation of the transition from the regolith weathering horizon into more competent fresh granite to be made. These boundaries will then be used in the Aquifer Modelling discussion to investigate the groundwater development on site in the context of the interpreted geological boundaries.

3.1 Seismoelectric Interface Modelling

The *Electroseismic Change in Total Gradient Tomography* (ESCTGT) is used to differentiate absolute electrical changes in rock formation properties (zeta potential), proportional to each other. This method allows the identification of rock formations with similar electrical characteristics. It is useful for mapping soft materials, soils and weathered lithology as unconsolidated topsoil and transported material will generally exhibit positive zeta potentials. It is also used to distinguish between consolidated rocks and the unconsolidated regolith and surface sediments.

In the deep weathering and dry subsurface environment encountered at Sandy Ridge, the seismoelectric interface tomography has struggled to delineate the interface clearly, most likely due to the lack of moisture in the subsurface (required to generate a strong zeta potential) and the transitional nature of the geology. At some points along the survey lines, a strong ESCTGT response is seen that corresponds to the interpreted basement from the ETIT discussed in the next section. At other points the response is weak and no clear interface is seen and for this reason no seismoelectric interface data is presented.

3.2 Electrotelluric Interface Modelling

Electrotelluric currents are geo-magnetically induced currents that flow through conductive formations in the subsurface. They are primarily created by natural fluctuations in the earth's geo-magnetic field, caused by solar winds. The ET data set describes the variability in conductivity of the formations under a site. The data set does not describe the apparent conductivity of the formations underlying a site as it is only a representation of the potential difference generated by a streaming current as it passes through a conductive medium. The data does indicate a relative variability in conductivity, which can be used to delineate conductive formations, even though the exact conductivity cannot be determined without calibration against a resistivity downhole well log.

The ET data set is generated by frequency analysis of the background noise on the site, during the data recording, to a maximum frequency of 10Hz. The frequency domain data is analysed for amplitude to determine the variability of conductivity for the formations at specific depths under the site. This data set is not linear in resolution. Resolution decreases exponentially from surface level to depth. It is very important that interpretations of conductive formations at depth consider this lower vertical resolution limitation.

The ET modelling is a completely separate geophysical technique to ES and where similarities are identified in both data sets, it allows a high degree of confidence in the modelled result as it has been arrived at via two separate geophysical techniques.

The ET data provides a much clearer picture than the ES data and appears to model the major transition to solid granite reasonably accurately based on the change in electrical conductivity. The *Electrotelluric Interface Tomography* (ETIT) data set describes the position and depths of interface indicators that occur at the boundaries between two geological units with differing variability in their electrical conductivity.

The ETIT data recognizes a major change at depth that correlates well with the drilling results where solid granite has been encountered across the survey lines, generally at depths between 30-50m. The change in response in the ETIT is gradual, recognizing the transitional and irregular nature of the change but does pick up a noticeable contrast where the basement is encountered. ETIT data along the survey lines is presented in Figures 7, 8 and 9 with the basement interpretation indicated on the imagery. Drillholes that are within 50m of the survey lines have been added and appear in most cases to correlate very well with the ETIT data. Some variation is to be expected as the basement is highly variable and not all drillholes plotted are exactly on the survey line. The basement interpreted on the diagrams is derived from the ETIT data, drillhole data where available and ES data where an interface response was measurable.

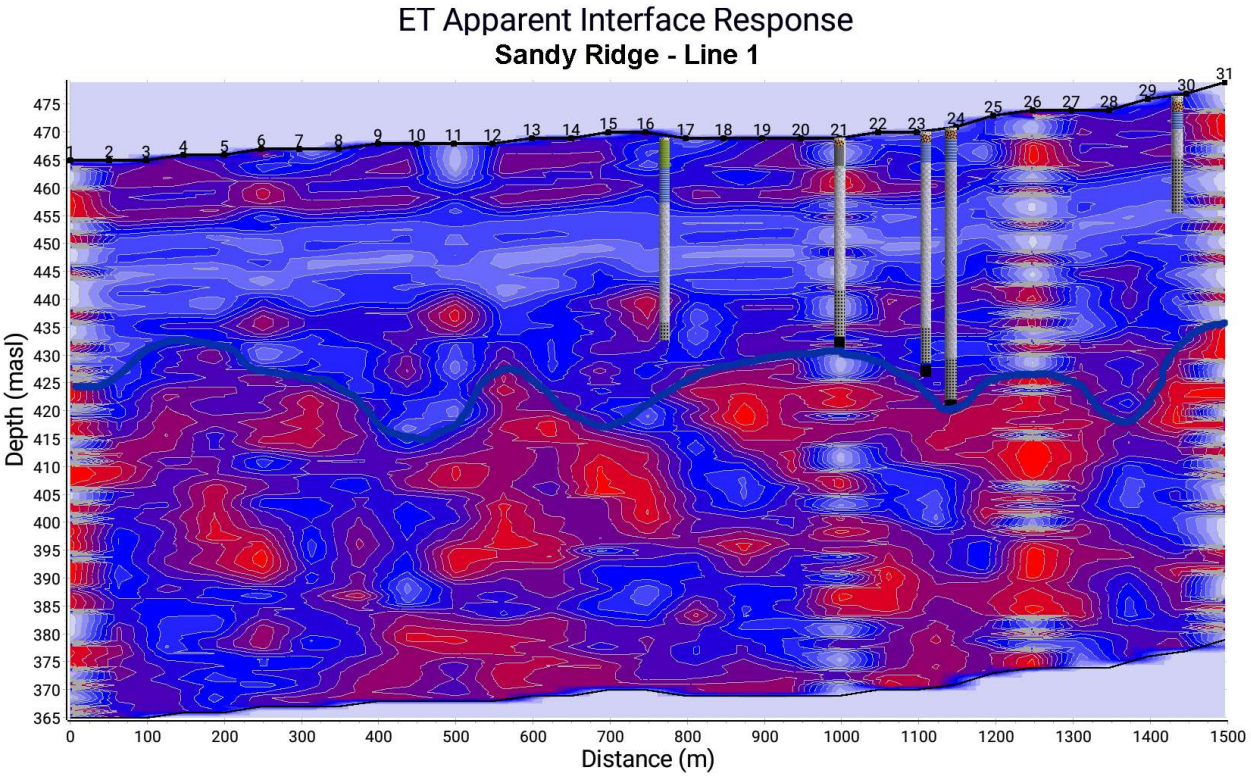

Figure 7. ETIT response across Survey Line 1 with interpreted basement transition marked. Drillholes in close proximity to the survey line (within 50m) are marked in their approximate position.

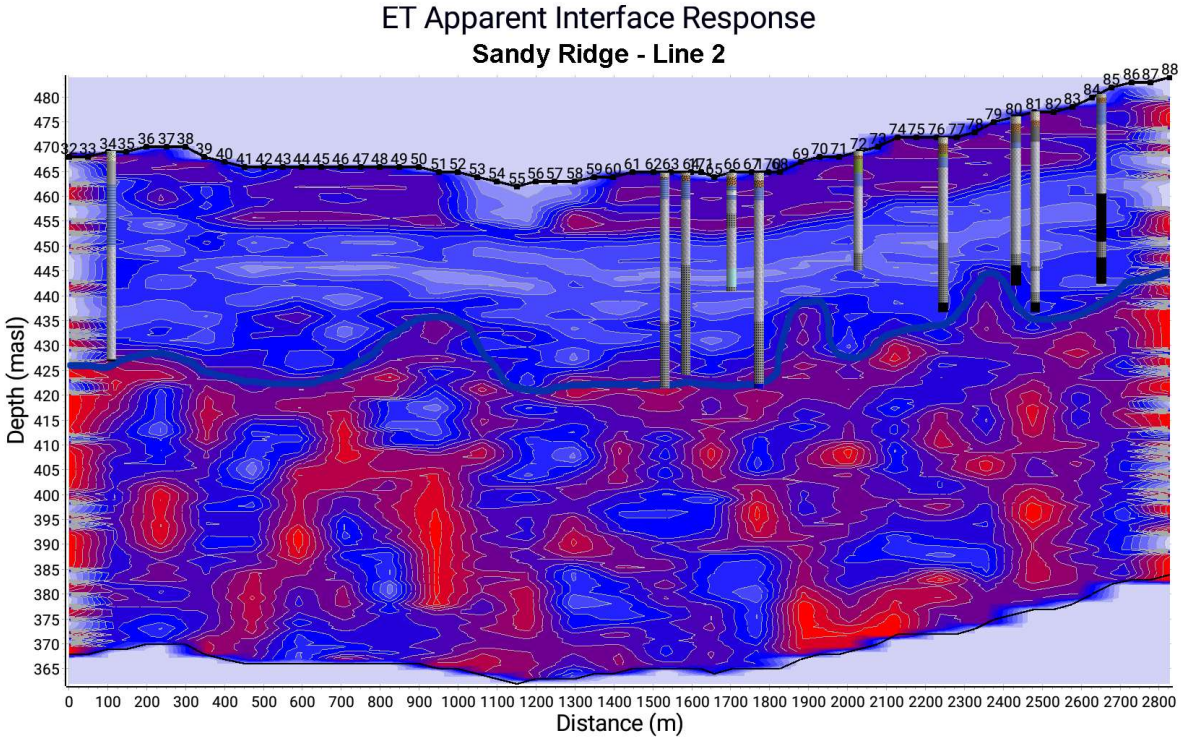

Figure 8. ETIT response across Survey Line 2 with interpreted basement transition marked. Drillholes in proximity to the survey line (within 50m) are marked in their approximate position. Drillholes that encountered moisture are all located in the basement low between survey points 55 and 68.

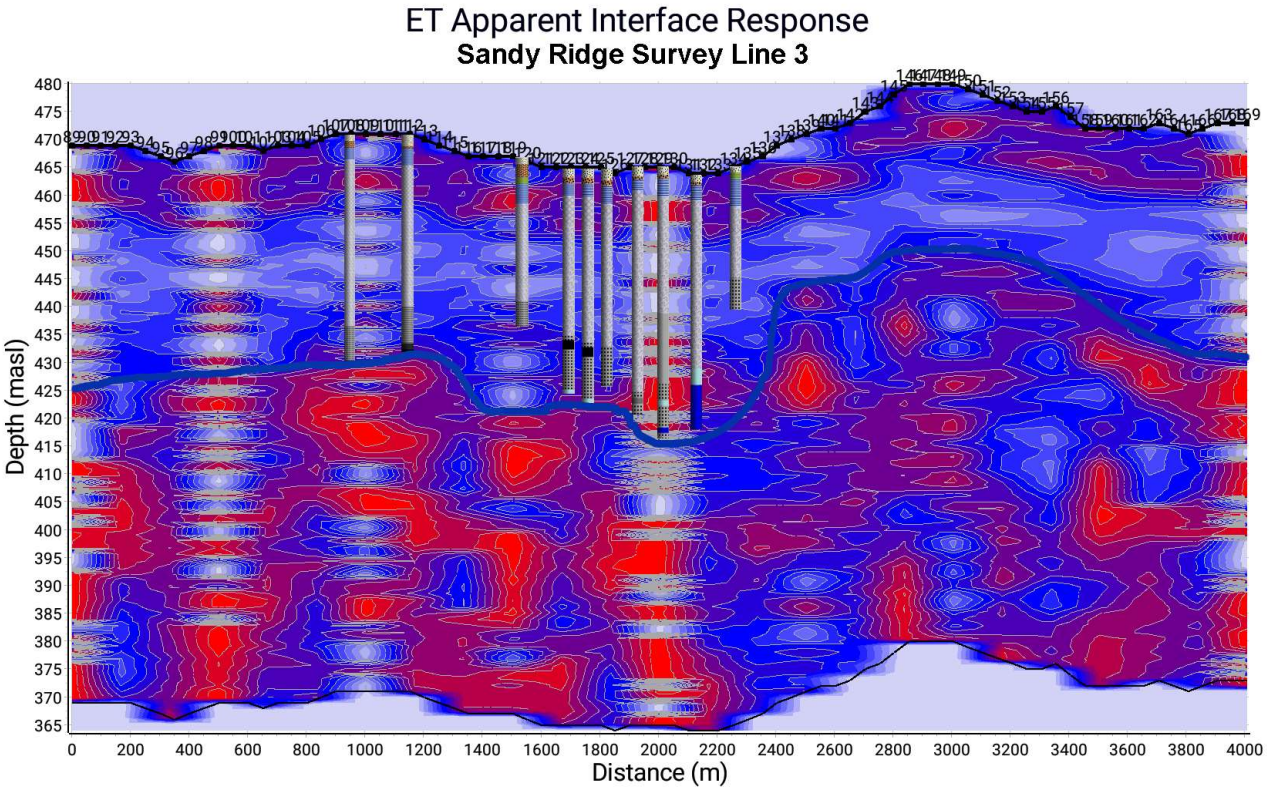

Figure 9. ETIT response across Survey Line 3 with interpreted basement transition marked. Drillholes in proximity to the survey line (within 50m) are marked in their approximate position. Drillholes that encountered moisture while drilling are again confined to the basement low between points 117 and 133.

When correlating the basement modelling with the drill results, it is observed that subsurface water is only encountered in basement lows where a natural basin structure has developed. The structure is seen in both survey lines 2 and 3 which are perpendicular to each other. The basement topography indicates that the water encountered appears to be sitting at the bottom of a natural sump. This matches the basement contours that were interpreted from the drilling data that are presented in Figure 3.

The basement appears to rise abruptly between Points 133 and 135 beneath a gentle rise in the surface topography also. The basement appears to be shallow underneath the low ridge between Points 134 and 158 before again becoming deeper as the surface topography flattens out to the northwest.

4. Groundwater Modelling

4.1.1 Electroseismic Hydraulic Conductivity Tomography (ESKT)

The *electroseismic hydraulic conductivity tomography* (ESKT) is an indicative measure of hydraulic conductivity (K in Darcy's Law), or the ease at which a fluid, water in this case, can flow through a porous medium. Hydraulic conductivity is expressed as a velocity, based on distance in a given time (usually in units of metres/day or otherwise stated), that a fluid will move through a medium under gravity in the direction of a hydraulic gradient.

ESKT is the measurement of relative potential hydraulic conductivity across the survey area. The ESKT data measures potential hydraulic conductivity as a normalised percentage relative to the highest value found across the site, the maximum being 100%. Detailed descriptions of all ES modelled data is presented in Appendix 3.

Figure 10 shows a 3D view of the entire model presenting only the ESKT data. Data tubes modulate and are pseudo-coloured to represent the modelled ESKT values.

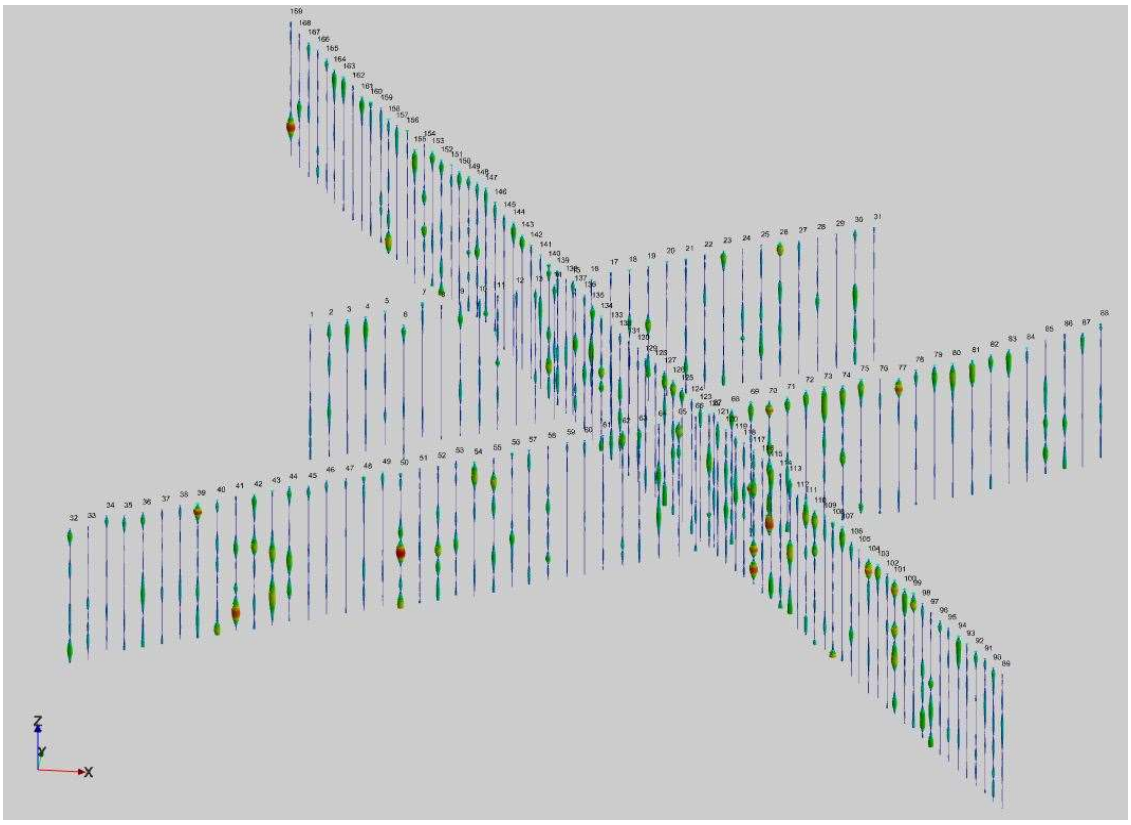

Figure 10. 3D Model showing ESKT values across the site looking north. Areas of highest relative ESKT are easily identifiable as wider red/orange tube sections. There are very few areas of high ESKT observed across the site and where they are, they appear isolated with no real horizontal connectivity to suggest any likelihood of potential aquifer development.

The model will be discussed by survey line for greater resolution but the overall picture is apparent even at the sitewide view. High relative ESKT is seen in areas at the near-surface

in the sand/gravel/silcrete horizons and in isolated areas at depth at/or below the regolith/granite transition. There is no evidence of any significant aquifer development in the area as the zones of relatively high permeability are isolated with little to no interconnection between them evident. Where connection is seen in the ESKT data it tends to be in a vertical direction below the transition to solid granite, possibly related to vertical fracturing preserved in the fresh rock.

Survey Line 1

Survey Line 1 is the northernmost of the two northeast-southwest survey lines and runs from Point 1 to Point 31 at the northern end of the main drilling program (refer Figure 3). ESKT results are presented in Figure 11. Five drill holes have been added to the data representing those drill holes that are in reasonable proximity (<50m) to the survey line. The previously interpreted approximation of the basement has been added to the data. This should only be viewed as an approximation as drill hole data is scarce in this part of the site and the nature of the granite contact is highly transitional due to the age and depth of the weathering horizon.

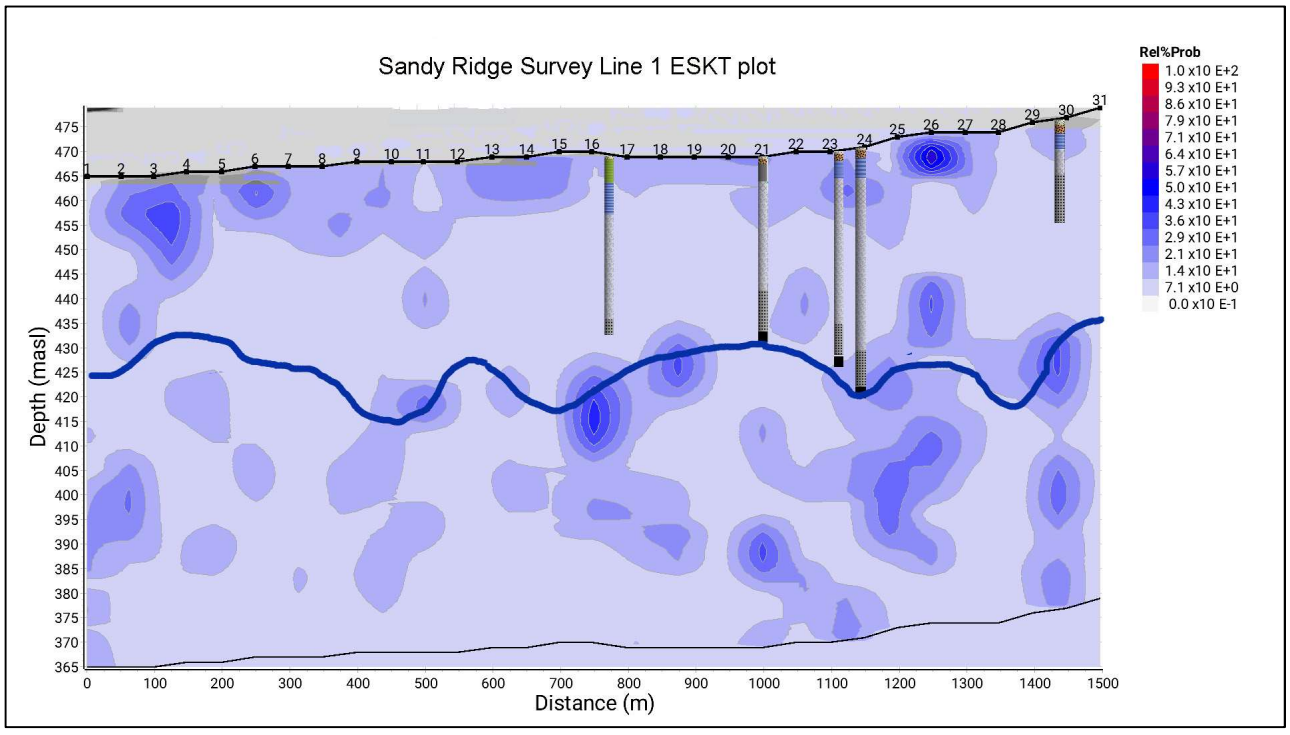

Figure 11. Survey Line 1 ESKT nearest neighbour interpolation contour plot. Interpreted basement level indicated in dark blue. Drill holes shown along the traverse are (from left to right) SRAC 158, SRAC029, SRAC309, SRAC252 and SRAC 153.

ESKT values are low across this northern survey line and there is little evidence of any groundwater potential in this part of the site. The highest ESKT values are observed in the near surface sands and gravel horizons and sometimes immediately below the silcrete layer. High ESKT is then observed at a depth at, or immediately below the basement transition. Between the surficial response and that at the basement, the ESKT responses are very low indicating very low permeability generally between 10 and at least 35m. Even

the highest ESKT response along this survey line has an isovalue below 60% so in general, and relative to the rest of the survey area, the modelled potential hydraulic conductivity along this survey line is very low.

A drillhole (SRAC251) encountered water at a depth of 51m approximately 40m northwest of Point 23 at the top of the fresh granite horizon. At Points 24, 25 and 26 an area of moderate ESKT is seen in this area at a similar depth most likely related to the basement granite transition and is also potentially a wet area most likely connected to the water encountered in SRAC251. This area may extend across to Point 30 where an elevated response is seen, although at Point 29 the response is low. There is also a response at depths in the 60-80m range underneath this area suggestive of potential fracturing in the granite in this region.

A similar area of elevated ESKT is seen between Points 16 to 19 again at depths greater than 40m, likely to correspond to the top of the fresh granite. The measured ESKT here is the strongest along Survey Line 1. West of Point 16 there is little ESKT response until the far western end of the line at Points 1 and 2 where some ESKT response is observed at a depth of approximately 70m. Again, this appears to be potentially related to a dip in the basement in this area.

Survey Line 2

Survey Line 2 is the southernmost of the two northeast-southwest and runs from Point 32 to Point 88 cutting across the middle of the main drilling program (refer Figure 3). ESKT results are presented in Figure 12.

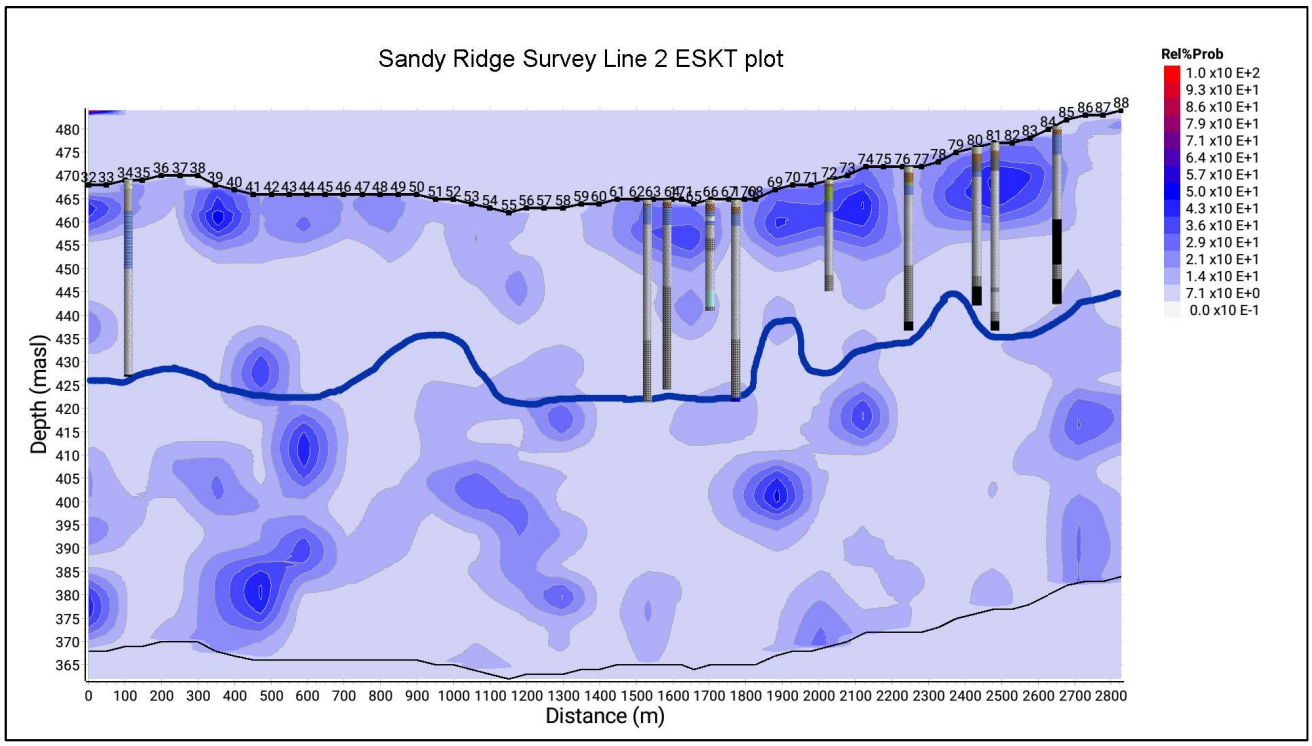

Figure 12. Survey Line 2 ESKT nearest neighbour plot. Interpreted basement level indicated in dark blue. Ten drill holes shown along the traverse are (from left to right) SRMB164, SRAC232, SRMB153, SRAC178, SRAC226, SRAC175, SRAC001, SRAC008, SRAC007 and SRAC016.

There is a consistent and strong elevated ESKT response at the surface in the eastern half of the survey line between Points 68 and 83 that appears to develop at the base of the thick silcrete horizon in this area. There is only minor response at depth anywhere east of Point 75 and this area appears completely dry other than the deep vertical ESKT response at Point86

The area between Points 39 and 44 has the highest ESKT response in the survey area and is potentially a wet area along this survey line. The ESKT response again is seen at, and below the bottom of a basin-like structure in the basement topography and extends to approximately 90m depth, again suggestive of a vertical fracture system. This is the most significant area of elevated ESKT seen on the site but occurs well outside the limits of the mine footprint.

The broad basement low indicated between Points 55 and 68 crosses the southern edge of the basement low on the site where water has been encountered in the drilling program. Water was encountered at the granite contact at the base of hole SRAC226 and also within a damp layer in hole SRAC178 in the kaolinite. Both of these occurrences of groundwater

appear minor and do not extend laterally in the orientation of the survey line. On the western edge of this basement low, another area of high ESKT occurs and extends to depth beneath Point 55.

The area between Points 70-74 also shows elevated ESKT response extending to depth beneath the solid granite boundary. The ET basement profile already identified in Figure 8 also suggests a significant basement ridge in this area, as did the previously modelled basement contours from the drilling program.

At both edges of the basement low (~Point 55 and ~Point 70) there appears to be a pronounced change in elevation in the basement and ESKT response that extends to depth. It may be a fault or fracture system that has resulted in the change observed or it may more simply be related to the paleo-topography of the ancient land surface. The ESKT response not have any major horizontal extent in the orientation of the survey line (some deep response is seen between Points 68 and 72) and the basement low appears from correlation with the drilling data to be a north-south trending feature. The basement contours interpreted from the drilling results (Figure 3) certainly indicate a strong north-south trend in the basement topography running through the vicinity of Point 70.

Survey Line 3

Survey Line 3 is the longer, northwest-south east traverse and runs from Point 89 in the south to Point 169 in the north. It was designed to pass through the centre of the area where water was encountered during the drilling programs (refer Figure 3). ESKT results are presented in Figure 13.

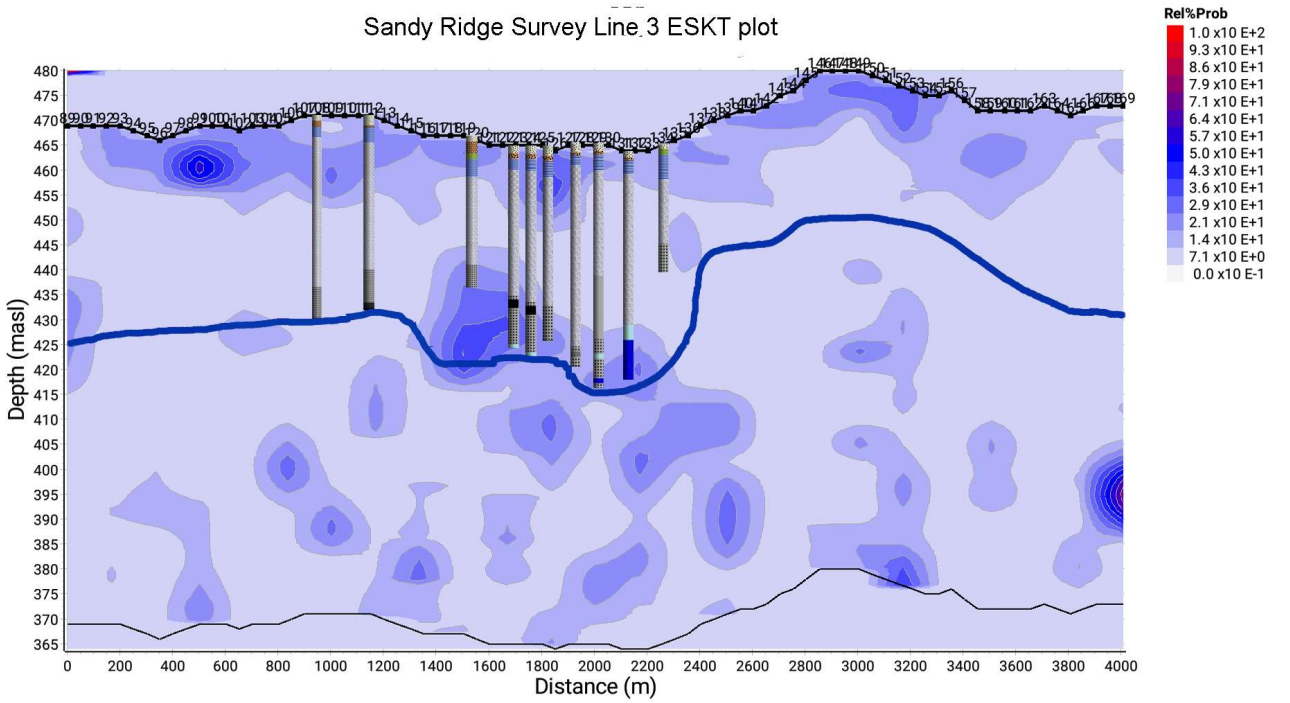

Figure 13. Survey Line 1 ESKT nearest neighbour plot. Ten drillholes shown along the traverse are (from left to right) SRAC300, SRAC279, SRAC 181, SRAC 226, SRAC235, SRAC225, SRAC224, SRAC217, SRAC223 and SRAC164

Survey Line 3 confirms what the 2 southwest – northeast survey lines indicated. On the higher ground north of Survey Line 1 (which crosses Line 3 at Point 138) the modelled relative hydraulic conductivity is very low with little evidence of any groundwater potential in this area. At the extreme northern end of the survey there is a very high ESKT reading observed at a depth of approximately 80m, but there appears to be no potential groundwater connection with the area to the south.

As seen in the other survey lines, the ESKT response is highest around the pronounced basement low, in this case between Points 117-134. The survey results match the known occurrence of groundwater on the site. The extensive area of elevated ESKT observed in the basement low along this survey line corresponds to the area where water has been encountered in drillholes. The natural basin can be seen clearly in the basement data with water only encountered at the bottom of the basin.

Similar to Line 2, the high ESKT values extend to depth beneath the bottom of the basin. This also occurs almost directly underneath the sharp rise in the basement at Point 134. Again, the trend observed is indicative of a potential, near-vertical fault or fracture system controlling the basement topography and the zone of higher permeability extending to depth. This area

also corresponds with and may be related to to an ENE-WSW trending magnetic lineation that passes through the centre of the site that was identified in the Stage 1 preliminary investigation.

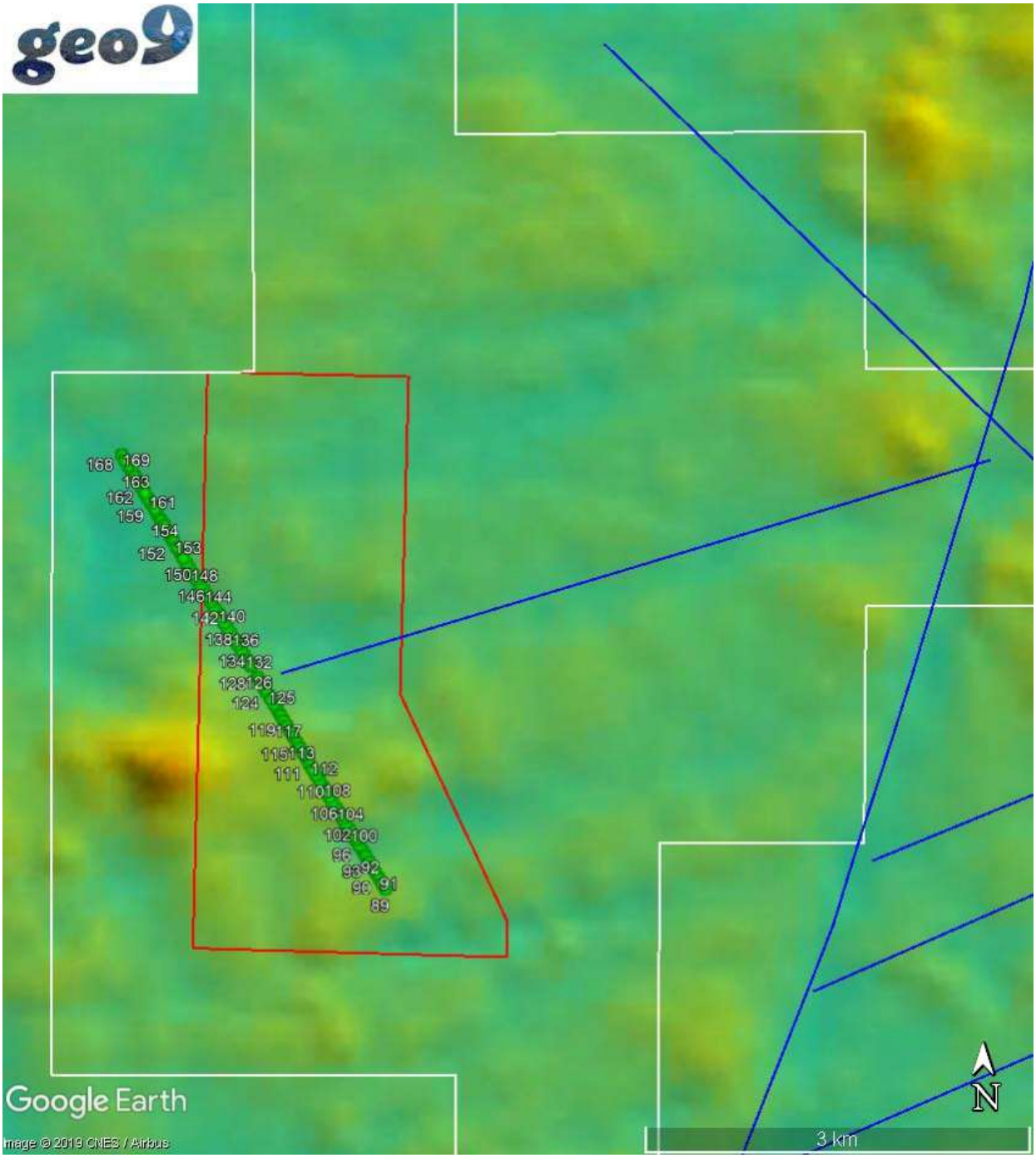

Figure 14. Total Magnetic Intensity (TMI) image of Sandy River site with magnetic lineations interpreted in blue. Approximate location of lineation corresponds closely with deepest part of basement and also the change in slope at the surface.

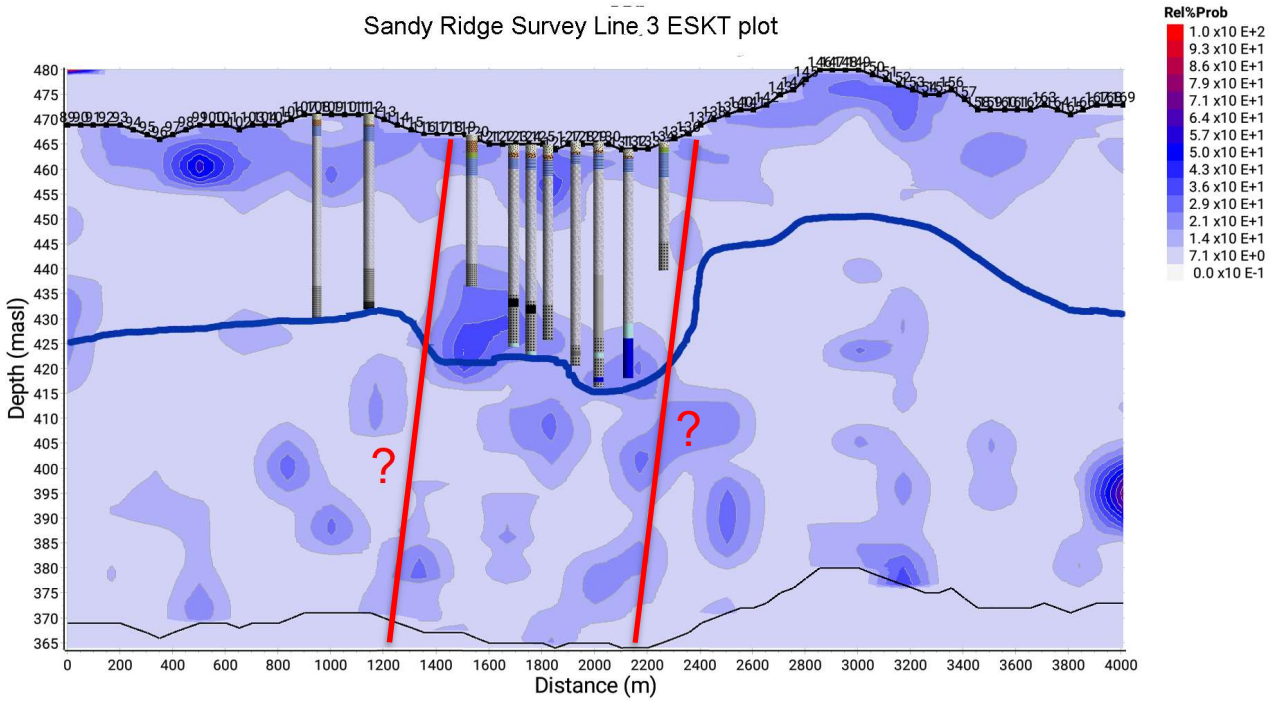

Figure 15. Possible fault/fracture system causing basement rise and elevated ESKT observed extending to depth?

Survey Conclusions

Above the granite basement, the survey shows good agreement and expands upon the previous drilling results. The Electrotelluric interface results show very good correlation with the drilling results and provide a valuable insight into the subsurface geology and hydrogeology of the site.

The granite basement across the site is irregular in nature with a number of subsurface ridges and basins evident. Where groundwater has been encountered it occurs in natural traps in the deepest parts of the basement surface.

The areas of elevated ESKT and groundwater potential occur along each survey line in, and beneath these modelled basement lows. In most of these basement lows, the ESKT response is seen extending to depth directly beneath the areas of elevated ESKT and may be indicative of near-vertical faulting and/or fracturing.

There does not appear to be any significant ESKT response developed horizontally in the survey orientations, other than within the confines of the basement lows which appear to act as groundwater traps.

There does not appear to be any surface recharge of groundwater in the survey area with a significant horizon of low permeability indicated in the kaolinite and saprock horizons. High ESKT response in the surface overburden is not seen extending through the kaolinite horizon at any point.

The areas of highest potential permeability appear well below the kaolinite horizons in the solid granite basement. **Relative** permeability appears in mostly vertical structures, possibly where fracturing has been preserved in the hard rock.

Recommended Reading

Fourie, F.D., 2003, *Application of Electroseismic Techniques to Geohydrological Investigations in Karoo Rocks*, PhD thesis, University of the Free State, Bloemfontein, South Africa.

Frenkel, J., 1944, On the Theory of Seismic and Seismoelectric Phenomena in Moist Soil. Journal of Physics, 8, 230-241.

Haartsen, M. W. and Pride, S. R., 1997, *Electroseismic Waves from Point Sources in Layered Media*. Journal of Geophysical Research.

Shaw, D.J., 1992, Introduction to Colloid and Surface Chemistry, Fourth Edition.

Appendix 1. Details of Survey Point Locations

Table A.1 Survey point co-ordinates (WGS84) and elevation.

WAYPOINT #	LATITUDE (Nth Decimal Degree WGS84)	LONGITUDE (East Decimal Degree WGS84)	ELEVATION m (SRTM)	STRIKES #	SOIL TYPE Sand / Clay / Rock	SOIL CONDITION Hard / Firm / Soft	SOIL MOISTURE Wet / Moist / Dry
1	-30.353456	120.074401	464.7330	10	Sand	Firm	Dry
2	-30.353294	120.074890	464.9231	10	Sand	Firm	Dry
3	-30.353147	120.075357	465.4628	10	Sand	Firm	Dry
4	-30.352984	120.075828	465.6648	10	Sand	Firm	Dry
5	-30.352792	120.076326	466.4345	10	Sand	Firm	Dry
6	-30.352650	120.076807	466.6190	10	Sand	Firm	Dry
7	-30.352514	120.077294	467.4817	10	Sand	Firm	Dry
8	-30.352343	120.077779	468.2476	10	Sand	Firm	Dry
9	-30.352157	120.078267	468.3145	10	Sand	Firm	Dry
10	-30.351996	120.078761	468.5268	10	Sand	Firm	Dry
11	-30.351847	120.079227	468.3897	10	Sand	Firm	Dry
12	-30.351688	120.079714	468.6081	10	Sand	Firm	Dry
13	-30.351494	120.080200	469.0191	10	Sand	Firm	Dry
14	-30.351324	120.080689	468.9701	10	Sand	Firm	Dry
15	-30.351169	120.081163	469.4133	10	Sand	Firm	Dry
16	-30.351023	120.081638	469.0017	10	Sand	Firm	Dry
17	-30.350844	120.082139	469.2432	10	Sand	Firm	Dry
18	-30.350701	120.082624	469.7298	10	Sand	Firm	Dry
19	-30.350523	120.083102	469.3510	10	Sand	Firm	Dry
20	-30.350349	120.083581	469.7807	10	Sand	Firm	Dry
21	-30.350194	120.084074	469.8257	10	Sand	Hard	Dry
22	-30.350041	120.084561	470.5732	10	Sand	Firm	Dry
23	-30.349859	120.085042	471.6914	10	Sand	Firm	Dry
24	-30.349689	120.085534	472.1452	10	Sand	Firm	Dry
25	-30.349551	120.086013	473.5238	10	Sand	Firm	Dry
26	-30.349382	120.086500	473.7323	10	Sand	Firm	Dry
27	-30.349217	120.086986	474.9133	10	Sand	Firm	Dry
28	-30.349041	120.087460	475.2831	10	Sand	Firm	Dry
29	-30.348877	120.087947	476.5228	10	Sand	Firm	Dry
30	-30.348710	120.088429	477.4794	10	Sand	Firm	Dry
31	-30.348554	120.088918	478.2425	10	Sand	Firm	Dry
32	-30.363994	120.068966	468.4246	10	Red Sand	Firm	Dry

33	-30.363819	120.069429	468.9094	10	Red Sand	Firm	Dry
34	-30.363618	120.069908	469.1878	10	Red Sand	Firm	Dry
35	-30.363436	120.070359	469.2364	10	Red Sand	Firm	Dry
36	-30.363224	120.070835	469.2331	10	Red Sand	Firm	Dry
37	-30.363036	120.071326	468.7112	10	Red Sand	Firm	Dry
38	-30.362850	120.071788	468.2006	10	Red Sand	Firm	Dry
39	-30.362677	120.072239	467.3603	10	Red Sand	Firm	Dry
40	-30.362477	120.072740	466.4066	10	Red Sand	Firm	Dry
41	-30.362269	120.073215	465.8086	10	Red Sand	Firm	Dry
42	-30.362088	120.073688	465.7251	10	Red Sand	Firm	Dry
43	-30.361910	120.074151	465.5045	10	Red Sand	Firm	Dry
44	-30.361700	120.074583	465.5838	10	Red Sand	Firm	Dry
45	-30.361536	120.075079	465.3755	10	Red Sand	Firm	Dry
46	-30.361330	120.075536	465.3941	10	Red Sand	Firm	Dry
47	-30.361137	120.076031	465.4796	10	Red Sand	Firm	Dry
48	-30.360960	120.076493	465.6250	10	Red Sand	Firm	Dry
49	-30.360777	120.076977	465.3872	10	Red Sand	Firm	Dry
50	-30.360586	120.077436	465.2095	10	Red Sand	Firm	Dry
51	-30.360378	120.077924	464.8054	10	Sand	Firm	Dry
52	-30.360203	120.078394	464.5120	10	Sand	Firm	Dry
53	-30.359991	120.078850	464.0072	10	Sand	Firm	Dry
54	-30.359821	120.079326	463.5486	11	Sand	Firm	Dry
55	-30.359623	120.079818	463.4223	10	Sand	Firm	Dry
56	-30.359451	120.080290	463.7290	10	Sand	Firm	Dry
57	-30.359232	120.080722	463.3769	10	Sand	Firm	Dry
58	-30.359051	120.081209	463.4868	10	Sand	Firm	Dry
59	-30.358872	120.081699	463.7201	10	Sand	Firm	Dry
60	-30.358690	120.082146	463.9794	10	Sand	Firm	Dry
61	-30.358489	120.082621	464.0853	10	Sand	Firm	Dry
62	-30.358281	120.083117	464.3228	10	Sand	Firm	Dry
63	-30.358121	120.083549	464.5225	10	Sand	Firm	Dry
64	-30.357923	120.084047	464.7051	10	Sand	Firm	Dry
65	-30.357729	120.084560	464.7754	10	Sand	Firm	Dry
66	-30.357530	120.084990	464.0640	10	Sand	Firm	Dry
67	-30.357332	120.085457	465.5858	10	Sand	Firm	Dry
68	-30.357169	120.085914	465.8765	10	Sand	Firm	Dry
69	-30.356950	120.086404	466.8009	10	Sand	Firm	Dry
70	-30.356775	120.086876	467.8212	10	Sand	Firm	Dry
71	-30.356589	120.087341	468.2458	10	Sand	Firm	Dry
72	-30.356384	120.087814	469.2181	10	Sand	Firm	Dry
73	-30.356216	120.088285	470.1704	10	Sand	Firm	Dry
74	-30.356008	120.088755	471.0609	10	Sand	Firm	Dry
75	-30.355833	120.089224	471.4574	10	Sand	Firm	Dry
76	-30.355632	120.089711	472.2437	10	Sand	Firm	Dry
77	-30.355441	120.090190	473.1422	10	Sand	Firm	Dry

78	-30.355268	120.090632	473.6975	10	Sand	Firm	Dry
79	-30.355090	120.091108	474.8939	10	Sand	Firm	Dry
80	-30.354881	120.091572	475.9747	10	Sand	Firm	Dry
81	-30.354680	120.092072	476.6296	10	Sand	Firm	Dry
82	-30.354475	120.092544	477.8325	10	Sand	Firm	Dry
83	-30.354297	120.093004	477.2417	10	Sand	Firm	Dry
84	-30.354126	120.093475	480.3981	10	Sand	Firm	Dry
85	-30.353917	120.093948	481.4693	10	Sand	Firm	Dry
86	-30.353737	120.094440	482.9012	10	Sand	Firm	Dry
87	-30.353567	120.094897	482.7598	10	Sand	Firm	Dry
88	-30.353355	120.095362	484.2018	10	Sand	Firm	Dry
89	-30.370059	120.094248	469.2306	10	Sand	Firm	Dry
90	-30.369675	120.093978	469.2275	10	Sand	Firm	Dry
91	-30.369300	120.093724	469.2969	10	Sand	Firm	Dry
92	-30.368922	120.093446	469.0144	10	Sand	Firm	Dry
93	-30.368524	120.093173	468.5455	10	Sand	Firm	Dry
94	-30.368133	120.092916	467.9476	10	Sand	Firm	Dry
95	-30.367732	120.092610	467.3727	10	Sand	Firm	Dry
96	-30.367366	120.092355	466.9621	10	Sand	Firm	Dry
97	-30.366997	120.092079	467.2012	10	Sand	Firm	Dry
98	-30.366590	120.091822	467.6332	10	Sand	Firm	Dry
99	-30.366203	120.091548	468.2329	10	Sand	Firm	Dry
100	-30.365823	120.091279	468.4541	10	Sand	Firm	Dry
101	-30.365453	120.090977	468.6340	10	Sand	Firm	Dry
102	-30.365052	120.090743	468.9280	10	Sand	Firm	Dry
103	-30.364665	120.090463	469.0393	10	Sand	Firm	Dry
104	-30.364295	120.090184	469.5599	10	Sand	Firm	Dry
105	-30.363918	120.089897	469.8830	10	Sand	Firm	Dry
106	-30.363531	120.089656	470.2473	10	Sand	Firm	Dry
107	-30.363149	120.089383	471.0324	10	Sand	Firm	Dry
108	-30.362761	120.089099	471.2264	10	Sand	Firm	Dry
109	-30.362359	120.088849	471.3522	10	Sand	Firm	Dry
110	-30.361978	120.088545	471.1041	10	Sand	Firm	Dry
111	-30.361581	120.088276	470.7973	10	Sand	Firm	Dry
112	-30.361223	120.088018	470.3501	10	Sand	Firm	Dry
113	-30.360815	120.087786	469.9153	10	Sand	Firm	Dry
114	-30.360425	120.087499	469.4077	10	Sand	Firm	Dry
115	-30.360035	120.087212	468.5494	10	Sand	Firm	Dry
116	-30.359671	120.086950	467.9739	10	Sand	Firm	Dry
117	-30.359277	120.086683	467.2357	10	Sand	Firm	Dry
118	-30.358894	120.086394	466.7585	10	Sand	Firm	Dry
119	-30.358499	120.086138	466.2791	10	Sand	Firm	Dry
120	-30.358124	120.085850	465.7368	10	Sand	Firm	Dry
121	-30.357749	120.085593	465.4125	10	Sand	Firm	Dry
122	-30.357353	120.085334	465.3551	10	Sand	Firm	Dry

123	-30.356971	120.085065	465.3213	10	Sand	Firm	Dry
124	-30.356595	120.084801	465.2950	10	Sand	Firm	Dry
125	-30.356191	120.084505	465.4157	10	Sand	Firm	Dry
126	-30.355833	120.084240	465.4263	10	Sand	Firm	Dry
127	-30.355426	120.083978	465.4659	10	Sand	Firm	Dry
128	-30.355054	120.083700	465.5407	10	Sand	Firm	Dry
129	-30.354671	120.083406	465.3436	10	Sand	Firm	Dry
130	-30.354264	120.083166	465.0598	10	Sand	Firm	Dry
131	-30.353891	120.082885	465.8765	10	Sand	Firm	Dry
132	-30.353508	120.082624	464.8709	10	Sand	Firm	Dry
133	-30.353123	120.082358	465.3121	10	Sand	Firm	Dry
134	-30.352733	120.082058	465.7262	10	Sand	Hard	Dry
135	-30.352356	120.081791	465.6721	10	Sand	Firm	Dry
136	-30.351951	120.081540	467.1518	10	Sand	Firm	Dry
137	-30.351599	120.081267	467.9236	10	Sand	Firm	Dry
138	-30.351198	120.080987	469.4133	10	Sand	Firm	Dry
139	-30.350794	120.080724	470.2343	10	Sand	Firm	Dry
140	-30.350423	120.080458	471.0065	10	Sand	Firm	Dry
141	-30.350034	120.080199	472.6221	10	Sand	Firm	Dry
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143	-30.349259	120.079645	475.5636	10	Sand	Firm	Dry
144	-30.348883	120.079384	476.6545	10	Sand	Firm	Dry
145	-30.348523	120.079102	477.6891	10	Sand	Firm	Dry
146	-30.348103	120.078823	479.3097	10	Sand	Firm	Dry
147	-30.347760	120.078549	479.8260	10	Sand	Firm	Dry
148	-30.347361	120.078283	480.1924	10	Sand	Firm	Dry
149	-30.346973	120.078020	479.8128	10	Sand	Firm	Dry
150	-30.346587	120.077739	479.1914	10	Sand	Firm	Dry
151	-30.346179	120.077493	478.1053	10	Sand	Firm	Dry
152	-30.345809	120.077195	477.3109	10	Sand	Firm	Dry
153	-30.345397	120.076919	476.3301	10	Sand	Firm	Dry
154	-30.345050	120.076669	475.6683	10	Sand	Firm	Dry
155	-30.344645	120.076381	475.0500	10	Sand	Firm	Dry
156	-30.344258	120.076150	474.2485	10	Sand	Firm	Dry
157	-30.343906	120.075842	473.5780	10	Sand	Firm	Dry
158	-30.343510	120.075586	472.9448	10	Sand	Firm	Dry
159	-30.343122	120.075353	472.4614	10	Sand	Firm	Dry
160	-30.342719	120.075043	472.2839	10	Sand	Firm	Dry
161	-30.342349	120.074777	472.5321	10	Sand	Firm	Dry
162	-30.341981	120.074507	472.5272	10	Sand	Firm	Dry
163	-30.341582	120.074221	472.4131	10	Sand	Firm	Dry
164	-30.341184	120.073939	472.3108	10	Sand	Firm	Dry
165	-30.340793	120.073702	472.1385	10	Sand	Firm	Dry
166	-30.340437	120.073435	472.1040	10	Sand	Firm	Dry
167	-30.340035	120.073158	472.4803	10	Sand	Firm	Dry

168	-30.339644	120.072871	472.6018	10	Sand	Firm	Dry
169	-30.339261	120.072613	472.6500	10	Sand	Firm	Dry
170	-30.357443	120.085867	465.7563	10	Sand	Firm	Dry
171	-30.357948	120.084302	464.6460	10	Sand	Firm	Dry

Appendix 2. The Electroseismic Effect

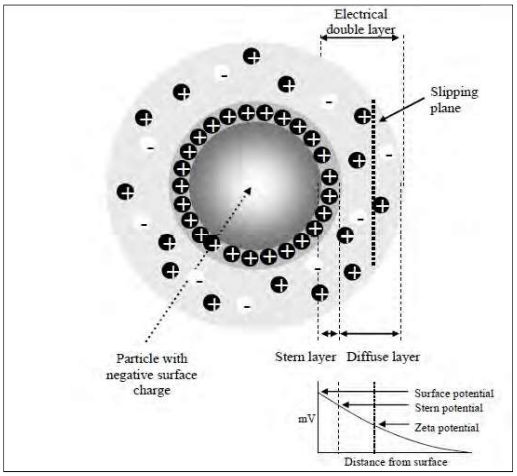


Figure A.1. The Electric Double Layer (http://www.escubed.co.uk/sites/default/files/zeta_potential_(an013)_streaming_potential.pdf)

A charge distribution at the interface between a mineral grain and fluid is organised on the molecular scale, and is referred to as the electrical double layer (Fig. A1). The fluid's molecules arranged next to the mineral's surface, are disrupted and mobilised as the compression wave from the hammer blow passes. The relative motion caused between mineral and fluid leads to small scale electric currents with associated and detectable electromagnetic fields. The resulting ES signal can then be related to how relative movement of the matrix and water (dynamic permeability) and the strength of electrical attraction between the mineral and the fluid (zeta potential). Different fluids located in the same rock type will inherently produce differing ES responses, as does different geological materials with the same water quality throughout. The differences are discernible and the 3D maps that are produced form the basis for the analysis of groundwater flow paths.

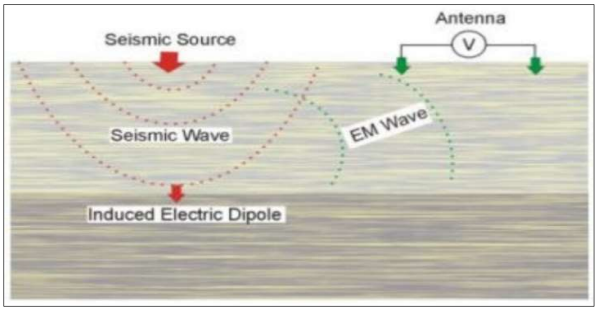


Figure A2. Seismic wave crossing an interface **ge**nerating an electromagnetic wave

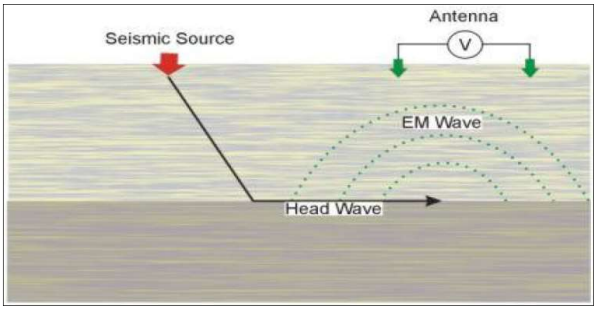


Figure A3. Head wave travelling along an interface generating an electromagnetic wave

Appendix 3. Electroseismic Modelling and Investigation

The descriptions following refer to the electroseismic data discussed in the results section.

3.1 Hydraulic Conductivity Tomography

The electroseismic hydraulic conductivity tomography (**ESKT**) is an indicative measure of hydraulic conductivity (K in Darcy's Law), or the ease at which a fluid, water in this case, can flow through a porous medium. It is expressed as a velocity, usually in units of metres/day, or otherwise stated as how far a fluid will move through a medium over a certain amount of time under gravity or a hydraulic gradient. No data exists in the study area at this stage which can be used to calibrate this and other hydrogeological parameters. The results shown are displayed in relative terms, where a value of 100% is assigned to the highest hydraulic conductivity and 0% is the lowest of the values detected during ES survey. Since these values are relative it is possible that the material with a relative value = 100% could have low hydraulic conductivity in absolute terms. The data can easily be linearly calibrated to a known value at any sounding point at any depth on the model.

3.2 Electroseismic Coupling Coefficient Tomography

The electroseismic coupling coefficient tomography data (**ESCCT**) is representative of the electrical characteristics that define the conversion efficiency between the seismic waves to electrical field. The ESCCT data is expressed as a percentage of conversion. The data can be used as indicators for salinity and temperature variations within an aquifer system. (The parameter is also sensitive to other factors such as pH and viscosity). In groundwater studies ESCCT data can differentiate water quality or type variations and is useful for defining aquifer systems with different feed systems.

3.3 Electroseismic Change in Absolute Gradient Tomography

The electroseismic change in absolute gradient tomography (**ESCAGT**) data is used to differentiate absolute electrical changes in rock formation properties, proportional to each other. This method allows the user to discern formations of similar electrical characteristics and when used in conjunction with the ESIT and electroseismic change in total response tomography (see below), provides deeper insight into the geological and lithological information for subsurface formations. It is also used to support the delineation of subsurface faulting and intrusive formations not from an interface standpoint but rather from an absolute electrical standpoint.

3.4 Electroseismic Groundwater Flow Potential Tomography

The electroseismic groundwater flow potential tomography (**ESGFPT**) data indicates the areas under the site with the highest flow rate potential. This data incorporates primary and secondary permeability data as well as ESCCT and gradient electrical response data to determine the areas of highest probability of groundwater flow. This data is primarily used to find the best location to tap a groundwater reserve.

3.5 Electroseismic Interface Tomography

Interface tomography (**ESIT**) indicates the positions of interfaces between different rock types and also between layers of unconsolidated materials with different electrical and elastic properties. It makes use of the interface effects generated by electroseismic responses as the pressure wave passes through a resistive interface between different geological materials. This data can be used to determine if there are large geological shifts such as faults. Furthermore, the interface tomography results indicate positive (red) and negative (blue) interface changes. Interface response polarities indicate the type of fluids and rock involved in the generation of the ES response. Similar rock types generate similar polarity responses thus indicating stratification boundaries. Information from this parameter is often interpreted in combination with information from parameters ESIAT and ESIANT as discussed below.

3.6 Electrotelluric Tomography (ET)

This data provides further information with which to delineate lithological changes and geological formations with similar characteristics by identifying the variability in conductivity in the subsurface material. The data resolution changes exponentially with depth. The interpretation requires a process of systematically changing the isosurface values until the structures become apparent at various depths.

3.7 Electrotelluric Interface Tomography (ETIT)

This data provides an enhancement of parameter ET by focussing on the differences in the variability of the electrical conductivity within geological materials. The ETIT data set describes the position and depths of interface indicators that occur at the boundaries between two geological units with differing electrical conductivity variability. This data allows for the delineation of ET generated interface data.

Appendix 4. Electrotelluric Geophysics

Electrotelluric currents are geo-magnetically induced currents that flow through conductive formations in the subsurface. They are primarily created by natural fluctuations in the earth's geo-magnetic field, caused by solar winds. These currents are generally very low in frequency, Less than 0.1Hz, however lightning in the earth's atmosphere also causes high frequency telluric currents to be induced in the subsurface.
The lower the frequency of the geomagnetic field disruption the deeper the EM field can penetrate into the subsurface, to create a telluric current. Thus the frequency of the detected electrotelluric current is directly proportional to its depth.

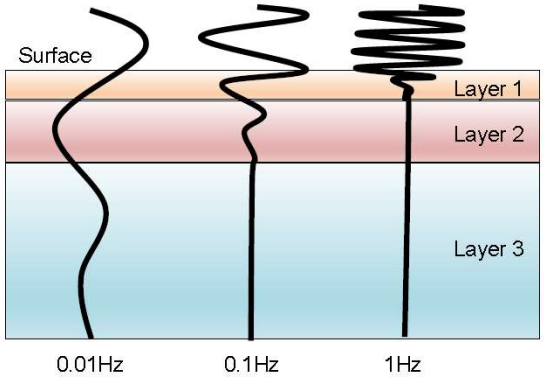


Figure 1 - Electrotelluric Frequency dependence

4.1 Theory of Operation

The depth to which a particular frequency can penetrate the subsurface is known as the skin depth, and is determined by the frequency of the EM field and the resistivity of the surface. This is shown in the equation below.

$$\delta = \sqrt{\frac{2\rho}{\omega\mu}}$$

Where:

- δ : is skin depth
- ρ : is the ground resistivity
- ω : is the angular frequency of the telluric current
- μ : is the magnetic permeability

Electrotelluric geophysics makes use of this frequency to depth dependence to allow for the calculation of the strength of a telluric current at any given depth.
The strength of a particular telluric current frequency is determined by calculating the Fourier transform of the recorded frequency spectrum at a sounding location as shown in Figure 2.

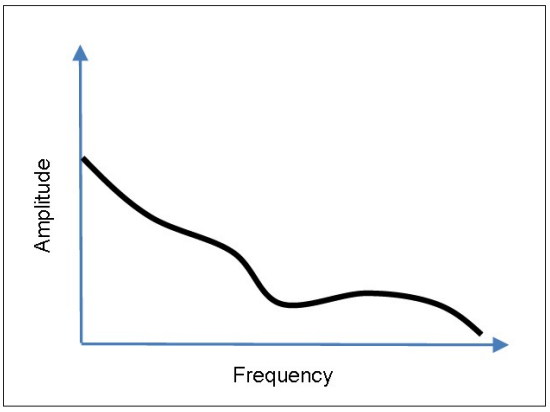


Figure 2 - ET Frequency domain

This in effect shows the electrical conductivity variability within a formation at any given depth.

In order to calculate the actual formation apparent resistivity, the magnetic field component at the right angle to the electric field must be integrated using the equation:

$$\rho_a = 0.2\tau \left(\frac{\mathrm{Ex}}{\mathrm{Hy}}\right)^2$$

Where:

- ρ_a : is the apparent resistivity
- τ : 2 π/ω
- Ex : is the Electric Field component
- Hy : is the magnetic field component

Electrotelluric methods are useful at delineating lithological structures at great depth. They are also useful at providing calibration information to the electroseismic data in terms of seismic velocity estimation.
When correlated against electroseismic data, they can provide deeper insight into the nature of the electroseismic response interpretations.

Appendix 5. Electroseismic Interpretation parameters, assumptions and limitations.

5.1 Parameters

All ES investigations produce data sets which are relative by definition. These relativities include:

1) Depth estimates are relative to the applied seismic velocity models utilised while producing an ES model.
2) Hydraulic parameters are relative to the applied calibration data used to create a model.
3) Geological parameters such as formation conductivity and chemical composition affect the ES data being interpreted.
4) Electroseismic interpretations are relative and subject to the geological context of the site being investigated.

Thus all the ES response data is considered to be relative to the site geological and hydrogeological composition.

5.2 Assumptions

As such, assumptions must be made when interpreting ES data sets. These include but are not limited to:

- The site geology at each survey point is assumed to be of similar seismic velocity parameters. This is not always the case as slight variations in geological formation density, porosity, compressibility and stratification are always present. This results in slight variations in the seismic velocity profiles between each unique ES sounding location even if the geology is similar. Statistically, these variations can be up to 25% of the base velocity model for the site. As such, any interpretation of the depth estimates for ES responses must account and compensate for these potential depth estimate variations. In most cases, the unique seismic velocity profile for each survey point generally can't be known, a general seismic velocity model is applied to all the survey points in a project. This may produce some variations in the interpreted depth of the resultant ES responses.
- ES data sets are vertical data sets, describing the geology and hydrogeology of the site directly under the survey point. As such, ES survey point lateral resolution plays a significant role in the size and dimensions of the near vertical geological structures and features that be delineated or interpreted by ES data sets.
- Even though the vertical resolution of an ES sounding is relatively high, with samples being taken every 8 to 12cm vertical depth depending on the velocity model used, it is important to note that a great deal of raw resolution is lost during the processing of the data. This is due to filtering and smoothing constraints applied to the data sets. As such, it is practically not possible to accurately delineate geological features thinner than 1m in thickness.

- ES data sets for 2D and 3D interpretations rely heavily on interpolation to describe the correlation between geological and hydrological features. As interpolation parameters are set to default values that assume that the geological setting of any particular site is mostly stratified in a horizontal or near horizontal plain, these interpolation strategies should always be considered when interpreting complex geologies.
- In the case of un-calibrated hydrological data interpretations, it must be understood that all ES hydrological data is subjective and relative to the maximum recorded ES response values. These data sets must be considered with reference to the geological setup of the site. For example, a low permeability formation such as granite generally does not host high permeability, or hydraulic conductivity, or aquifers. There may be slight variations in the hydraulic conductivity or permeability in the makeup of such geologies. However, a relative ES interpretation of such geology may be misinterpreted as a high permeability aquifer. The best way to avoid these misinterpretations is to calibrate the model to the hydrological parameters of a known well that resides within the same geology as the survey site.
- ES methods cannot predict the groundwater yield that an interpreted aquifer will produce. Any estimates of groundwater flow potential, discussed in this ES study report, are merely an indicator of where the best interpreted location is for groundwater flow.
- ES data cannot currently determine the porosity of a formation.
- The ES processing and interpretation workflow assumes that data collected in the field was done on surface soil and sediment conditions of similar characteristics. It assumes that the site soil conditions are uniform in moisture content, electrical conductivity and soil composition. It is also assumed that the ES electrode placement and recorder settings were conducted in exactly the same manner for each sounding and that noise sources were removed as far as possible. The seismic source energy is also assumed to be consistent in strength, for every seismic event generated to produce a recorded ES conversion.
- It is assumed that the ES survey was done in the lowest noise location possible and that all possible extraneous sources of seismic noise were eliminated from the site before surveying commenced.
- Any electrical noise sources such as power line noise is assumed to be consistent in frequency and amplitude and produces odd and even harmonics that can be predictably filtered out. Any other types of electrical noise sources such as electric fences are assumed to have been removed from the site.
- Fracture indicators can be generated by interfacial responses, ferrite, quart or sulphide bearing geological features. Any interpretation of possible bedding plain fractures must be done cautiously. Any other possible geological features that may have caused such fracture indications must be considered.
- ES data interpretations and calibrations rely heavily on the correctness and relevance of the geological and hydrological data provided for the investigation site.

If incorrect data is provided, then it is possible that incorrect results and interpretations of the ES data may result.

- Strong geological interfacial seismic reflectors may cause mirrored ghosting effects in an ES survey. This is due to a strong geological reflector re-bounding the injected seismic wave which then re-passes through geological features on its way back to the surface. This causes what appears to be a mirror image of the ES data with depth. As such, known strong geological seismic reflectors should always be considered when interpreting ES data set.
- ES methods cannot determine the depth of the static water table at a survey point. As such, any permeable formations indicated on ES data sets that reside above the static water table, must be considered as poor aquifers that do not contribute to groundwater flow or yield.
- ES Methods cannot differentiate between fully and partially saturated aquifers. As such, ES methods cannot determine if an aquifer has been partially dewatered or if an aquifer is fully saturated. Even if an aquifer has been depleted, there is still water within the aquifer which allows an Electro-seismic conversion to take place which describes the permeability of the aquifer and the pore space fluid characteristics. However, it will not indicate whether the aquifer is productive or not. With this in mind, all aquifers delineated by ES methods are assumed to be fully saturated and capable of yielding groundwater.

5.3 Limitations

As there are a number of assumptions made using ES methods to estimate and interpret the geology and geohydrology of a site, the results presented as well as the interpretations made, in this report, cannot be guaranteed to be absolutely correct. ES data can only provide an estimated insight into the geological and hydrogeological makeup of a study site based on the information available.

The behaviour of groundwater is complex. Our conclusions are based upon the analytical data presented in this report and our technical experience. Future advances in regard to the understanding of groundwater and its behaviour, and changes in regulations affecting its management, would impact on our conclusions regarding its potential presence on this site. Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, Geo9 must be notified of any such findings and be provided with an opportunity to review the data provided.

APPENDIX D: CONCEPTUAL SITE MODEL AND CELL CONTAINMENT FIGURE

Waste cell backfilling and cap design requirements

The key containment infrastructure to prevent free liquid ingress into a waste cell is the cell's cap (refer to the cell containment of Class IV and Class V wastes below). Each waste cell is capped with a three-part cap, constructed with natural materials mined from the waste cell locations. The cap construction consists (from bottom to top) of:

- 3m thick kaolinized granite, compacted to 90% Maximum Modified Dry Density (**MMDD**), keyed into the silcrete layer.
- 4m thick mixed laterite, broken silcrete and sandy clays, compacted to 95% MMDD with top surface graded outwards at 1:20.
- 1.5m thick kaolinized granite, compacted to 95% MMDD, graded outwards at 1:20.

After 10 years of monitoring, each cell cap is also covered with any remaining kaolinized granite spoil (un-compacted) and both sub-soil and topsoil. This complete cap design is engineered to:

- Resist water ingress by promoting run-off.
- Resist water ingress using low permeability barriers.
- Resist water ingress using a store-and-release barrier.
- Resist erosion.
- Maintain integrity whilst allowing for some settlement of the waste cell contents.

Potential cap failure scenarios are described below:

- Localised subsidence. This could potentially occur if there were insufficient compaction of a waste or interstitial fill within the wastes within the cell, or a loss of volume due to degradation of a waste material within the cell.
- Wide area subsidence.
- Erosion.
- Intentional damage or human intrusion.

Waste cell generating leachate

Leachate is typically generated because of rainwater percolation through contaminated wastes disposed into landfill, or as moisture is released from a placed waste during decomposition or compaction. Leachate generation remains continuous when water encounters contaminated waste.

The discharge of leachate may result in serious adverse environmental problems because they contain an array of heavy metals derived from waste with simultaneous, chemical, physical and biological activities. Accordingly, heavy metals or persistent organic pollutants present in leachate can migrate away from the disposal site and create a serious pollution threat to a water table and soils around the landfill.

Traditional landfill leachate collection systems are designed to factor hydraulic systems and engineered landfill liner systems (i.e. HDPE geomembranes placed over natural geological foundations).

For each waste cell constructed at the Facility, leachate generation is extremely low. The average yearly leachate generated has been modelled at approximately 57 L/year assuming a 7,200 m2 surface area of a cell.

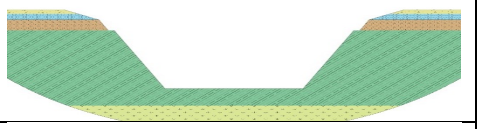
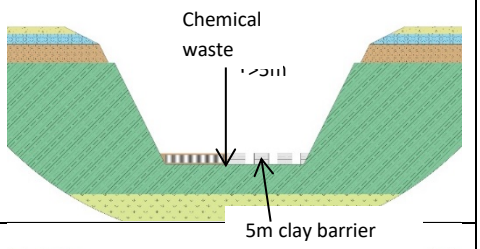
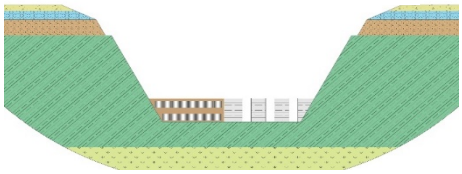
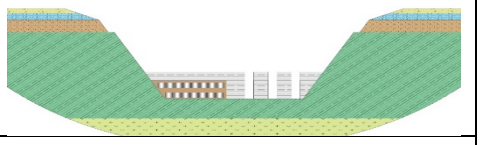
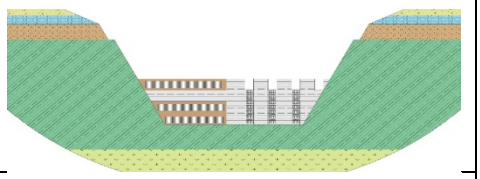
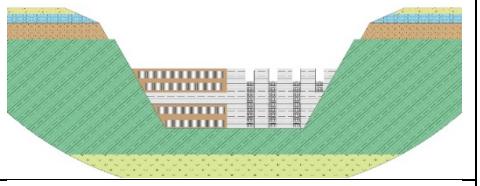
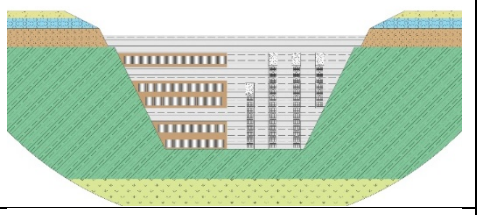
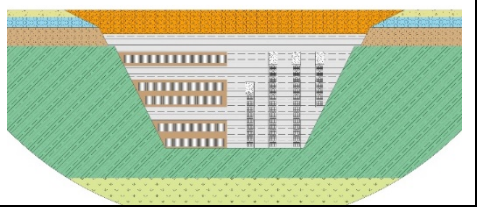
The Sandy Ridge Facility relies on natural impermeable geology rather than an engineered liner system, and a combination of a strict waste acceptance process and the exclusion of all moisture via an air dome during operations and a cap during closure, to prevent the waste cell generating leachate.

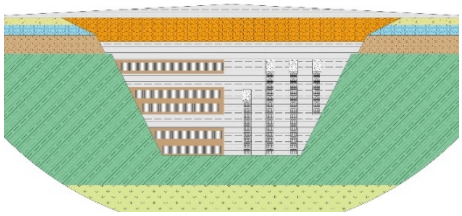
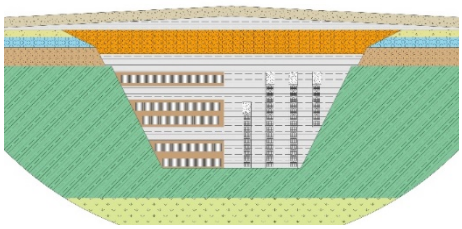
Waste for disposal in cell will be subject to the strict Tellus waste acceptance criteria, ensuring that no wastes containing free liquids (such as a sludge or liquid waste inside drums), no putrescible waste that may decompose into a liquid state, and no wastes that when compacted will release moisture, will be deposited.

Water used for dust suppression or compaction within a cell will be applied in a controlled manner to ensure that no free liquid or saturated ground is generated.

As there will be no free liquid within the cell, and no wastes that are able to decompose or emit free liquid under compaction, the waste cell will not have the capacity to generate leachate without external inputs.

Cell containment of Class IV and Class V intractable waste materials

The bottom of the mine void would be a minimum of 5 m above the unweathered/fresh granite bedrock.	
A base layer of waste is placed on one side of the floor of the mine void. Wastes of incompatible types are segregated by internal compacted kaolin walls which are typically 5 m wide. The height of each waste layer and barrier wall is the equivalent of the height of a waste package, typically 0.9 metres. Waste packages are placed tightly next to each other in a row. Granular material is backfilled between and around the waste packages to fill any air spaces.	
A thin (300 mm) layer of compacted granular material is placed over the chemical waste layer. Compaction testing would be carried out in accordance with *AS1289.5.8.1* (Australian Standard for testing soils for engineering.) to confirm material is compacted to the density required by the engineering design. The next layer of chemical waste packages is placed on the kaolin compacted layer along with the ~5 m wide kaolin separation wall.	
A 3 m thick capping layer of kaolin is compacted onto the second waste layer if waste of an incompatible type is to be placed immediately above.	
The next layer of waste packages is tightly placed on the thick capping layer and backfilled with granular material to exclude air pockets and voids. The separation barrier is maintained in the middle of the cell if incompatible wastes are located laterally to each other.	
The process repeats as the cell is filled.	
When the waste materials reach 7m below the natural ground level, a 3 m thick kaolin cap is placed on the waste packages and is keyed into the surrounding silcrete and clay.	
A 4 m thick layer of compacted crushed silcrete and laterite material, with some kaolinised granite or clayey sand is placed between the kaolin cap and the natural ground surface.	

The compacted kaolin clay dome cap is placed over the cell. The final capping layer is formed of compacted kaolinised granite material (permeability approximately 6.0 x 10^{-8} m/s) and placed in the form of a dome, to shed stormwater from the structure into perimeter V drains, which flow to a sump. The cap would have a 1:20 gradient and be an approximate thickness of two metres in the middle, thinning as it slopes to integrate into the landscape. Subsidence monitoring of the cap would commence.	
Excess kaolinised granite, subsoil and topsoil is replaced on the cap after the cessation of subsidence monitoring. **LEGEND - Cell Backfill** Mottled clays compacted to 95%mmdd Mixed laterite and silcrete and Clayey sand compacted to 95%mmdd, Max particle size 40mm Waste sand backfilled around drums/bags compacted to 90%mmdd **LEGEND - Existing Ground** Clayey sand Laterite Silcrete Weathered granite Unweathered granite	

APPENDIX E: BASELINE SOIL AND GROUNDWATER QUALITY RESULTS TO DATE

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05 April 2020

2230.19b (Rev 2)

Attn: Richard Phillips, General Manager – Health, Safety, Environment, Compliance & Quality

Memorandum: Surface soil sampling at Sandy Ridge Project – Interim results

Interim Results

1. Introduction

Tellus Holdings Ltd (Tellus) plans to construct and operate an open-cut kaolin (clay) mine in association with a near-surface geological waste repository (the Facility). The mine and the Facility and the associated infrastructure are collectively referred to as the Sandy Ridge Project). The Sandy Ridge Project will be located approximately 75km north east of Koolyanobbing, in the Shire of Coolgardie, within the Goldfields region of Western Australia (WA). A regional location map is given in Attachment 1.

A bilateral assessment under Part IV of the WA Environmental Protection Act 1986 (EP Act) and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was conducted. WA Environment Ministerial Approval was granted for the Sandy Ridge Project on 27 June 2018. Ministerial Approval from the federal Government was granted on 7 January 2019 (EPBC2015/7478). On 27 November 2019, the Facility's Crown Lease was registered in WA by Landgate. Condition 6 of the Crown Lease requires Tellus to complete a baseline soil audit of land within the Crown Lease boundary, and land within miscellaneous tenure including the Mt Walton Access Road and Sandy Ridge Facility Access Road.

Sampling for this baseline soil audit was completed in two campaigns. The first was completed in April 2019 and focussed on the land within the Crown Lease boundary in the vicinity of the Facility. The second campaign was completed in January 2020 and focussed on the Mt Walton Access Road and the Sandy Ridge Facility Access Road, a requirement of the Facility's Crown Lease. These sampling campaigns were completed to support baseline soil sampling conducted in 2014 and 2015.

This memorandum seeks to provide interim results and discussion of the soil audit. The data received from the relevant laboratories as at 5 April 2020 are included. A final report will be provided containing discussion on the scope of work, detail on the sampling methodologies, the complete set of laboratory results, images of each sampling site, and a copy of all laboratory analysis certificates.

2. Sample and test suite details

2.1 Sample description

A summary of the number of soil samples collected and tests performed is given in Table 1. Table 1 separates the data collected for the Facility area (April 2019 campaign) and the Mt Walton Access Road and the Sandy Ridge Facility Access Road (January 2020 campaign).

The coordinates of each sample are given in Attachment 3 as part of the full listing of the data. All coordinates are provided in the GDA94 (Zone 51) map datum. Maps of the sample locations are provided as part of the discussion of the results below.

Table 1: Number of samples tested (number of duplicates in brackets) for each test suite

Campaign	Inorganics	Heavy Metals	Asbestos	PCB	PFAS	Radionuclides
April 2019	210 (42)	210 (42)	21 (4)	11 (4)	11 (4)	21 (4)
January 2020	48 (3)	48 (3)	10 (1)	10 (1)	10 (1)	7 (1)

Soil samples were taken from the surface 0.1m at each location using a shovel. Samples were bagged into sealable plastic bags in preparation of their transport to the necessary soils' laboratories. Photographs of each sampling site were also taken. These images will be supplied as part of the final report.

2.2 Sample testing

The samples were subjected to different suites of tests. The test suites to which each sample were subjected are indicated in Attachment 2. The details of these test suites are given in Table 2. Some variation in the test suites occurred between the April 2019 and January 2020 campaigns. Where this occurred, it is indicated in Table 2.

Table 2: Summary of tests included in each suite

Test Suite	Analyte description	Abbreviation	Limits of Reporting
Inorganics	pH of a 1:5 soil/water solution	$pH_{1:5}$	0.1 pH units
	Conductivity of a 1:5 soil/water solution	$EC_{1:5}$	0.01mS/cm
	Total Organic Carbon⁺	TOC	0.1%
Heavy Metals	Total Arsenic by ICPOES/MS	As	5mg/kg
	Total Cadmium by ICPOES/MS	Cd	0.2mg/kg
	Total Chromium by ICPOES/MS	Cr	1mg/kg
	Total Copper by ICPOES/MS	Cu	1mg/kg
	Total Mercury by Cold Vapour Atomic Absorption Spectrophotometry	Hg	0.02 mg/kg
	Total Nickel by ICPOES/MS	Ni	1mg/kg
	Total Lead by ICPOES/MS	Pb	1mg/kg
	Total Zinc by ICPOES/MS	Zn	1mg/kg
Asbestos	Qualitative identification of fibre type by stereo microscope examination and polarised light microscopy (AS4964-2004)	Asbestos	0.1g/kg

Interim Results

Test Suite	Analyte description	Abbreviation	Limits of Reporting
PCB	Polychlorinated Biphenyl as Aroclor Ind	PCB	0.2mg/kg
PFAS	Perfluorobutanoic acid	PFBA	0.0008mg/kg
	Perfluoropentanoic acid	PFPeA	0.0002mg/kg
	Perfluorohexanoic acid	PFHxA	0.0004mg/kg
	Perfluoroheptanoic acid	PFHpA	0.0008mg/kg
	Perfluorooctanoic acid	PFOA	0.0002mg/kg
	Perfluorononanoic acid*	PFNA	0.0002mg/kg
	Perfluorodecanoic acid*	PFDA	0.0002mg/kg
	Perfluoroundecanoic acid*	PFUnDA	0.0002mg/kg
	Perfluorododecanoic acid*	PFDoDA	0.0002mg/kg
	Perfluorotridecanoic acid*	PFTrDA	0.0002mg/kg
	Perfluorotetradecanoic acid*	PFTeDA	0.0002mg/kg
	Perfluorobutane sulfonic acid	PFBS	0.0004mg/kg
	Perfluoropentane sulfonic acid*	PFPeS	0.0004mg/kg
	Perfluorohexane sulfonic acid	PFHxS	0.0004mg/kg
	Perfluoroheptane sulfonic acid*	PFHpS	0.0004mg/kg
	Perfluorooctane sulfonic acid	PFOS	0.0004mg/kg
	Perfluorodecane sulfonic acid*	PFDS	0.0004mg/kg
	4:2 Fluorotelomer sulfonic acid	4:2 FTS	0.0005mg/kg
	6:2 Fluorotelomer sulfonic acid	6:2 FTS	0.0005mg/kg
	8:2 Fluorotelomer sulfonic acid	8:2 FTS	0.0005mg/kg
	10:2 Fluorotelomer sulfonic acid	10:2 FTS	0.0005mg/kg
	Perfluorooctane sulphonamide*	FOSA	0.0004mg/kg
	N-Methyl perfluorooctane sulphonamide*	Me-FOSA	0.0004mg/kg
	N-Ethyl perfluorooctane sulphonamide*	Et-FOSA	0.0004mg/kg
	Perfluorooctane sulfonamidoacetic acid*	FOSAA	0.0004mg/kg
	N-Methyl perfluorooctane sulfonamidoacetic acid*	Me- FOSAA	0.0004mg/kg
	N-Ethyl perfluorooctane sulfonamidoacetic acid*	Et-FOSAA	0.0004mg/kg
	N-Methyl perfluorooctane sulfonamidoethanol*	N-Me-FOSE	0.0008mg/kg
	N-Ethyl perfluorooctane sulfonamidoethanol*	N-Et-FOSE	0.0008mg/kg
	Sum of PFAS	Sum PFAS	0.0002mg/kg
	Sum of PFHxS and PFOS	Sum PFHxS + PFOS	0.0004mg/kg
	Sum of PFAS (WA DER List)	Sum PFAS (DER)	0.0002mg/kg
Radionuclides	Americium-241	Am 241	TBC Bq/kg^
	Caesium-137	Cs 137	TBC Bq/kg^
	Cobalt-60	Co 60	TBC Bq/kg^
	Strontium-90	Sr 90	TBC Bq/kg^
	Radium-226	Ra 226	TBC Bq/kg^

Notes: + TOC is included in all Inorganic test suites done in January 2020 but only in select suites done in April 2019. * These analytes are not included in April 2019 testing but included in January 2020 testing. ^ To be confirmed once the laboratory data has been made available.

Testing for the Asbestos, PFAS, PCB, Heavy Metals, and Inorganics suites was conducted by Analytical Reference Laboratory (WA) Pty Ltd (ARL). ARL is an Australian NATA-accredited laboratory. Testing for the Radionuclides suite was conducted by Eurofins Eichrom radioactivity laboratory in France. Eurofins Eichrom are accredited by COFRAC, the French accreditation body, and satisfy the requirements specified in standard ISO 17025 (Testing and Calibration Laboratories). Data for the radionuclides are currently incomplete. Only radionuclide data for the April 2019 campaign will be reported in this memorandum. All radionuclide data, the limits of reporting, and an accompanying interpretation of the data will be provided in the final audit report.

3. Results

A summary of the results for each testing suite is given below. Results from each test suite are discussed separately. The full listing of results can be found in Attachment 3.

3.1 Inorganics

Classification schemes

Inorganics testing includes testing of the soil's pH ($pH_{1:5}$), salinity ($EC_{1:5}$), and Total Organic Carbon (TOC). A general classification of soil $pH_{1:5}$ values is given in Table 3[1]. The values reported are those measured for a 1:5 soil/water solution and not those measured using a $CaCl_2$ solution. pH values measured in water are usually 0.5-1.0 pH units higher than pH measured in $CaCl_2$. This is noted to avoid confusion, as both solutions are within soils audits conducted in Western Australia (and Australia more broadly).

Table 3: General soil $pH_{1:5}$ – water classification

$pH_{1:5}$ – water (pH units)	**Rating**
<4.0	Very strongly acid
4.0-5.5	Strongly acid
5.5-6.0	Moderately acid
6.0-7.0	Slightly acid
7.0-8.0	Slightly alkaline
8.0-9.0	Moderately alkaline
9.0-10.0	Strongly alkaline
>10.0	Very strongly alkaline

A similar classification scheme for $EC_{1:5}$ is provided in Table 4[1]. The classification provided assumes a loam texture at the soil surface (10-20% clay)[2]. This assumption is based on available Australia Soil Classification mapping and broadscale mapping of surface clay contents as sourced from the Australian Soil Resource Information System (ASRIS)[3]. The soils in the vicinity of the Sandy Ridge Project are classed as either Kandosols or Tenosols. Both of these soil types have clay contents of not more than 15% at the surface.

[1] Hazelton, P. and Murphy, B. (2016) *Interpreting soil test results: what do all the numbers mean?*, CSIRO Publishing, Clayton South.
[2] Other classification threshold values exist for soils of different clay contents.
[3] Australian Soil Resource Information System, https://www.asris.csiro.au/index.html

Interim Results

Total Organic Carbon (TOC) is an indicator of the organic matter levels found in soils. Organic matter levels tend to be 1.72-2.00 times greater than TOC. A classification scheme for TOC is provided in Table 5[1].

Table 4: General soil $EC_{:5}$ classification for loam soils with clay contents of 10-20%

$EC_{1:5}$ (dS/m)*	**Rating**
<0.07	Very low
0.07-0.15	Low
0.15-0.34	Medium
0.34-0.63	High
0.63-0.93	Very high
>0.93	Extreme

*1dS/m is equivalent to 1mS/cm

Table 5: General TOC classification

TOC (%)	**Rating**
<0.40	Extremely low
0.40-0.60	Very low
0.60-1.00	Low
1.00-1.80	Moderate
1.80-3.00	High
>3.00	Very high

These classification schemes are provided to give context to the values reported in this memorandum. However, the actual suitability of these values for the growth of vegetation should be determined on a site specific basis. Given that this audit aims to establish baseline values of the existing soil conditions and that vegetation currently exists in the soils assessed (to varying degrees), it is assumed that the values measured represent $pH_{1:5}$, $EC_{1:5}$ and TOC values that could be considered suitable for plant growth.

Results

A total of 258 samples and 45 duplicate samples were assessed for the Inorganic suite of tests. Sampling locations for the Facility area are shown in Figure 1[4]. Sample locations for the access roads are shown in Figure 2[5]. The complete results for the Inorganic testing are given in Attachment 3. The results are summarised in Table 6. The distribution of the results within the classification scheme's groupings of values is given in Figure 3.

Table 6: Summary of Inorganic suite results

Analyte	**Unit**	**Min**	**Max**	**Median**
$pH_{1:5}$	pH units	4.6	9.4	5.5
$EC_{1:5}$	dS/m	<0.01	2.2	0.02
TOC	%	0.1	4.0	0.5

[4] Only 90 TOC samples (82 samples and 8 duplicates) were taken.
[5] Sample labels with a 'B' or 'C' suffix denote duplicate locations.

Interim Results

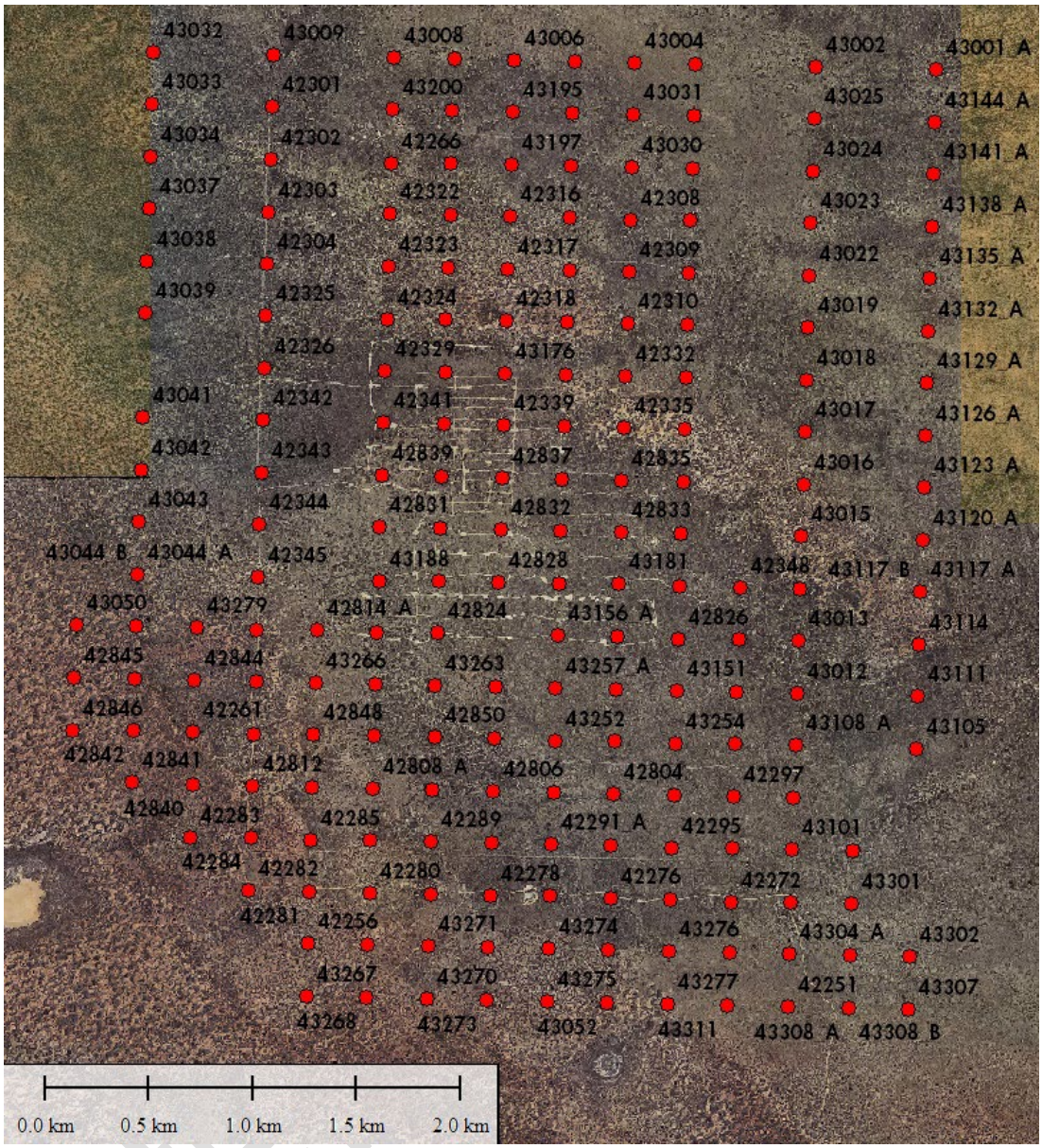


Figure 1: Sampling locations for Inorganics testing– April 2019 campaign

The soils tend to be strongly acid, with a median pH value of 5.5 (strongly acidic). Of all the samples collected, 88% had acidic pH values.

Salinity ($EC_{1:5}$) is typically very low or low (90% of samples). The median $EC_{1:5}$ value for all samples is 0.02dS/m (low). The highest $EC_{1:5}$ value recorded is 2.2dS/m. Although this is classified as extreme, several species in the WA Goldfields region are adapted to grow in saline soils. Several species of *Atriplex*, *Halosarcia*, *Casuarina*, and *Acacia* are known to grow in extremely saline soils[6]. Therefore, the high salinity is unlikely to completely eliminate plant growth but is likely to limit the range of species that can grow.

[6] Department of Agriculture (1998) *Annex 6. Trees and shrubs for saltland, salinity ratings and species lists*, in Tanji, K.K. and Kielen, N.C. (2002) 'Agricultural drainage water management in arid and semi-arid areas, FAO Irrigation and Drainage Paper 61, Food and Agriculture Organisation of the United Nations, Rome.

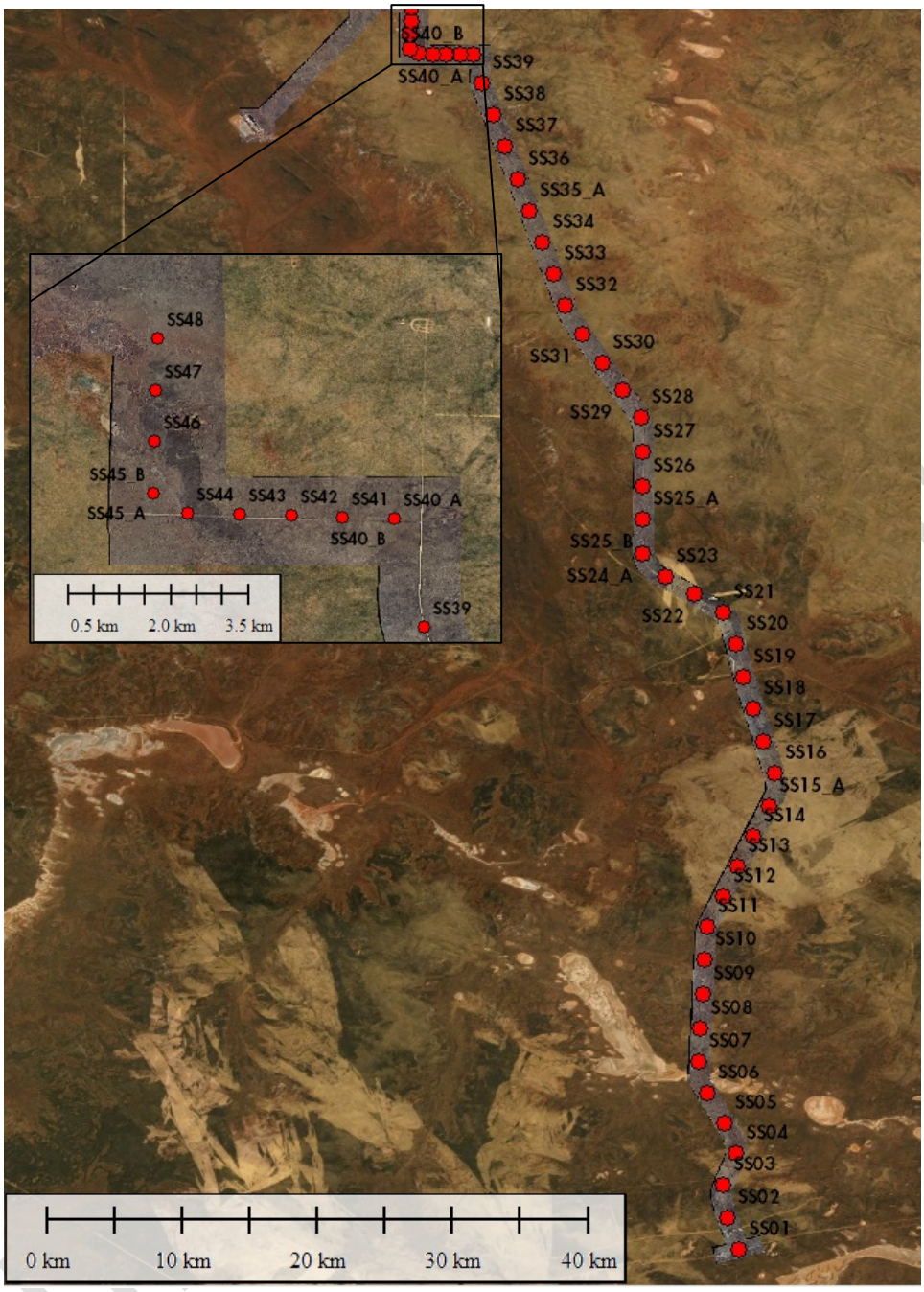


Figure 2: Sampling locations for Inorganics testing– April 2019 campaign

TOC tends to be low to extremely low. The median value is 0.5% (very low). This TOC value is consistent with values often measured for arid land soils. Based on a C/N ratio of 15 (moderate), a TOC value of 0.5% would be equivalent to a Total N value of ~333mg/kg (a reasonable value for loamy arid zone soils).

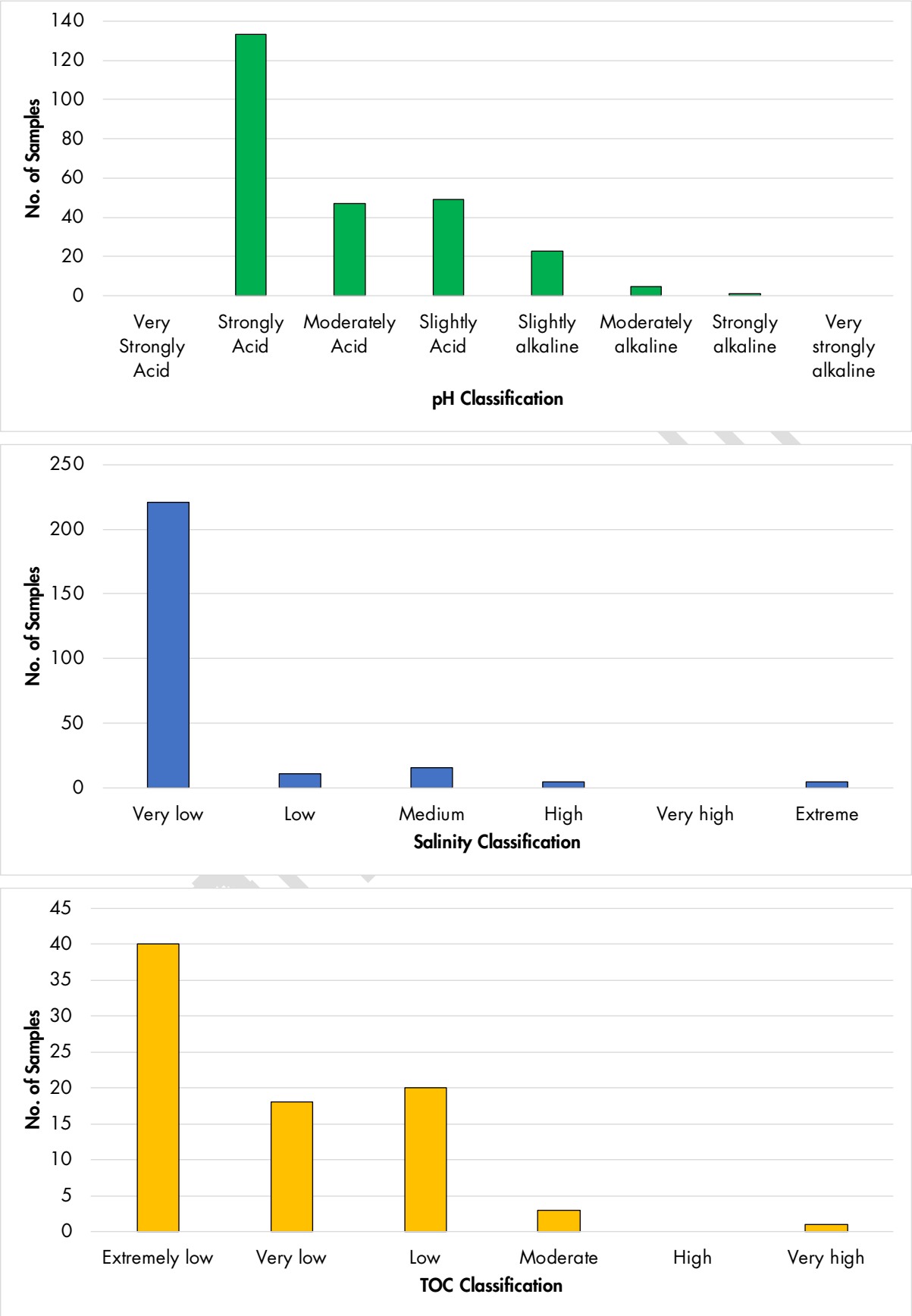


Figure 3: Distribution of $pH_{1:5}$, salinity($EC_{1:5}$) and TOC within the classification schemes.

The location of the soils with alkaline $pH_{1:5}$, high-extreme $EC_{1:5}$, and moderate-very high TOC are shown in Figure 4. The alkaline soils are located within the Facility area and the northern half of the Mt Walton Access Road (1 sample in the southern half of the Mt Walton Access Road is alkaline) but not on the Sandy Ridge Facility Access Road. The alkaline soils are well distributed across the Facility area. The moderate-very high TOC soils are located only in the Facility area, and not along either access road. The distribution within the Facility area appears well distributed. The high-extreme salinity soils are confined to the southern half of the Mt Walton Access Road.

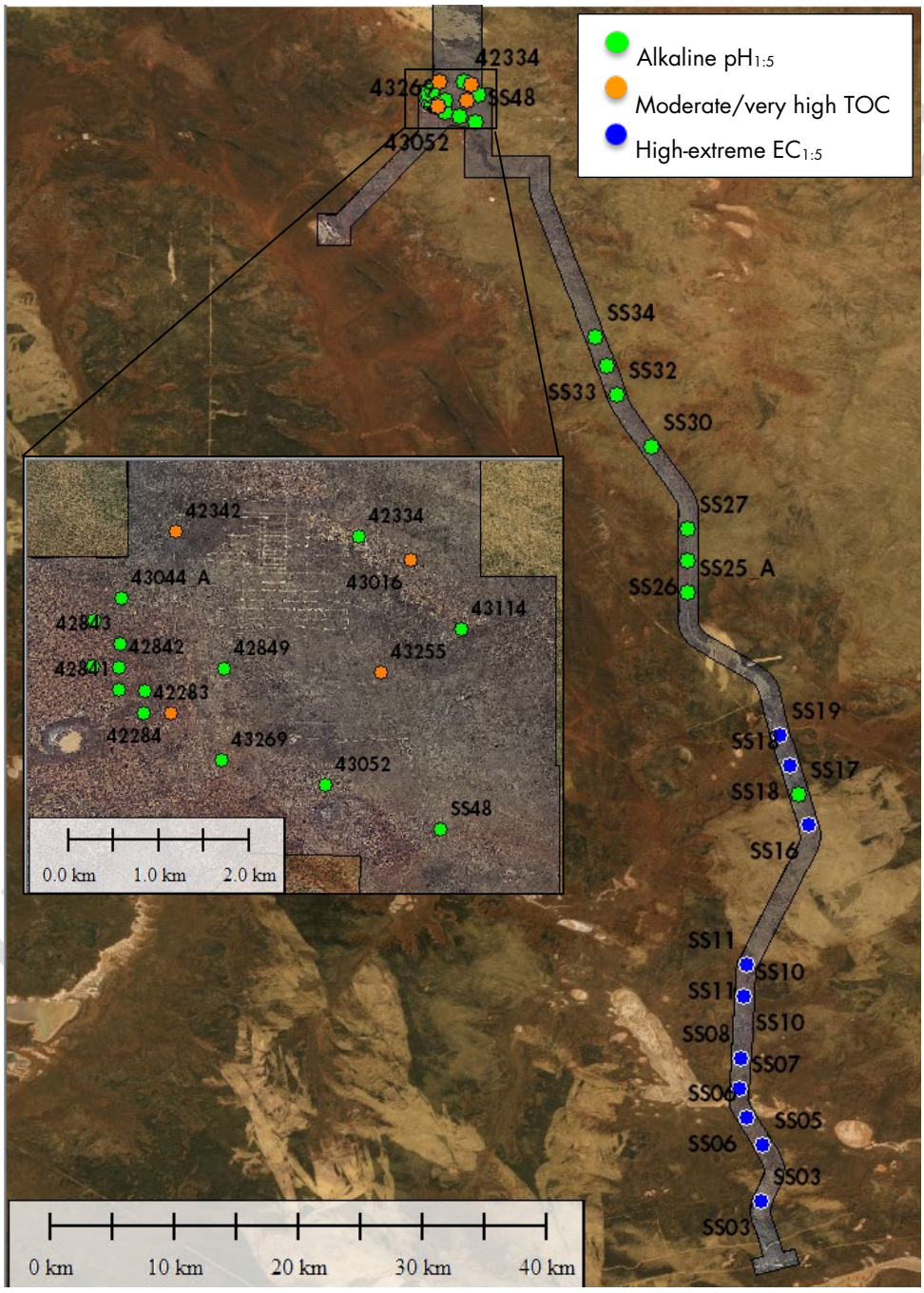


Figure 4: Distribution of alkaline, high-extreme salinity, and moderate-very high TOC samples.

3.2 Heavy metals

Classification scheme

The Heavy Metals suite includes testing of the total concentrations for Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel (Ni), Lead (Pb), and Zinc (Zn). Classification of the concentrations of these elements was based on the levels listed in Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure (NEPM), April 2011. Schedule B1 deals with investigation levels for soil and groundwater. These values are not used to indicate unacceptable levels of metals, but rather soils for which further, more detailed investigations are warranted.

The guideline sets Ecological Investigation Levels (EILs) and Health Investigation Levels (HILs). The EILs vary based on specific soil physicochemical properties and land use scenarios whereas the HILs apply across Australia to all soil types. The EILs were established using the EIL Calculation Spreadsheet (2010) developed by the CSIRO for the National Environment Protection Council[7]. The EILs and HILs adopted for this audit are listed in Table 7. No EILs are offered in Schedule B1 for Cd or Hg. For these elements, only the HILs were considered. An open space and recreational land use was assumed.

Table 7: EILs and HILs adopted for use at the Sandy Ridge Project

Analyte	**EIL (mg/kg)***	**HIL (mg/kg)***
As	50	300
Cd	-	100
Cr+	280	240^
Cu	45	20,000
Hg	-	4,00
Ni	35	800
Pb	270	600
Zn	70	30,000

* Assumes an open space and recreational land use. + An EIL is set only for Cr (III). This EIL was used for Total Cr to provide a conservative assessment of the risk posed by the presence of Cr. ^ A HIL is set only for Cr (VI). This HIL was used for Total Cr to provide a conservative assessment of the risk posed by the presence of Cr.

Results

A total of 258 samples and 45 duplicate samples were assessed for the Heavy Metals suite of tests. Sampling locations for the Facility area are shown in Figure 5. Sample locations for the access roads are shown in Figure 6[5]. The complete results for the Heavy Metals testing are given in Attachment 3. The results are summarised in Table 8.

All soils tested have heavy metal concentrations below both the EILs and HILs outlined in Table 7. Therefore, the total metal concentrations measured do not warrant further investigation.

[7] For Zn, a cation exchange capacity of 2meq/100g, soil pH of 5.5 and 10% Fe content was assumed. For CrIII, a clay content of 15% and 10% Fe content was assumed. For Ni, a cation exchange capacity of 2meq/100g was assumed. For Cu, a cation exchange capacity of 2meq/100g, soil pH of 5.5, total organic carbon of 0.5%, and 10% Fe content was assumed. For As and Pb, no additional assumptions were required.

Interim Results

Table 8: Summary of Heavy Metals suite results

Analyte	Unit	Min	Max	Median
As	mg/kg	<5	6	<5
Cd	mg/kg	<0.1	0.1	<0.1
Cr^{+}	mg/kg	11	110	24
Cu	mg/kg	<5	11	3
Hg	mg/kg	<0.02	0.02	<0.02
Ni	mg/kg	1	15	3
Pb	mg/kg	<1	15	2
Zn	mg/kg	<1	9	2

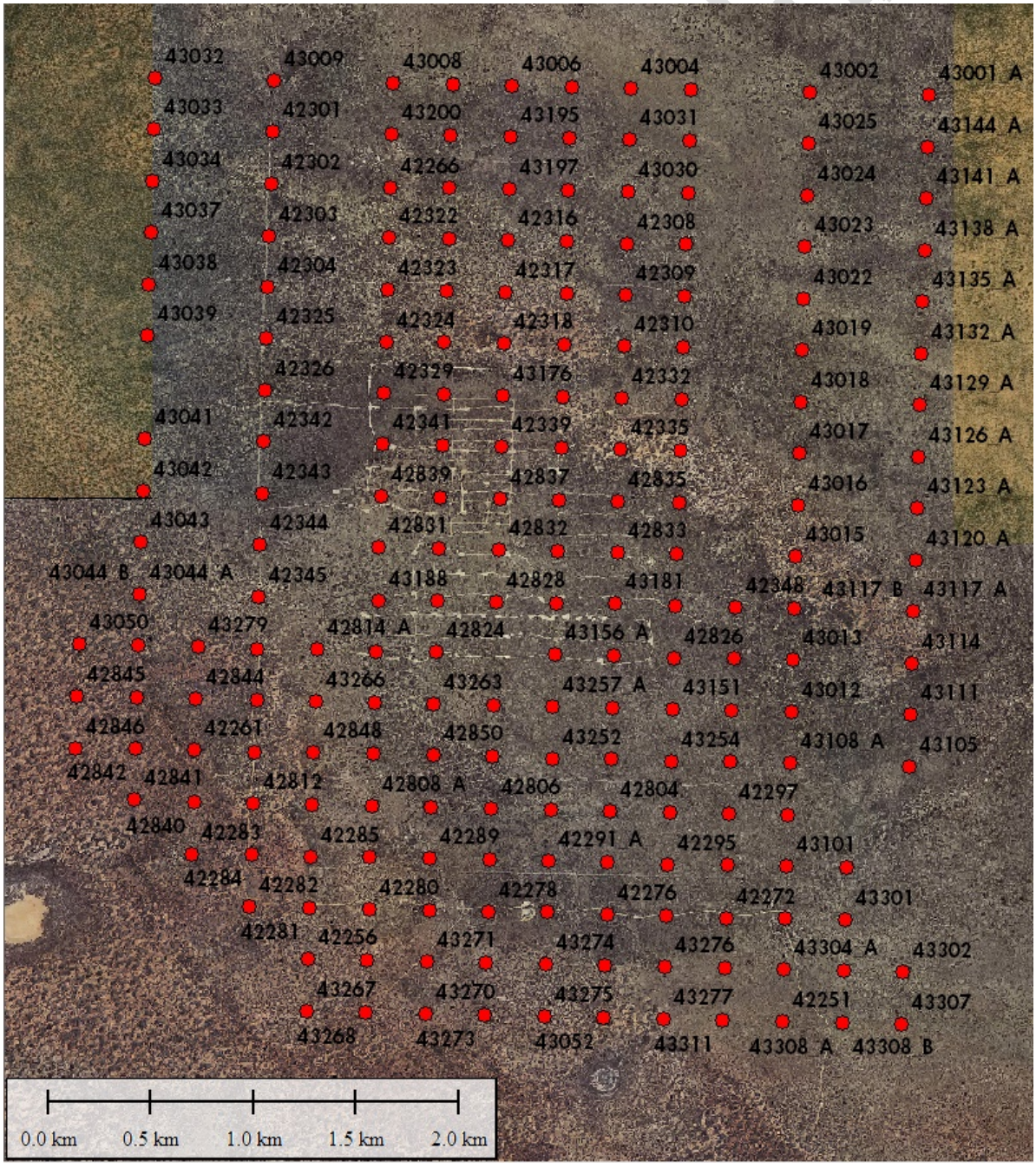


Figure 5: Sampling locations for Heavy Metals testing– April 2019 campaign

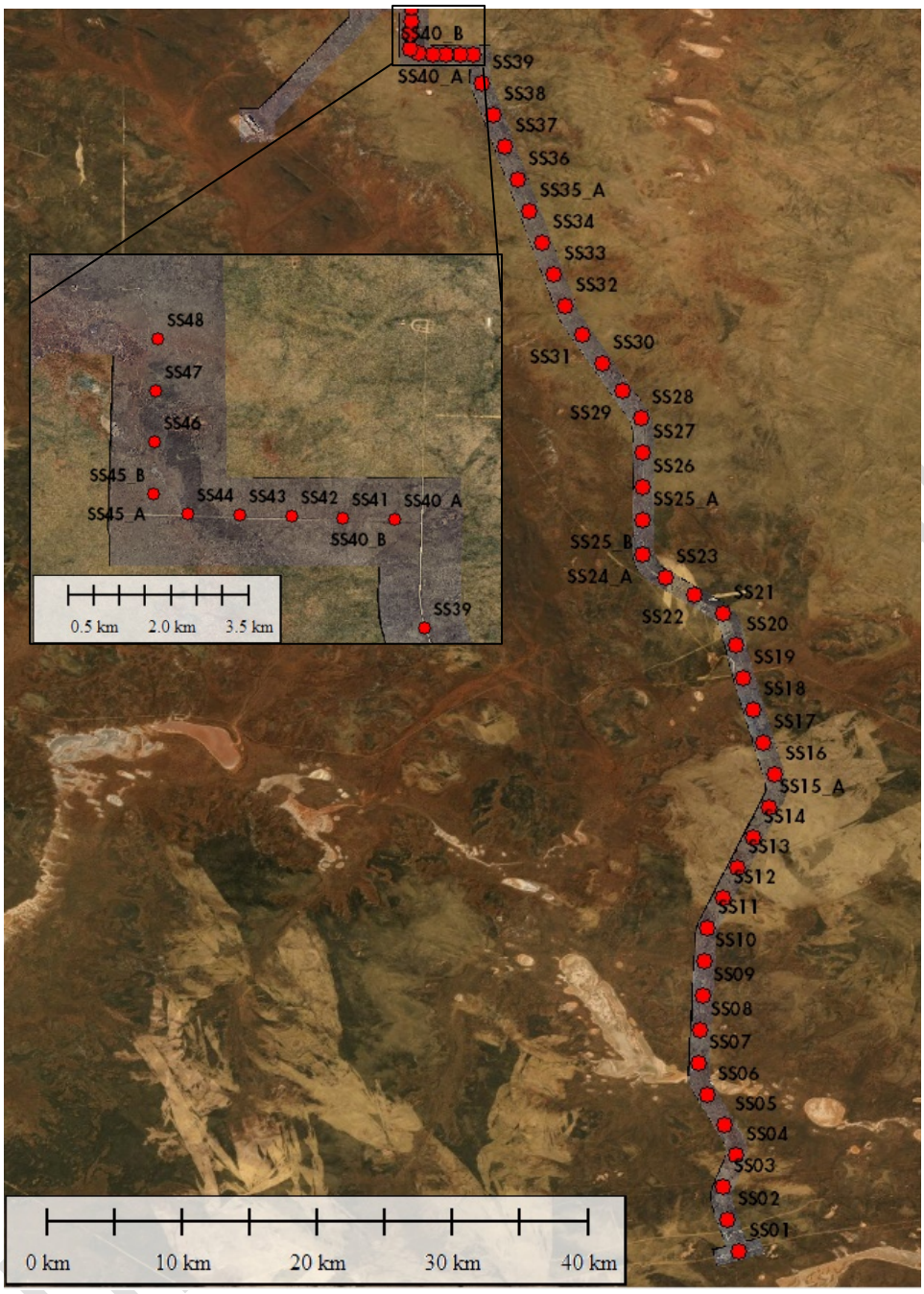


Figure 6: Sampling locations for Heavy Metals testing – January 2020 campaign

3.3 Asbestos

Classification scheme

Asbestos was assessed using a qualitative identification of fibre type by stereo microscope examination and polarised light microscopy. From this assessment, a concentration of fibres is measured. Where fibres are found, further investigation would be warranted.

Results

A total of 31 samples and 5 duplicate samples were assessed for Asbestos across both sampling campaigns. Asbestos test sample locations for the Facility area and the access roads are shown in Figures 7 and 8 respectively[5].

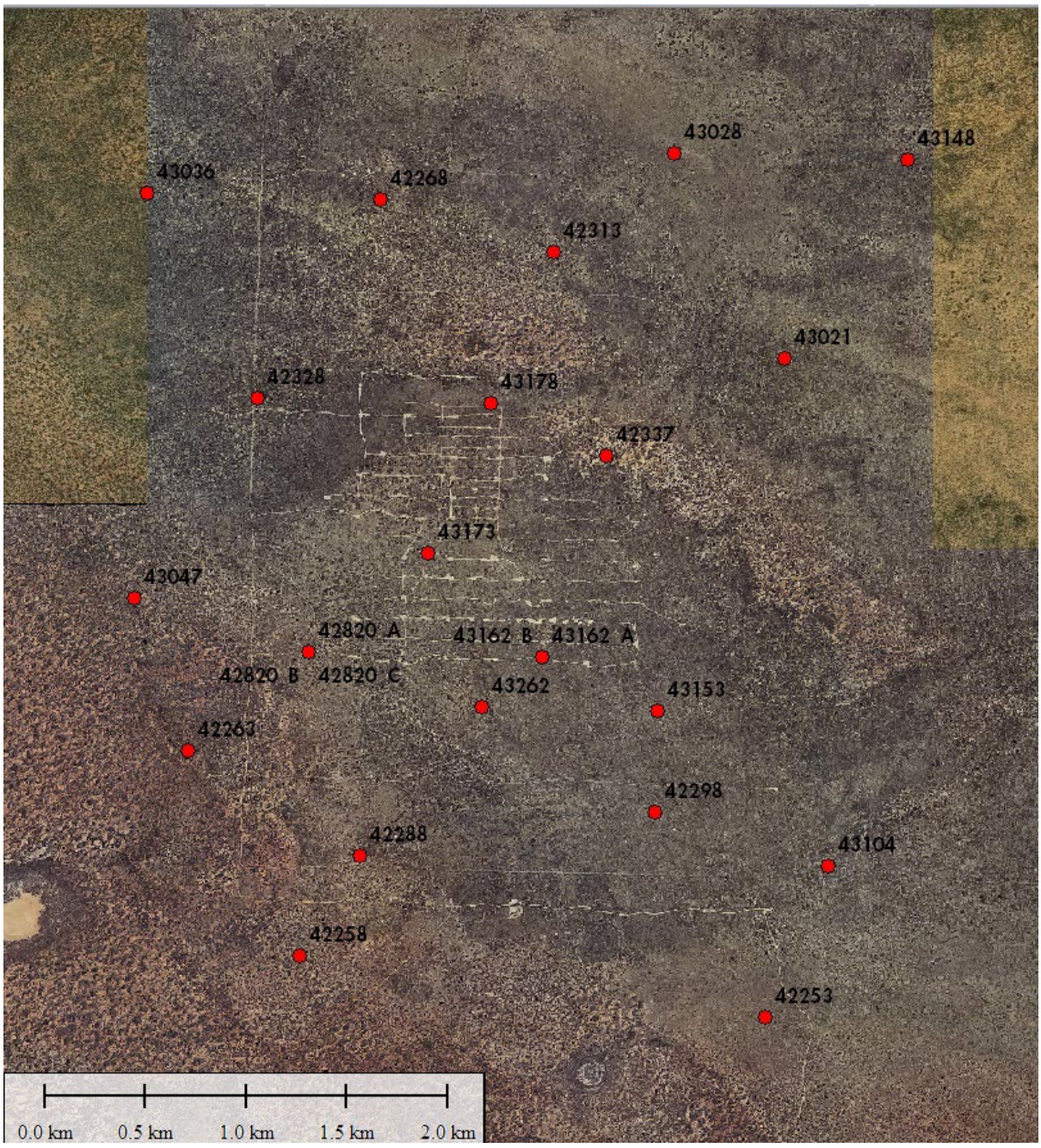


Figure 7: Sampling locations for Asbestos testing– April 2019 campaign

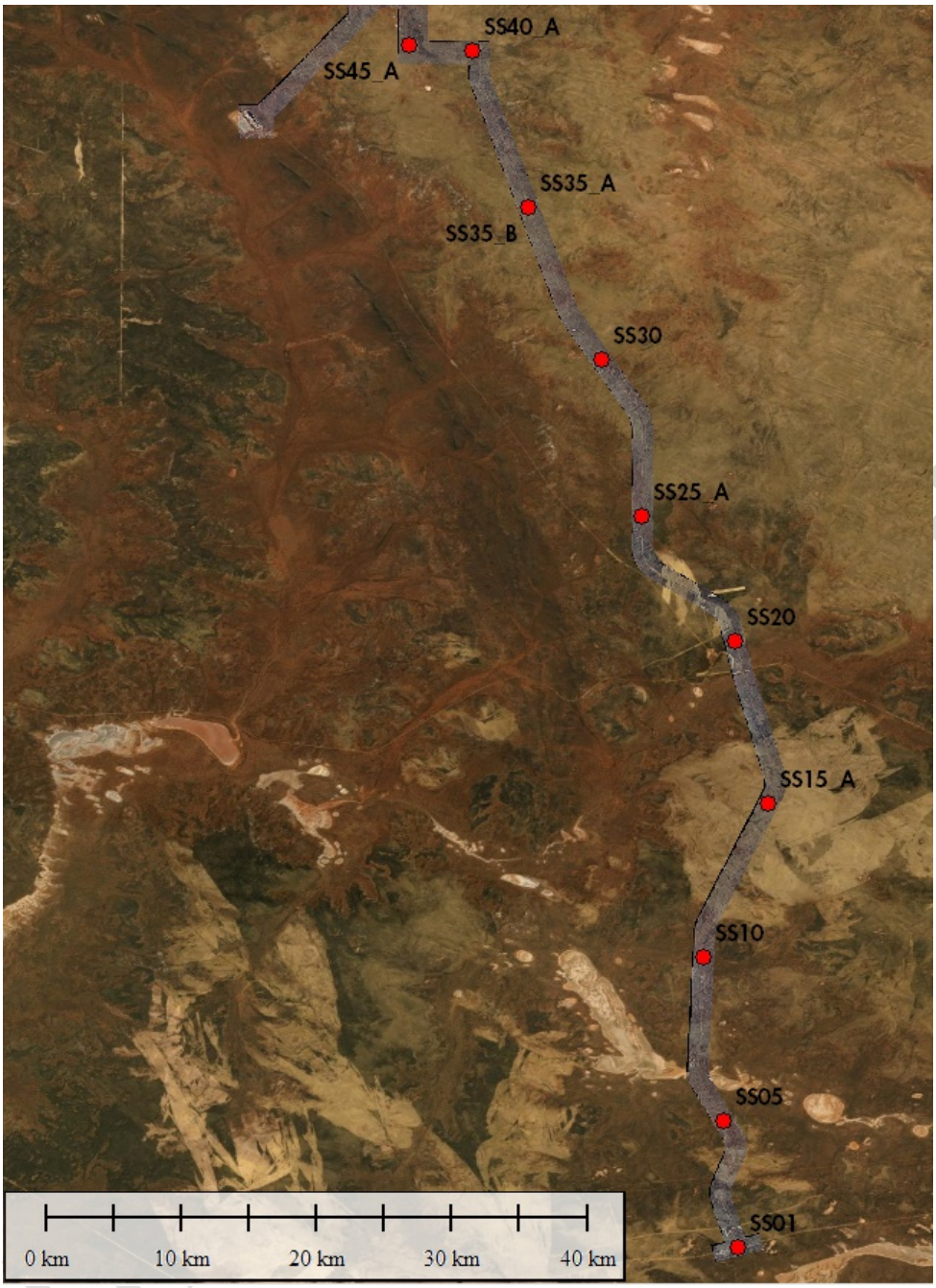


Figure 8: Sampling locations for Asbestos testing – January 2020 campaign

All samples and their duplicates were found to have Asbestos values below the limit of reporting (<0.1g/kg). Asbestos was further tested at a lower limit of reporting (<0.01g/kg) for two samples (42820_C and 43162_C). Asbestos levels for these samples were found to be below this lower reporting limit. Based on these results, the likelihood of Asbestos exposure at both the Facility and the access roads is considered low.

3.4 PCB

Classification scheme

PCB contamination is not commonly considered in soils and is more commonly assessed in waters and sediments. To assist in assessing the suitability of the PCB concentrations found in the soils at the Sandy Ridge Project, a maximum concentration of 1mg/kg was adopted. This is consistent with the definition of uncontaminated fill found in the *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)*[8].

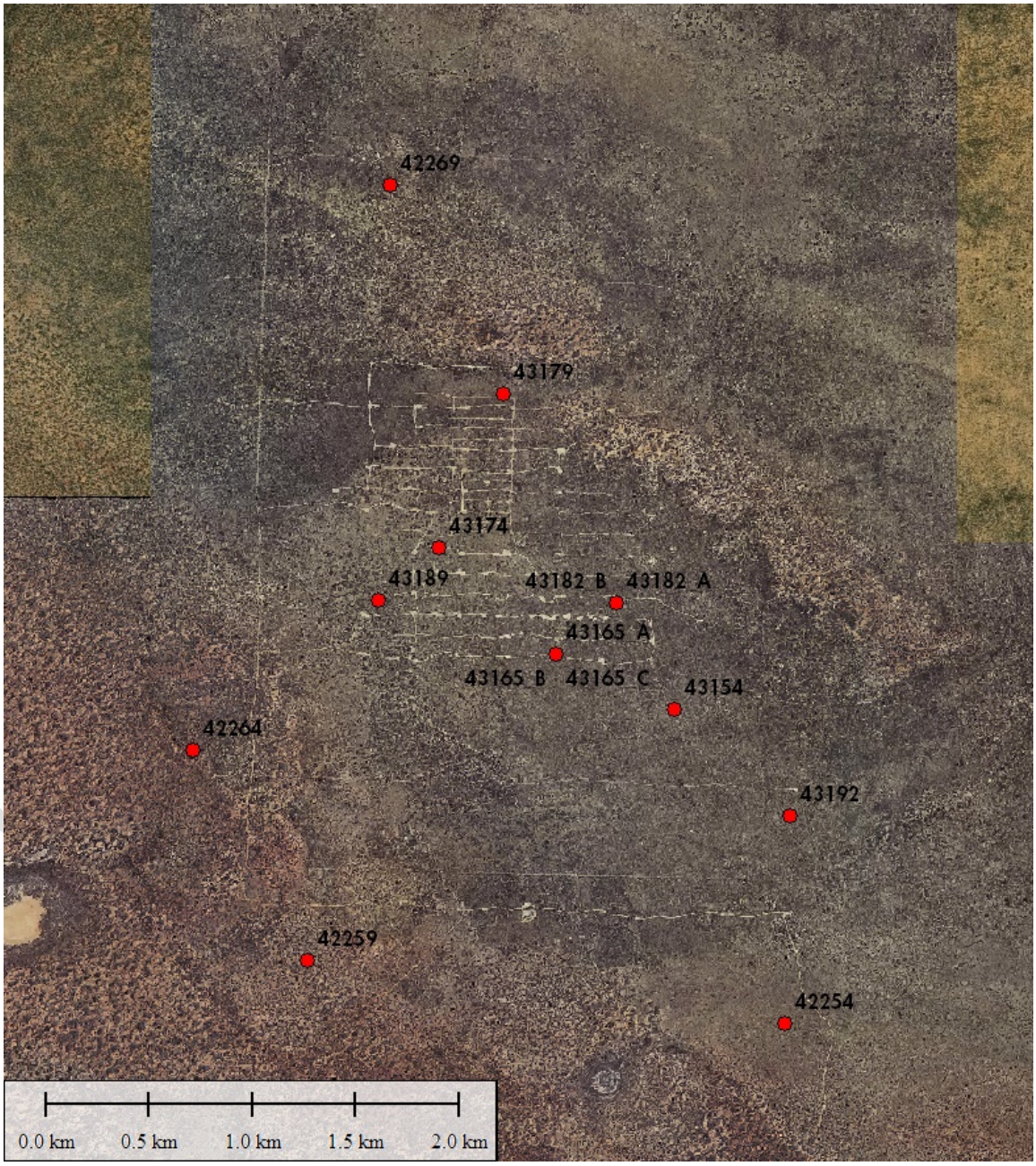


Figure 9: Sampling locations for PCB testing– April 2019 campaign

[8] Department of Water and Environmental Regulation (2019) *Landfill Waste Classification and Waste Definitions 1996 (as amended 2019)*, State of Western Australia.

Results

A total of 21 samples and 5 duplicate samples were assessed for PCB across both sampling campaigns. PCB testing sample locations for the Facility area and access roads are shown in Figures 9 and 10 respectively[5].

All 26 samples have PCB concentrations below the limit of reporting (0.2mg/kg) and could be considered uncontaminated with PCBs. Based on these results, the levels of PCBs at both the Facility and the access roads is considered low.

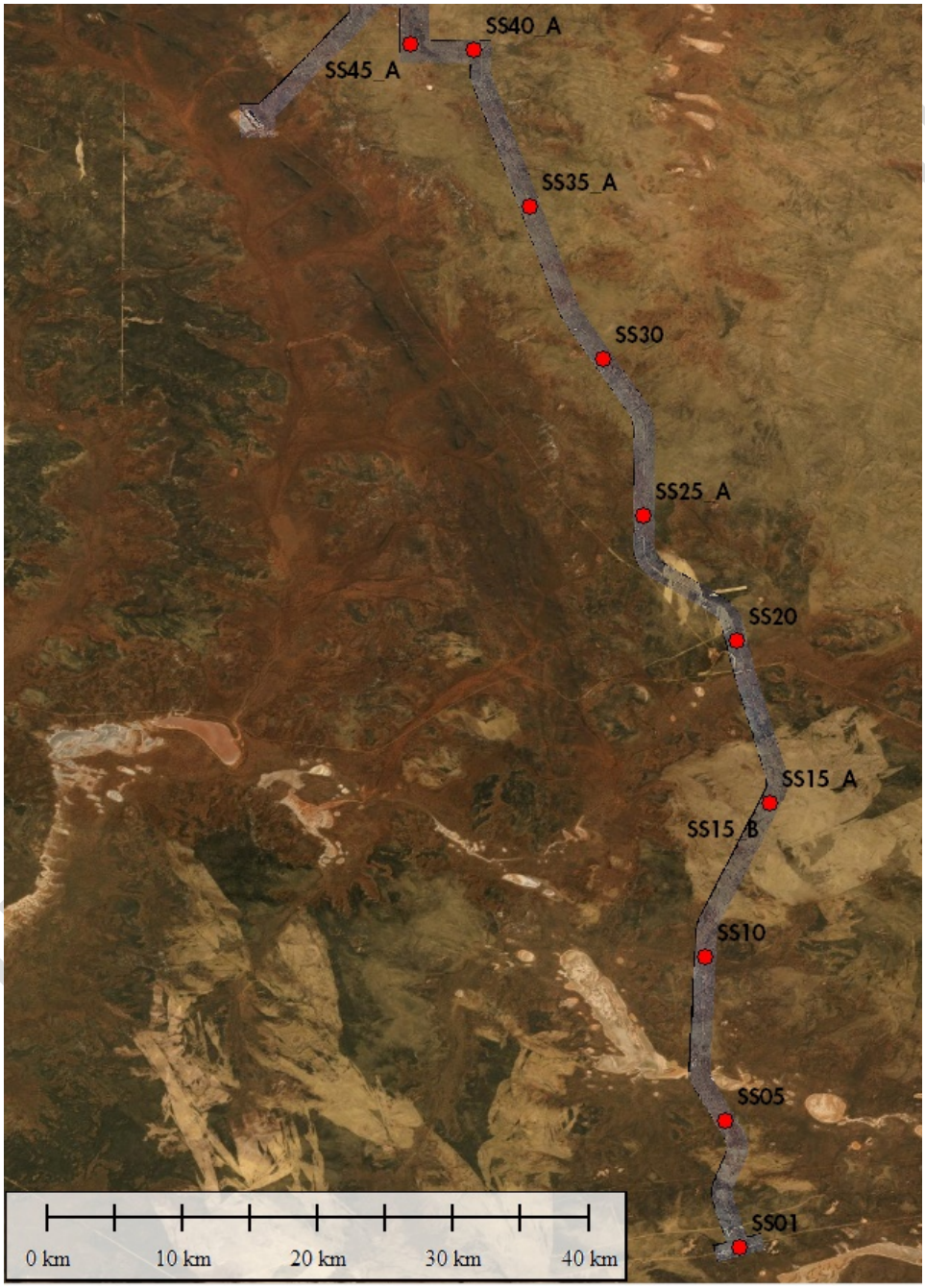


Figure 10: Sampling locations for PCB testing – January 2020 campaign

3.5 PFAS

Classification scheme

The PFAS values for the Sandy Ridge Project were compared against interim screening levels found in the *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)*[9]. The interim screening levels can be used to indicate whether PFAS is likely to be a contamination issue for the site and to inform subsequent investigations is required. The following health-based screening levels are given:

- 4mg/kg of PFHxS+PFOS & 40mg/kg for PFOA for residential land; and
- 100mg/kg of PFHxS+PFOS & 1,000mg/kg for PFOA for commercial/industrial land.

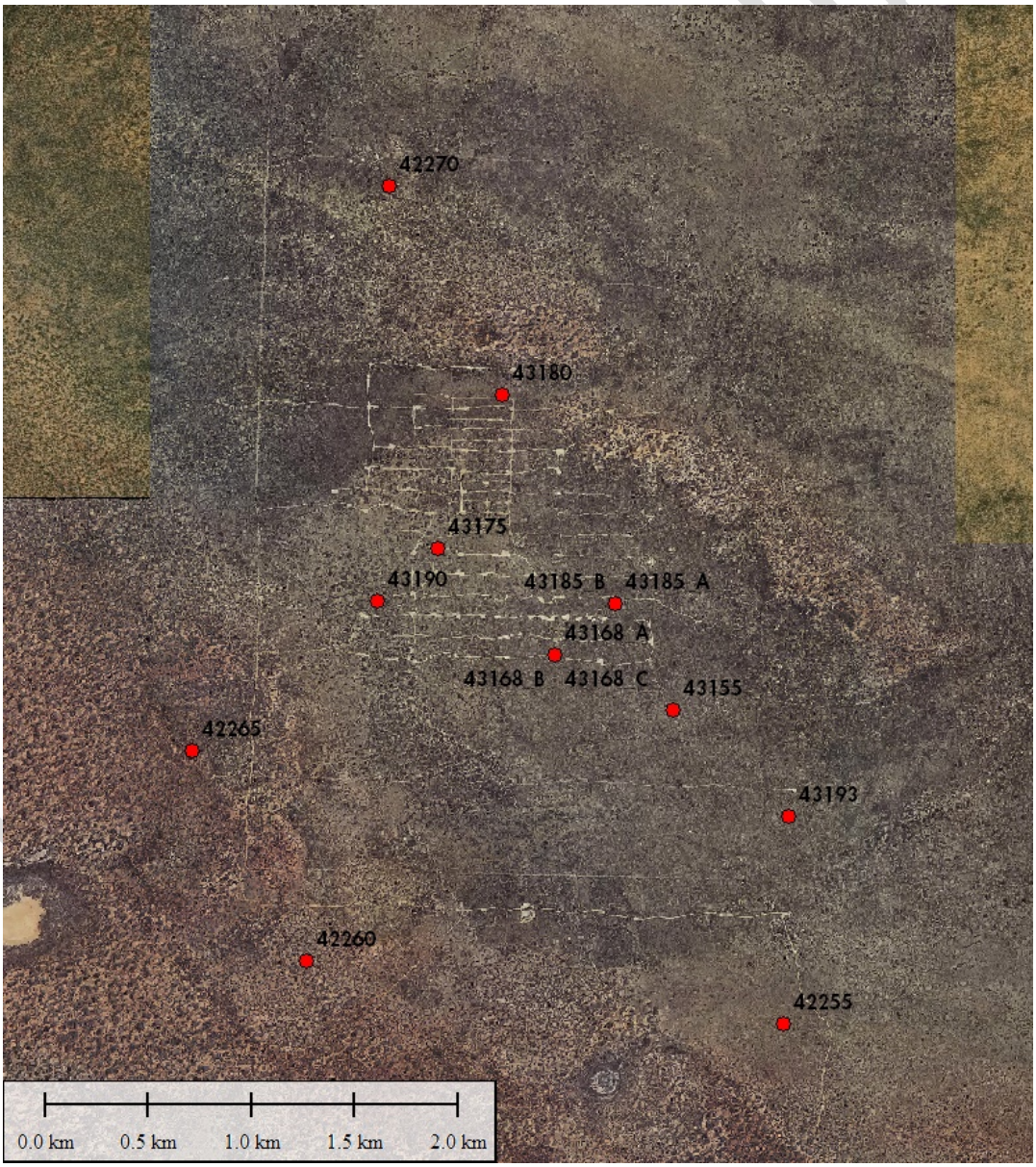


Figure 11: Sampling locations for PFAS testing– April 2019 campaign

[9] WA Department of Environment and Regulation (2017) *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)*, State of Western Australia.

Results

A total of 21 samples and 5 duplicate samples were assessed for the PFAS suite of tests. PFAS testing sample locations for the Facility area are shown in Figure 11. PFAS testing sample locations for the access roads are shown in Figure 12[5].

The maximum value of the sum of PFHxS and PFOS for all samples and their duplicates was 0.0012mg/kg. The vast majority (23 of the 26 samples) had values below the limit of reporting (0.0004mg/kg). All 26 samples had PFOA values below the limit of reporting (0.0002mg/kg). Based on these results, PFAS contamination at both the Facility and the access roads is not considered to be an issue that warrants further investigation at this time.

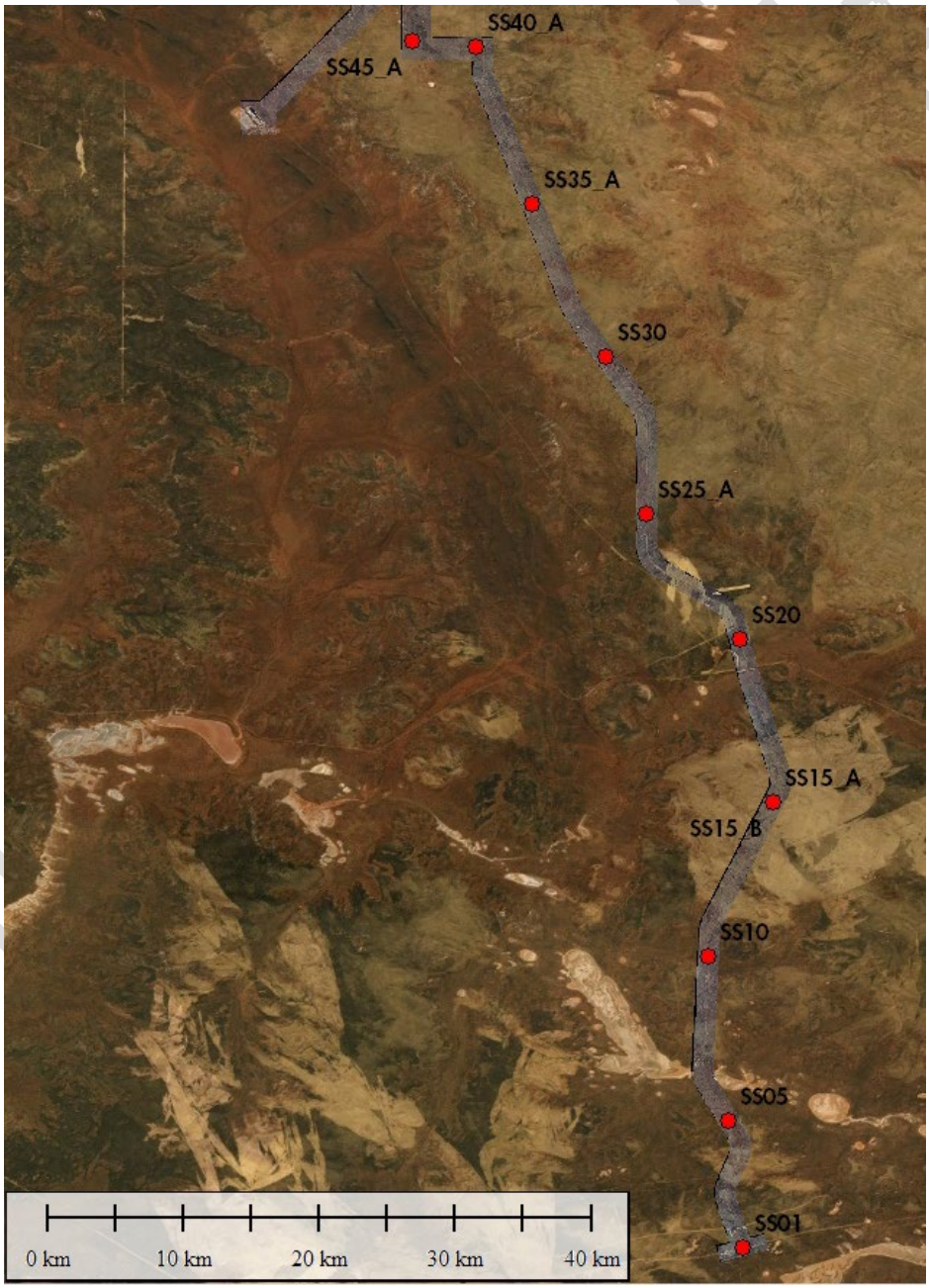


Figure 12: Sampling locations for PFAS testing – January 2020 campaign

3.6 Radionuclides

The Radionuclides suite includes testing the radiation activity for Americium-241 (Am 241), Caesium-137 (Cs 137), Cobalt-60 (Co 60), Strontium-90 (Sr 90), and Radium-226 (Ra 226). Radionuclide testing sample locations for the Facility area are shown in Figure 13. No data for the January 2020 sampling campaign is currently available. The full set of data are given in Attachment 3. A summary of the data is given in Table 9. An interpretation of the data will be provided in the final report once all these data are available.

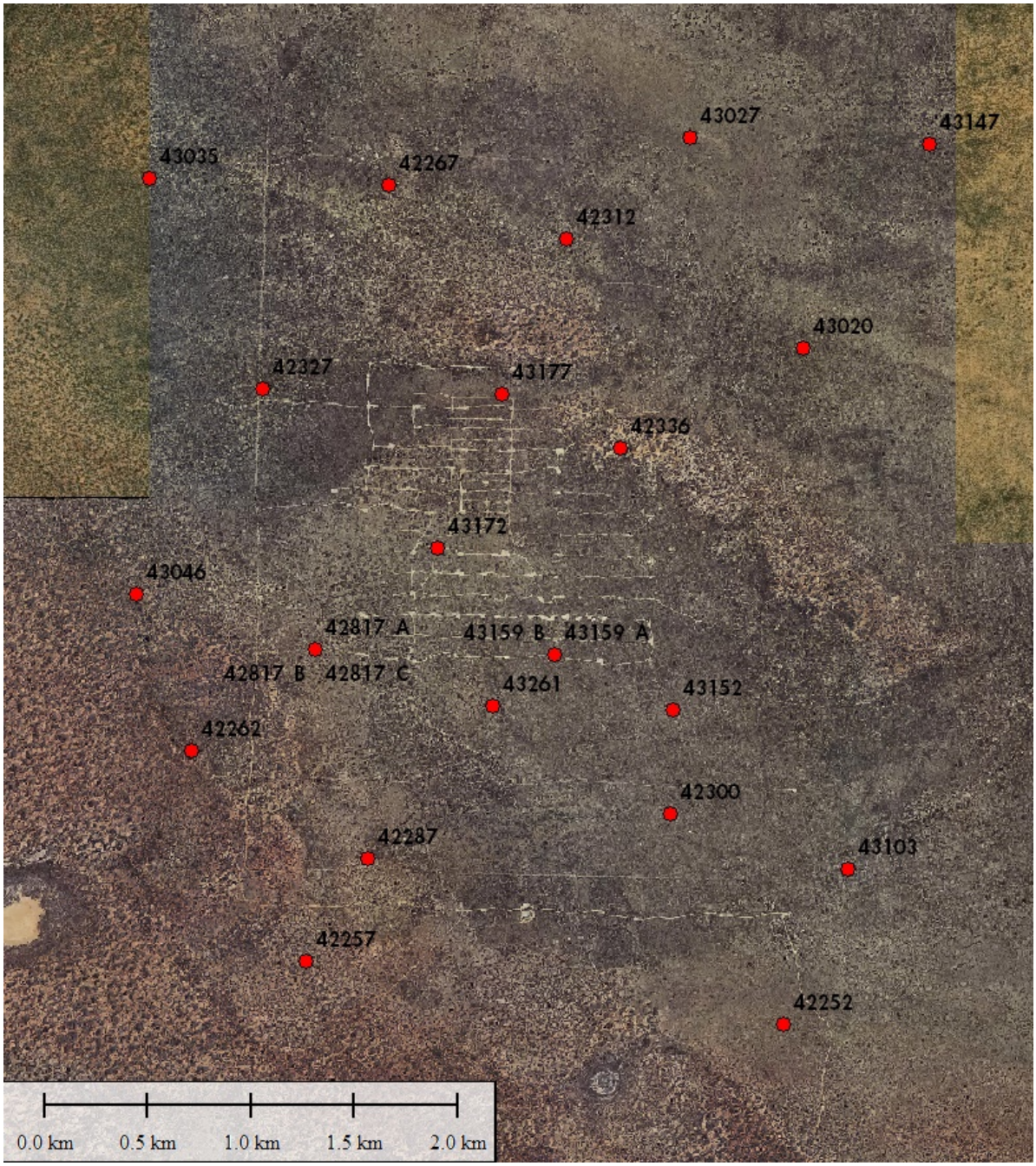


Figure 13: Sampling locations for Radionuclides testing– April 2019 campaign

Table 9: Summary of Radionuclide testing for the April 2019 campaign samples only.

Analyte	Unit	Min	Max	Median
Am 241	Bq/kg	<1	<1	<1
Cs 137	Bq/kg	<1	14.2	<1
Co 60	Bq/kg	<1	<1	<1
Sr 90	Bq/kg	<1	<1	<1
Ra 226	Bq/kg	<1	66	9.6

4. Closing

This memorandum serves as an interim audit report of the soils data collected from the Sandy Ridge Project Facility and access road areas. The data contained herein indicate that no considerable risks to soils currently exist at the Facility, the Mt Walton Access Road, or the Sandy Ridge Facility Access Road.

This excludes consideration of the radionuclides, because as the time of writing this memorandum, the radionuclide data is incomplete and has not yet been interpreted. Additional radionuclide data and an interpretation of all the radionuclide data will be included in the final report.

A final report will be provided containing discussion on the scope of work, detail on the sampling methodologies, the complete set of laboratory results, images of each sampling site, and a copy of all laboratory analysis certificates.

Regards

Evan Howard
Principal Consultant

Attachment 1: Regional location map
Attachment 2: Sample testing suite summary
Attachment 3: Sample characterisation data

Interim Results

Interim Results

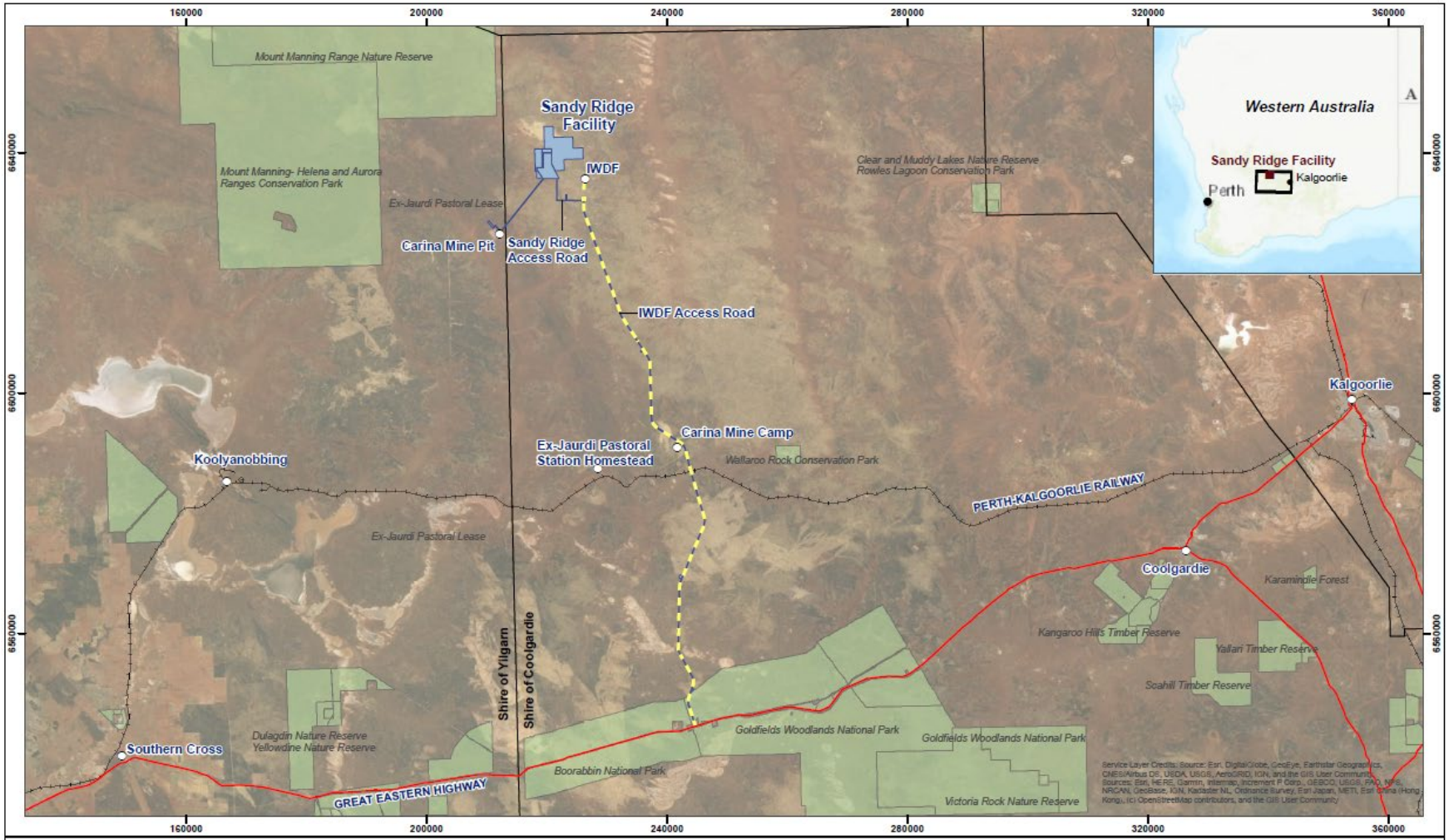
Disclaimer

All care and diligence has been exercised in testing, interpreting data and the development of recommendations presented in this document. The monitoring and testing have been undertaken in a skilled, professional manner, according to accepted practices. Specific circumstances and research findings after the date of publication may influence the accuracy of the data and recommendations within this document.

The landscape is not uniform. Because of this non-uniformity, no monitoring, testing or sampling technique can produce completely precise results for any site. Any conclusions based on the monitoring and/or testing presented in this document can therefore only serve as a 'best' indication of the environmental condition of the site at the time of preparing this document. It should be noted that site conditions can change with time.

The information that comprises this document should only be used within the limitations stipulated herein. Landloch does not accept any risks and responsibilities for losses, damages, costs and other consequences resulting from using any information, material and recommendations in this document.

Attachment 1: Sandy Ridge Project regional location (Source: Tellus Holdings Ltd).



Attachment 2: Summary of samples collected and the test suites to which each sample was subjected.

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
April 2019 Sampling – Within Crown Lease Boundary Near Facility									
43267	219,309	6,635,859							-
43268	219,555	6,635,858							-
43270	219,808	6,635,857							-
43273	220,058	6,635,859							-
43275	220,308	6,635,859							-
43052	220,558	6,635,860							-
43277	220,810	6,635,860							-
43311	221,058	6,635,860							-
42251	221,308	6,635,860							-
42252	221,308	6,635,860							-
42253	221,308	6,635,860							-
42254	221,308	6,635,860							-
42255	221,308	6,635,860							-
43308_A	221,558	6,635,860							Triplicate – Heavy Metals, Inorganics
43308_B	221,558	6,635,860							
43308_C	221,558	6,635,860							
43307	221,808	6,635,860							-
42256	219,308	6,636,110							-
42257	219,308	6,636,110							-
42258	219,308	6,636,110							-
42259	219,308	6,636,110							-
42260	219,308	6,636,110							-
43269	219,557	6,636,111							-
43271	219,807	6,636,110							-
43272	220,058	6,636,111							-
43274	220,308	6,636,110							-

Interim Report

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
43051	220,558	6,636,110							-
43276	220,806	6,636,110							-
43278	221,058	6,636,112							-
43304_A	221,308	6,636,110							Triplicate – Heavy Metals, Inorganics
43304_B	221,308	6,636,110							
43304_C	221,308	6,636,110							
43303	221,559	6,636,110							-
43302	221,808	6,636,111							-
42282	219,055	6,636,361							-
42281	219,309	6,636,358							-
42280	219,560	6,636,361							-
42279	219,811	6,636,358							-
42278	220,058	6,636,359							-
42277	220,308	6,636,363							-
42276	220,558	6,636,360							-
42273_A	220,809	6,636,358							Triplicate – Heavy Metals, Inorganics
42273_B	220,809	6,636,358							
42273_C	220,809	6,636,358							
42272	221,062	6,636,355							-
42271	221,308	6,636,360							-
43301	221,558	6,636,360							-
42283	218,808	6,636,608							-
42284	219,058	6,636,609							-
42285	219,308	6,636,609							-
42286	219,557	6,636,613							-
42287	219,557	6,636,613							-
42288	219,557	6,636,613							-
42289	219,807	6,636,610							-

Interim Re

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42290	220,058	6,636,611							-
42291_A	220,307	6,636,610							Triplicate – Heavy Metals, Inorganics
42291_B	220,307	6,636,610							
42291_C	220,307	6,636,610							
42294	220,554	6,636,611							-
42295	220,806	6,636,608							-
42296	221,056	6,636,610							-
43101	221,308	6,636,610							-
43102	221,558	6,636,610							-
43103	221,558	6,636,610							-
43104	221,558	6,636,610							-
42841	218,559	6,636,862							-
42840	218,813	6,636,858							-
42812	219,057	6,636,859							-
42811	219,308	6,636,862							-
42808_A	219,559	6,636,858							Triplicate – Heavy Metals, Inorganics
42808_B	219,559	6,636,858							
42808_C	219,559	6,636,858							
42807	219,807	6,636,862							-
42806	220,056	6,636,859							-
42805	220,310	6,636,860							-
42804	220,558	6,636,861							-
42298	220,808	6,636,861							-
42299	220,808	6,636,861							-
42300	220,808	6,636,861							-
42297	221,057	6,636,860							-
43191	221,304	6,636,860							-
43192	221,304	6,636,860							-

Interim Re

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
43193	221,304	6,636,860							-
42846	218,309	6,637,106							-
42842	218,558	6,637,110							-
42261	218,806	6,637,110							-
42262	218,806	6,637,110							-
42263	218,806	6,637,110							-
42264	218,806	6,637,110							-
42265	218,806	6,637,110							-
42847	219,058	6,637,107							-
42848	219,307	6,637,111							-
42849	219,559	6,637,112							-
42850	219,810	6,637,110							-
43251	220,057	6,637,111							-
43252	220,308	6,637,108							-
43253	220,557	6,637,111							-
43254	220,809	6,637,109							-
43255	221,059	6,637,111							-
43108_A	221,308	6,637,110							Triplicate – Heavy Metals, Inorganics
43108_B	221,308	6,637,110							
43108_C	221,308	6,637,110							
43105	221,808	6,637,110							-
42845	218,308	6,637,361							-
42843	218,559	6,637,360							-
42844	218,808	6,637,360							-
43265	219,061	6,637,362							-
43266	219,308	6,637,361							-
43264	219,558	6,637,359							-
43263	219,806	6,637,357							-

Interim Report

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
43260	220,059	6,637,360							-
43261	220,059	6,637,360							-
43262	220,059	6,637,360							-
43257_A	220,306	6,637,359							Triplicate – Heavy Metals, Inorganics
43257_B	220,306	6,637,359							
43257_C	220,306	6,637,359							
43256	220,558	6,637,360							-
43151	220,807	6,637,362							-
43152	220,807	6,637,362							-
43153	220,807	6,637,362							-
43154	220,807	6,637,362							-
43155	220,807	6,637,362							-
42346	221,058	6,637,360							-
43012	221,308	6,637,360							-
43111	221,808	6,637,360							-
43050	218,308	6,637,610							-
43049	218,558	6,637,610							-
43279	218,808	6,637,610							-
42813	219,059	6,637,607							-
42814_A	219,308	6,637,610							Triplicate – Heavy Metals, Inorganics
42814_B	219,308	6,637,610							
42814_C	219,308	6,637,610							
42817_A	219,308	6,637,610							Triplicate – Radionuclides
42817_B	219,308	6,637,610							
42817_C	219,308	6,637,610							
42820_A	219,308	6,637,610							Triplicate – Asbestos
42820_B	219,308	6,637,610							
42820_C	219,308	6,637,610							

Interim Results

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42823	219,554	6,637,609							-
42824	219,808	6,637,611							-
43156_A	220,308	6,637,614							Triplicate – Heavy Metals, Inorganics
43156_B	220,308	6,637,614							
43156_C	220,308	6,637,614							
43159_A	220,308	6,637,614							Triplicate – Radionuclides
43159_B	220,308	6,637,614							
43159_C	220,308	6,637,614							
43162_A	220,308	6,637,614							Triplicate – Asbestos
43162_B	220,308	6,637,614							
43162_C	220,308	6,637,614							
43165_A	220,308	6,637,614							Triplicate – PCB
43165_B	220,308	6,637,614							
43165_C	220,308	6,637,614							
43168_A	220,308	6,637,614							Triplicate – PFAS
43168_B	220,308	6,637,614							
43168_C	220,308	6,637,614							
42825	220,557	6,637,610							-
42826	220,808	6,637,609							-
42347	221,058	6,637,610							-
43013	221,308	6,637,610							-
43114	221,808	6,637,610							-
43044_A	218,558	6,637,860							Triplicate – Heavy Metals, Inorganics
43044_B	218,558	6,637,860							
43044_C	218,558	6,637,860							
43046	218,558	6,637,860							-
43047	218,558	6,637,860							-
42345	219,058	6,637,860							-

Interim Results

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
43188	219,559	6,637,855							-
43189	219,559	6,637,855							-
43190	219,559	6,637,855							-
42827	219,808	6,637,862							-
42828	220,056	6,637,861							-
42829	220,307	6,637,859							-
43181	220,556	6,637,864							-
43182_A	220,556	6,637,864							Triplicate – PCB
43182_B	220,556	6,637,864							
43182_C	220,556	6,637,864							
43185_A	220,556	6,637,864							Triplicate – PFAS
43185_B	220,556	6,637,864							
43185_C	220,556	6,637,864							
42830	220,808	6,637,859							-
42348	221,058	6,637,860							-
43014	221,308	6,637,860							-
43117_A	221,808	6,637,860							Triplicate – Heavy Metals, Inorganics
43117_B	221,808	6,637,860							
43117_C	221,808	6,637,860							
43043	218,558	6,638,110							-
42344	219,056	6,638,110							-
42831	219,557	6,638,110							-
43171	219,807	6,638,112							-
43172	219,807	6,638,112							-
43173	219,807	6,638,112							-
43174	219,807	6,638,112							-
43175	219,807	6,638,112							-
42832	220,057	6,638,110							-

Interim Results

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42834	220,308	6,638,110							-
42833	220,557	6,638,110							-
42350	220,808	6,638,110							-
43015	221,308	6,638,110							-
43120_A	221,808	6,638,110							Triplicate – Heavy Metals, Inorganics
43120_B	221,808	6,638,110							
43120_C	221,808	6,638,110							
43042	218,558	6,638,360							-
42343	219,057	6,638,360							-
42839	219,558	6,638,360							-
42838	219,808	6,638,360							-
42837	220,058	6,638,360							-
42836	220,308	6,638,360							-
42835	220,555	6,638,361							-
42349	220,808	6,638,360							-
43016	221,308	6,638,360							-
43123_A	221,808	6,638,360							Triplicate – Heavy Metals, Inorganics
43123_B	221,808	6,638,360							
43123_C	221,808	6,638,360							
43041	218,558	6,638,610							-
42342	219,058	6,638,610							-
42341	219,559	6,638,610							-
42340	219,808	6,638,613							-
42339	220,058	6,638,613							-
42338	220,308	6,638,610							-
42335	220,558	6,638,610							-
42336	220,558	6,638,610							-
42337	220,558	6,638,610							-

Interim Re

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42334	220,808	6,638,610							-
43017	221,308	6,638,610							-
43126_A	221,808	6,638,610							Triplicate – Heavy Metals, Inorganics
43126_B	221,808	6,638,610							
43126_C	221,808	6,638,610							
42326	219,058	6,638,860							-
42327	219,058	6,638,860							-
42328	219,058	6,638,860							-
42329	219,558	6,638,860							-
42330	219,808	6,638,860							-
43176	220,058	6,638,860							-
43177	220,058	6,638,860							-
43178	220,058	6,638,860							-
43179	220,058	6,638,860							-
43180	220,058	6,638,860							-
42331	220,308	6,638,860							-
42332	220,558	6,638,859							-
42333	220,808	6,638,860							-
43018	221,308	6,638,860							-
43129_A	221,808	6,638,860							Triplicate – Heavy Metals, Inorganics
43129_B	221,808	6,638,860							
43129_C	221,808	6,638,860							
43039	218,558	6,639,110							-
42325	219,058	6,639,110							-
42324	219,560	6,639,108							-
42321	219,805	6,639,111							-
42318	220,058	6,639,110							-
42315	220,308	6,639,112							-

Interim Res

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42310	220,558	6,639,114							-
42307	220,807	6,639,111							-
43019	221,308	6,639,110							-
43020	221,308	6,639,110							-
43021	221,308	6,639,110							-
43132_A	221,808	6,639,110							Triplicate – Heavy Metals, Inorganics
43132_B	221,808	6,639,110							
43132_C	221,808	6,639,110							
43038	218,558	6,639,360							-
42304	219,058	6,639,360							-
42323	219,558	6,639,360							-
42320	219,808	6,639,362							-
42317	220,056	6,639,361							-
42314	220,310	6,639,360							-
42309	220,558	6,639,360							-
42306	220,808	6,639,360							-
43022	221,308	6,639,360							-
43135_A	221,808	6,639,360							Triplicate – Heavy Metals, Inorganics
43135_B	221,808	6,639,360							
43135_C	221,808	6,639,360							
43037	218,558	6,639,610							-
42303	219,056	6,639,609							-
42322	219,558	6,639,610							-
42319	219,810	6,639,610							-
42316	220,058	6,639,610							-
42311	220,308	6,639,610							-
42312	220,308	6,639,610							-
42313	220,308	6,639,610							-

Interim Report

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
42308	220,558	6,639,607							-
42305	220,805	6,639,610							-
43023	221,308	6,639,610							-
43138_A	221,808	6,639,610							Triplicate – Heavy Metals, Inorganics
43138_B	221,808	6,639,610							
43138_C	221,808	6,639,610							
43034	218,558	6,639,860							-
43035	218,558	6,639,860							-
43036	218,558	6,639,860							-
42302	219,058	6,639,860							-
42266	219,561	6,639,856							-
42267	219,561	6,639,856							-
42268	219,561	6,639,856							-
42269	219,561	6,639,856							-
42270	219,561	6,639,856							-
43198	219,808	6,639,860							-
43197	220,058	6,639,860							-
43196	220,308	6,639,859							-
43030	220,558	6,639,860							-
43029	220,808	6,639,860							-
43024	221,308	6,639,860							-
43141_A	221,808	6,639,860							Triplicate – Heavy Metals, Inorganics
43141_B	221,808	6,639,860							
43141_C	221,808	6,639,860							
43033	218,558	6,640,110							-
42301	219,060	6,640,111							-
43200	219,558	6,640,110							-
43199	219,807	6,640,110							-

Interim Report

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
43195	220,058	6,640,111							-
43194	220,307	6,640,110							-
43031	220,558	6,640,110							-
43026	220,808	6,640,110							-
43027	220,808	6,640,110							-
43028	220,808	6,640,110							-
43025	221,308	6,640,110							-
43144_A	221,808	6,640,110							Triplicate – Heavy Metals, Inorganics
43144_B	221,808	6,640,110							
43144_C	221,808	6,640,110							
43147	221,808	6,640,110							-
43148	221,808	6,640,110							-
43032	218,558	6,640,360							-
43009	219,058	6,640,360							-
43008	219,558	6,640,360							-
43007	219,808	6,640,360							-
43006	220,058	6,640,360							-
43005	220,308	6,640,360							-
43004	220,558	6,640,360							-
43003	220,808	6,640,360							-
43002	221,308	6,640,360							-
43001_A	221,808	6,640,360							Triplicate – Heavy Metals, Inorganics
43001_B	221,808	6,640,360							
43001_C	221,808	6,640,360							
January 2020 Sampling – Mt Walton Access Road and Sandy Ridge Facility Access Road									
SS01	244,691	6,544,663							-
SS02	243,932	6,547,002							-
SS03	243,603	6,549,396							-

Interim Report

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
SS04	244,373	6,551,714							-
SS05	243,583	6,553,961							-
SS06	242,428	6,556,071							-
SS07	241,857	6,558,399							-
SS08	241,906	6,560,891							-
SS09	241,959	6,563,384							-
SS10	242,011	6,565,876							-
SS11	242,127	6,568,359							-
SS12	243,044	6,570,605							-
SS13	243,975	6,572,845							-
SS14	244,905	6,575,086							-
SS15_A	245,835	6,577,326							Duplicate – PFAS, PCB
SS15_B	245,835	6,577,326							
SS16	246,092	6,579,688							-
SS17	245,396	6,582,053							-
SS18	244,700	6,584,418							-
SS19	244,007	6,586,784							-
SS20	243,414	6,589,186							-
SS21	242,596	6,591,460							-
SS22	240,744	6,592,735							-
SS23	238,852	6,593,942							-
SS24_A	237,396	6,595,655							Duplicate – Radionuclides
SS24_B	237,396	6,595,655							
SS25_A	237,323	6,598,146							Duplicate – Heavy Metals, Inorganics
SS25_B	237,323	6,598,146							
SS26	237,261	6,600,639							-
SS27	237,198	6,603,132							-
SS28	237,024	6,605,605							-

Interim Re

Sample ID	Easting (m)	Northing (m)	Testing Suite						QA/QC Duplicate
			Asbestos	PFAS	PCB	Heavy Metals	Inorganics	Radionuclides	
SS29	235,774	6,607,643							-
SS30	234,483	6,609,651							-
SS31	233,191	6,611,659							-
SS32	232,049	6,613,765							-
SS33	231,222	6,616,075							-
SS34	230,395	6,618,385							-
SS35_A	229,569	6,620,696							Duplicate - Asbestos
SS35_B	229,569	6,620,696							
SS36	228,742	6,623,006							-
SS37	227,915	6,625,317							-
SS38	227,092	6,627,628							-
SS39	226,263	6,629,939							-
SS40_A	225,716	6,632,030							Duplicate – Heavy Metals, Inorganics
SS40_B	225,716	6,632,030							
SS41	224,852	6,632,036							-
SS42	223,987	6,632,043							-
SS43	223,122	6,632,049							-
SS44	222,258	6,632,056							-
SS45_A	221,662	6,632,414							Duplicate – Heavy Metals, Inorganics
SS45_B	221,662	6,632,414							
SS46	221,663	6,633,412							-
SS47	221,663	6,634,409							-
SS48	221,661	6,635,407							-

Interim Report

Attachment 3: Sample characterisation data.

Asbestos									
Sample ID	**Easting (m)**	**Northing (m)**	**Asbestos** g/kg *LOR 0.1*	**Asbestos** g/kg *LOR 0.01*	**Sample ID**	**Easting (m)**	**Northing (m)**	**Asbestos** g/kg *LOR 0.1*	**Asbestos** g/kg *LOR 0.01*
SS01	244,691	6,544,663	<0.1		43153	220,807	6,637,362	<0.1	
SS05	243,583	6,553,961	<0.1		42820_A	219,308	6,637,610	<0.1	
SS10	242,011	6,565,876	<0.1		42820_B	219,308	6,637,610	<0.1	
SS15_A	245,835	6,577,326	<0.1		42820_C	219,308	6,637,610	<0.1	<0.01
SS20	243,414	6,589,186	<0.1		43162_A	220,308	6,637,614	<0.1	
SS25_A	237,323	6,598,146	<0.1		43162_B	220,308	6,637,614	<0.1	
SS30	234,483	6,609,651	<0.1		43162_C	220,308	6,637,614	<0.1	<0.01
SS35_A	229,569	6,620,696	<0.1		43047	218,558	6,637,860	<0.1	
SS35_B	229,569	6,620,696	<0.1		43173	219,807	6,638,112	<0.1	
SS40_A	225,716	6,632,030	<0.1		42337	220,558	6,638,610	<0.1	
SS45_A	221,662	6,632,414	<0.1		42328	219,058	6,638,860	<0.1	
42253	221,308	6,635,860	<0.1		43178	220,058	6,638,860	<0.1	
42258	219,308	6,636,110	<0.1		43021	221,308	6,639,110	<0.1	
42288	219,557	6,636,613	<0.1		42313	220,308	6,639,610	<0.1	
43104	221,558	6,636,610	<0.1		43036	218,558	6,639,860	<0.1	
42298	220,808	6,636,861	<0.1		42268	219,561	6,639,856	<0.1	
42263	218,806	6,637,110	<0.1		43028	220,808	6,640,110	<0.1	
43262	220,059	6,637,360	<0.1		43148	221,808	6,640,110	<0.1	

Interim Results

PFAS									
Sample ID			SS01	SS05	SS10	SS15_A	SS15_B	SS20	SS25_A
Easting (m)			244,691	243,583	242,011	245,835	245,835	243,414	237,323
Northing (m)			6,544,663	6,553,961	6,565,876	6,577,326	6,577,326	6,589,186	6,598,146
PFBA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
PFPeA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFHxA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFHpA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
PFOA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFNA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFUnDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFDoDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFTrDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFTeDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFBS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFPeS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFHxS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFHpS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFOS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFDS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
4:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
6:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
8:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
10:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Me-FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Et-FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004

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Me-FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Et-FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
N-Me-FOSE	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
N-Et-FOSE	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
Σ PFAS	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFHxS+PFOS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Σ PFAS (DER)	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

PFAS									
Sample ID			SS30	SS35_A	SS40_A	SS45_A	42255	42260	43193
Easting (m)			234,483	229,569	225,716	221,662	221,308	219,308	221,304
Northing (m)			6,609,651	6,620,696	6,632,030	6,632,414	6,635,860	6,636,110	6,636,860
PFBA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
PFPeA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFHxA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.0008	<0.0004	0.0015
PFHpA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
PFOA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PFNA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFUnDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFDoDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFTrDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFTeDA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
PFBS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFPeS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
PFHxS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFHpS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
PFOS	mg/kg	0.0004	<0.0004	0.0012	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
PFDS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
4:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Preliminary

6:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
8:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
10:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
Me-FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
Et-FOSA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
Me-FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
Et-FOSAA	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004			
N-Me-FOSE	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008			
N-Et-FOSE	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008			
Σ PFAS	mg/kg	0.0002	<0.0002	0.0012	<0.0002	<0.0002	0.0008	<0.0002	0.0015
PFHxS+PFOS	mg/kg	0.0004	<0.0004	0.0012	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Σ PFAS (DER)	mg/kg	0.0002	<0.0002	0.0012	<0.0002	<0.0002	0.0008	<0.0002	0.0015

PFAS									
Sample ID			42265	43155	43168_A	43168_B	43168_C	43190	43185_A
Easting (m)			218,806	220,807	220,308	220,308	220,308	219,559	220,556
Northing (m)			6,637,110	6,637,362	6,637,614	6,637,614	6,637,614	6,637,855	6,637,864
PFBA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0005	<0.0008	<0.0008
PFPeA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0002
PFHxA	mg/kg	0.0004	<0.0004	0.0009	0.0007	0.0006	<0.0005	0.0005	0.0009
PFHpA	mg/kg	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0005	<0.0008	<0.0008
PFOA	mg/kg	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0005	<0.0002	<0.0002
PFNA	mg/kg	0.0002							
PFDA	mg/kg	0.0002							
PFUnDA	mg/kg	0.0002							
PFDoDA	mg/kg	0.0002							
PFTrDA	mg/kg	0.0002							
PFTeDA	mg/kg	0.0002							

Interim Results

PFBS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0005	<0.0004	<0.0004
PFPeS	mg/kg	0.0004							
PFHxS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0005	<0.0004	<0.0004
PFHpS	mg/kg	0.0004							
PFOS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0005	<0.0004	<0.0004
PFDS	mg/kg	0.0004							
4:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
6:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.0005	<0.0005
8:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
10:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
FOSA	mg/kg	0.0004							
Me-FOSA	mg/kg	0.0004							
Et-FOSA	mg/kg	0.0004							
FOSAA	mg/kg	0.0004							
Me-FOSAA	mg/kg	0.0004							
Et-FOSAA	mg/kg	0.0004							
N-Me-FOSE	mg/kg	0.0008							
N-Et-FOSE	mg/kg	0.0008							
Σ PFAS	mg/kg	0.0002	<0.0002	0.0009	0.0007	0.0006	<0.005	0.0005	0.0009
PFHxS+PFOS	mg/kg	0.0004	<0.0004	<0.0004	<0.0004	<0.0004		<0.0004	<0.0004
Σ PFAS (DER)	mg/kg	0.0002	<0.0002	0.0009	0.0007	0.0006	<0.001	0.0005	0.0009

PFAS							
Sample ID			43185_B	43185_C	43175	43180	42270
Easting (m)			220,556	220,556	219,807	220,058	219,561
Northing (m)			6,637,864	6,637,864	6,638,112	6,638,860	6,639,856
PFBA	mg/kg	0.0008	<0.0008	<0.0005	<0.0008	<0.0008	<0.0008
PFPeA	mg/kg	0.0002	<0.0002	<0.0005	<0.0002	<0.0002	<0.0002
PFHxA	mg/kg	0.0004	<0.0004	<0.0005	0.0007	0.0007	<0.0004
PFHpA	mg/kg	0.0008	<0.0008	<0.0005	<0.0008	<0.0008	<0.0008

Interim Results

PFOA	mg/kg	0.0002	<0.0002	<0.0005	<0.0002	<0.0002	<0.0002
PFNA	mg/kg	0.0002					
PFDA	mg/kg	0.0002					
PFUnDA	mg/kg	0.0002					
PFDoDA	mg/kg	0.0002					
PFTrDA	mg/kg	0.0002					
PFTeDA	mg/kg	0.0002					
PFBS	mg/kg	0.0004	<0.0004	<0.0005	<0.0004	<0.0004	<0.0004
PFPeS	mg/kg	0.0004					
PFHxS	mg/kg	0.0004	<0.0004	<0.0005	<0.0004	<0.0004	<0.0004
PFHpS	mg/kg	0.0004					
PFOS	mg/kg	0.0004	<0.0004	<0.0005	<0.0004	<0.0004	<0.0004
PFDS	mg/kg	0.0004					
4:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
6:2 FTS	mg/kg	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
8:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
10:2 FTS	mg/kg	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
FOSA	mg/kg	0.0004					
Me-FOSA	mg/kg	0.0004					
Et-FOSA	mg/kg	0.0004					
FOSAA	mg/kg	0.0004					
Me-FOSAA	mg/kg	0.0004					
Et-FOSAA	mg/kg	0.0004					
N-Me-FOSE	mg/kg	0.0008					
N-Et-FOSE	mg/kg	0.0008					
Σ PFAS	mg/kg	0.0002	<0.0002	<0.005	0.0007	0.0007	<0.0002
PFHxS+PFOS	mg/kg	0.0004	<0.0004		<0.0004	<0.0004	<0.0004
Σ PFAS (DER)	mg/kg	0.0002	<0.0002	<0.001	0.0007	0.0007	<0.0002

Interim Results

PCB							
Sample ID	Easting (m)	Northing (m)	PCB mg/kg as Aroclor Ind *LOR 0.2*	Sample ID	Easting (m)	Northing (m)	PCB mg/kg as Aroclor Ind *LOR 0.2*
SS01	244,691	6,544,663	<0.2	43192	221,304	6,636,860	<0.2
SS05	243,583	6,553,961	<0.2	42264	218,806	6,637,110	<0.2
SS10	242,011	6,565,876	<0.2	43154	220,807	6,637,362	<0.2
SS15_A	245,835	6,577,326	<0.2	43165_A	220,308	6,637,614	<0.2
SS15_B	245,835	6,577,326	<0.2	43165_B	220,308	6,637,614	<0.2
SS20	243,414	6,589,186	<0.2	43165_C	220,308	6,637,614	< 0.5
SS25_A	237,323	6,598,146	<0.2	43189	219,559	6,637,855	<0.2
SS30	234,483	6,609,651	<0.2	43182_A	220,556	6,637,864	<0.2
SS35_A	229,569	6,620,696	<0.2	43182_B	220,556	6,637,864	<0.2
SS40_A	225,716	6,632,030	<0.2	43182_C	220,556	6,637,864	< 0.5
SS45_A	221,662	6,632,414	<0.2	43174	219,807	6,638,112	<0.2
42254	221,308	6,635,860	<0.2	43179	220,058	6,638,860	<0.2
42259	219,308	6,636,110	<0.2	42269	219,561	6,639,856	<0.2

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As mg/kg **5**	Ca mg/kg **0.1**	Cr mg/kg **1**	Cu mg/kg **1**	Hg mg/kg **0.02**	Ni mg/kg **1**	Pb mg/kg **1**	Zn mg/kg **1**
SS01	244,691	6,544,663	<5	<0.1	27	2	<0.02	1	2	1
SS02	243,932	6,547,002	<5	<0.1	22	2	<0.02	2	2	1
SS03	243,603	6,549,396	<5	<0.1	22	1	<0.02	1	2	2
SS04	244,373	6,551,714	<5	<0.1	38	3	<0.02	2	3	2
SS05	243,583	6,553,961	<5	<0.1	63	10	0.05	12	15	6
SS06	242,428	6,556,071	<5	<0.1	67	7	0.02	7	7	5
SS07	241,857	6,558,399	<5	<0.1	64	5	0.04	6	6	5

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
SS08	241,906	6,560,891	<5	<0.1	43	3	0.03	2	3	2
SS09	241,959	6,563,384	<5	<0.1	67	4	<0.02	3	5	3
SS10	242,011	6,565,876	<5	<0.1	65	11	0.03	15	14	9
SS11	242,127	6,568,359	<5	<0.1	68	10	<0.02	14	11	8
SS12	243,044	6,570,605	<5	<0.1	57	4	<0.02	4	5	3
SS13	243,975	6,572,845	<5	<0.1	28	2	<0.02	2	2	2
SS14	244,905	6,575,086	<5	<0.1	56	3	<0.02	2	4	2
SS15_A	245,835	6,577,326	<5	<0.1	20	2	<0.02	2	2	1
SS16	246,092	6,579,688	<5	<0.1	21	2	<0.02	1	3	1
SS17	245,396	6,582,053	<5	<0.1	90	3	<0.02	2	5	2
SS18	244,700	6,584,418	<5	<0.1	32	5	<0.02	7	4	5
SS19	244,007	6,586,784	<5	<0.1	51	5	<0.02	7	6	4
SS20	243,414	6,589,186	<5	<0.1	38	3	<0.02	3	4	2
SS21	242,596	6,591,460	<5	<0.1	22	2	<0.02	2	1	2
SS22	240,744	6,592,735	<5	<0.1	18	2	<0.02	1	2	1
SS23	238,852	6,593,942	<5	<0.1	17	1	<0.02	1	<1	1
SS24_A	237,396	6,595,655	<5	<0.1	44	2	<0.02	2	5	1
SS25_A	237,323	6,598,146	6	<0.1	100	6	<0.02	6	10	4
SS25_B	237,323	6,598,146	7	<0.1	120	7	0.02	6	12	4
SS26	237,261	6,600,639	<5	<0.1	70	6	0.02	6	12	3
SS27	237,198	6,603,132	<5	<0.1	21	2	<0.02	2	3	2
SS28	237,024	6,605,605	<5	<0.1	17	2	<0.02	2	3	1
SS29	235,774	6,607,643	<5	<0.1	27	2	<0.02	2	3	1
SS30	234,483	6,609,651	<5	<0.1	59	4	<0.02	4	11	3
SS31	233,191	6,611,659	<5	<0.1	17	3	<0.02	3	2	1
SS32	232,049	6,613,765	<5	<0.1	31	3	<0.02	3	7	2

interpretation

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
SS33	231,222	6,616,075	<5	<0.1	21	3	<0.02	3	4	2
SS34	230,395	6,618,385	<5	<0.1	13	2	<0.02	2	1	1
SS35_A	229,569	6,620,696	<5	<0.1	18	3	<0.02	3	2	1
SS36	228,742	6,623,006	<5	<0.1	28	2	<0.02	3	2	1
SS37	227,915	6,625,317	<5	<0.1	39	2	<0.02	2	4	2
SS38	227,092	6,627,628	<5	<0.1	29	4	<0.02	3	4	3
SS39	226,263	6,629,939	<5	<0.1	17	2	<0.02	1	2	1
SS40_A	225,716	6,632,030	<5	<0.1	16	2	<0.02	2	1	1
SS40_B	225,716	6,632,030	<5	<0.1	15	2	<0.02	1	1	1
SS41	224,852	6,632,036	<5	<0.1	15	2	<0.02	1	1	<1
SS42	223,987	6,632,043	<5	<0.1	23	2	<0.02	2	2	2
SS43	223,122	6,632,049	<5	<0.1	18	2	<0.02	2	2	2
SS44	222,258	6,632,056	<5	<0.1	16	2	<0.02	1	1	1
SS45_A	221,662	6,632,414	<5	<0.1	20	2	<0.02	3	2	2
SS45_B	221,662	6,632,414	<5	<0.1	20	2	<0.02	2	2	2
SS46	221,663	6,633,412	<5	<0.1	27	2	<0.02	1	2	2
SS47	221,663	6,634,409	<5	<0.1	110	6	0.02	9	8	2
SS48	221,661	6,635,407	<5	<0.1	38	9	<0.02	13	6	5
43267	219,309	6,635,859	<5	0.3	33	2	<0.02	5	3	3
43268	219,555	6,635,858	<5	0.4	38	5	<0.02	9	5	5
43270	219,808	6,635,857	<5	0.3	27	1	<0.02	5	2	3
43273	220,058	6,635,859	<5	0.2	15	1	<0.02	3	2	3
43275	220,308	6,635,859	<5	0.2	18	1	<0.02	3	3	3
43052	220,558	6,635,860	6	0.2	18	5	<0.02	5	3	5
43277	220,810	6,635,860	<5	0.4	29	2	<0.02	5	3	2
43311	221,058	6,635,860	<5	0.4	30	3	<0.02	4	2	1

Interpretation

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	**0.1**	**1**	**1**	**0.02**	**1**	**1**	**1**
42251	221,308	6,635,860	<5	0.3	19	2	0.1	3	2	1
43308_A	221,558	6,635,860	<5	0.3	23	1	<0.02	4	2	1
43308_B	221,558	6,635,860	<5	0.3	21	1	<0.02	4	2	1
43308_C	221,558	6,635,860	<2	<0.4	23	<5	<5	<0.1	<5	<5
43307	221,808	6,635,860	<5	0.3	24	1	<0.02	4	2	2
42256	219,308	6,636,110	<5	0.3	17	2	0.07	5	5	3
43269	219,557	6,636,111	<5	0.4	35	3	<0.02	7	4	3
43271	219,807	6,636,110	<5	0.3	28	2	<0.02	4	2	2
43272	220,058	6,636,111	<5	0.2	22	1	<0.02	3	2	1
43274	220,308	6,636,110	<5	0.3	22	<1	<0.02	3	2	2
43051	220,558	6,636,110	<5	0.6	35	6	<0.02	8	5	3
43276	220,806	6,636,110	<5	0.3	23	2	<0.02	3	2	1
43278	221,058	6,636,112	<5	0.3	26	2	0.02	4	2	1
43304_A	221,308	6,636,110	<5	0.3	24	1	<0.02	3	1	1
43304_B	221,308	6,636,110	<5	0.3	25	2	<0.02	3	2	1
43304_C	221,308	6,636,110	<2	<0.4	29	<5	<5	<0.1	<5	<5
43303	221,559	6,636,110	<5	0.3	26	2	0.08	3	1	2
43302	221,808	6,636,111	<5	0.3	24	2	<0.02	3	2	1
42282	219,055	6,636,361	<5	0.4	23	3	0.04	5	4	3
42281	219,309	6,636,358	<5	0.3	22	3	<0.02	5	4	2
42280	219,560	6,636,361	<5	0.4	22	3	0.02	5	4	2
42279	219,811	6,636,358	<5	0.3	17	2	<0.02	4	2	2
42278	220,058	6,636,359	<5	0.4	22	3	<0.02	4	3	2
42277	220,308	6,636,363	<5	0.4	33	3	0.02	3	3	2
42276	220,558	6,636,360	<5	0.3	15	2	0.02	2	2	2
42273_A	220,809	6,636,358	<5	0.4	24	2	0.04	3	3	1

Interim results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	**0.1**	**1**	**1**	**0.02**	**1**	**1**	**1**
42273_B	220,809	6,636,358	<5	0.3	19	2	0.03	2	2	2
42273_C	220,809	6,636,358	3.8	<0.4	95	<5	<5	<0.1	<5	<5
42272	221,062	6,636,355	<5	0.3	18	2	0.03	3	2	1
42271	221,308	6,636,360	<5	0.2	14	2	0.03	3	1	1
43301	221,558	6,636,360	<5	0.3	21	1	<0.02	3	1	1
42283	218,808	6,636,608	<5	0.4	27	4	0.03	10	3	5
42284	219,058	6,636,609	<5	0.6	28	4	0.03	11	5	8
42285	219,308	6,636,609	<5	0.3	22	3	0.03	5	3	2
42286	219,557	6,636,613	<5	0.2	18	2	<0.02	3	2	2
42289	219,807	6,636,610	<5	0.1	14	2	<0.02	3	1	1
42290	220,058	6,636,611	<5	0.2	34	4	<0.02	3	2	1
42291_A	220,307	6,636,610	<5	0.8	71	5	0.25	4	5	3
42291_B	220,307	6,636,610	<5	0.1	26	3	<0.02	2	2	1
42291_C	220,307	6,636,610	4.2	<0.4	68	<5	6.3	<0.1	<5	<5
42294	220,554	6,636,611	<5	0.1	53	4	<0.02	2	1	1
42295	220,806	6,636,608	<5	<0.1	16	2	<0.02	1	<1	<1
42296	221,056	6,636,610	<5	<0.1	15	2	<0.02	1	<1	<1
43101	221,308	6,636,610	<5	0.3	19	3	<0.02	3	2	1
43102	221,558	6,636,610	<5	0.2	17	3	<0.02	3	1	1
42841	218,559	6,636,862	<5	<0.1	52	5	0.02	8	6	6
42840	218,813	6,636,858	<5	<0.1	43	5	0.02	8	7	6
42812	219,057	6,636,859	<5	<0.1	33	4	<0.02	4	5	3
42811	219,308	6,636,862	<5	<0.1	26	4	<0.02	5	4	3
42808_A	219,559	6,636,858	<5	<0.1	29	4	<0.02	4	5	2
42808_B	219,559	6,636,858	<5	<0.1	31	4	<0.02	4	4	2
42808_C	219,559	6,636,858	<2	<0.4	36	<5	<5	<0.1	5.5	<5

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
42807	219,807	6,636,862	<5	<0.1	30	3	0.02	4	4	3
42806	220,056	6,636,859	<5	<0.1	24	2	<0.02	4	2	1
42805	220,310	6,636,860	<5	<0.1	26	2	0.02	3	2	2
42804	220,558	6,636,861	<5	<0.1	18	2	0.02	3	2	1
42299	220,808	6,636,861	<5	<0.1	11	1	<0.02	2	<1	<1
42297	221,057	6,636,860	<5	0.1	13	1	<0.02	2	<1	<1
43191	221,304	6,636,860	<5	0.3	24	3	<0.02	4	1	2
42846	218,309	6,637,106	<5	<0.1	70	5	<0.02	6	6	5
42842	218,558	6,637,110	<5	<0.1	61	5	<0.02	8	7	6
42261	218,806	6,637,110	<5	0.5	29	4	0.06	6	4	3
42847	219,058	6,637,107	<5	<0.1	43	4	<0.02	5	3	2
42848	219,307	6,637,111	<5	<0.1	45	5	<0.02	6	4	2
42849	219,559	6,637,112	<5	<0.1	39	3	0.02	4	3	2
42850	219,810	6,637,110	<5	<0.1	33	3	<0.02	3	2	2
43251	220,057	6,637,111	<5	0.2	14	1	<0.02	2	1	<1
43252	220,308	6,637,108	<5	0.2	16	1	<0.02	2	1	<1
43253	220,557	6,637,111	<5	0.2	16	1	<0.02	2	1	1
43254	220,809	6,637,109	<5	0.3	26	1	<0.02	2	2	1
43255	221,059	6,637,111	<5	0.2	13	1	<0.02	2	1	<1
43108_A	221,308	6,637,110	<5	0.3	17	2	<0.02	2	<1	1
43108_B	221,308	6,637,110	<5	0.2	15	2	<0.02	2	1	1
43108_C	221,308	6,637,110	<2	<0.4	19	<5	<5	<0.1	<5	<5
43105	221,808	6,637,110	<5	0.3	15	2	<0.02	2	2	1
42845	218,308	6,637,361	<5	<0.1	54	5	<0.02	7	6	4
42843	218,559	6,637,360	<5	<0.1	44	3	<0.02	6	6	4
42844	218,808	6,637,360	<5	<0.1	63	6	<0.02	5	6	3

Interpretation

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
43265	219,061	6,637,362	<5	0.4	35	3	<0.02	5	3	2
43266	219,308	6,637,361	<5	0.3	28	2	<0.02	4	2	1
43264	219,558	6,637,359	<5	0.3	22	1	<0.02	4	2	2
43263	219,806	6,637,357	<5	0.3	24	2	<0.02	4	2	2
43260	220,059	6,637,360	<5	0.3	25	1	<0.02	3	2	2
43257_A	220,306	6,637,359	<5	0.2	18	1	<0.02	2	1	1
43257_B	220,306	6,637,359	<5	0.2	16	1	<0.02	2	1	<1
43257_C	220,306	6,637,359	<2	<0.4	25	<5	<5	<0.1	<5	<5
43256	220,558	6,637,360	<5	0.3	22	1	<0.02	3	2	1
43151	220,807	6,637,362	<5	0.3	20	1	<0.02	3	1	1
42346	221,058	6,637,360	<5	<0.1	22	2	0.06	3	2	2
43012	221,308	6,637,360	<5	<0.1	30	2	<0.02	2	1	1
43111	221,808	6,637,360	<5	0.3	17	3	<0.02	3	2	1
43050	218,308	6,637,610	<5	0.6	40	5	<0.02	8	5	5
43049	218,558	6,637,610	<5	0.5	35	6	<0.02	9	6	5
43279	218,808	6,637,610	<5	0.5	38	4	<0.02	7	5	4
42813	219,059	6,637,607	<5	<0.1	24	4	<0.02	6	5	3
42814_A	219,308	6,637,610	<5	<0.1	22	3	<0.02	4	4	2
42814_B	219,308	6,637,610	<5	<0.1	21	3	<0.02	4	4	2
42814_C	219,308	6,637,610	<2	<0.4	30	<5	<5	<0.1	6.4	<5
42823	219,554	6,637,609	<5	<0.1	21	3	<0.02	3	3	1
42824	219,808	6,637,611	<5	<0.1	23	3	0.02	3	2	2
43156_A	220,308	6,637,614	<5	0.2	16	1	<0.02	2	1	1
43156_B	220,308	6,637,614	<5	0.2	18	2	<0.02	3	1	2
43156_C	220,308	6,637,614	<2	<0.4	21	<5	<5	<0.1	<5	<5
42825	220,557	6,637,610	<5	<0.1	18	3	<0.02	2	3	2

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
42826	220,808	6,637,609	<5	<0.1	21	3	0.02	3	2	2
42347	221,058	6,637,610	<5	<0.1	19	2	0.03	2	2	2
43013	221,308	6,637,610	<5	<0.1	29	2	<0.02	3	2	1
43114	221,808	6,637,610	<5	0.4	26	6	<0.02	7	3	6
43044_A	218,558	6,637,860	<5	0.4	30	6	<0.02	10	5	5
43044_B	218,558	6,637,860	<2	<0.4	38	6.8	5.2	<0.1	13	6.8
43044_C	218,558	6,637,860	<5	0.5	32	7	<0.02	10	6	6
42345	219,058	6,637,860	<5	<0.1	21	3	0.02	3	3	2
43188	219,559	6,637,855	<5	0.3	20	2	<0.02	3	1	1
42827	219,808	6,637,862	<5	<0.1	22	3	<0.02	3	2	1
42828	220,056	6,637,861	<5	<0.1	29	3	<0.02	3	2	2
42829	220,307	6,637,859	<5	<0.1	34	3	0.04	2	1	1
43181	220,556	6,637,864	<5	0.3	23	2	<0.02	4	2	3
42830	220,808	6,637,859	<5	<0.1	31	3	0.03	2	2	1
42348	221,058	6,637,860	<5	<0.1	25	3	0.02	3	2	6
43014	221,308	6,637,860	<5	<0.1	30	3	<0.02	2	2	1
43117_A	221,808	6,637,860	<5	0.2	13	2	<0.02	2	1	2
43117_B	221,808	6,637,860	<5	0.2	16	3	<0.02	3	2	2
43117_C	221,808	6,637,860	<2	<0.4	24	<5	<5	<0.1	<5	<5
43043	218,558	6,638,110	<5	0.5	32	4	<0.02	5	3	3
42344	219,056	6,638,110	<5	<0.1	24	4	0.02	5	3	2
42831	219,557	6,638,110	<5	<0.1	47	4	0.03	3	2	1
43171	219,807	6,638,112	<5	0.3	26	2	<0.02	3	2	1
42832	220,057	6,638,110	<5	<0.1	41	3	0.02	2	2	<1
42834	220,308	6,638,110	<5	<0.1	41	4	0.02	3	2	2
42833	220,557	6,638,110	<5	<0.1	36	3	0.03	3	2	2

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
42350	220,808	6,638,110	<5	<0.1	18	3	0.03	3	2	2
43015	221,308	6,638,110	<5	<0.1	26	3	<0.02	2	2	2
43120_A	221,808	6,638,110	<5	0.3	22	4	<0.02	4	2	3
43120_B	221,808	6,638,110	<5	0.3	16	3	<0.02	3	2	2
43120_C	221,808	6,638,110	<2	<0.4	25	<5	<5	<0.1	<5	<5
43042	218,558	6,638,360	<5	0.4	23	4	<0.02	4	3	2
42343	219,057	6,638,360	<5	<0.1	16	2	<0.02	2	2	2
42839	219,558	6,638,360	<5	<0.1	53	4	<0.02	4	3	2
42838	219,808	6,638,360	<5	<0.1	49	4	<0.02	4	3	2
42837	220,058	6,638,360	<5	<0.1	45	3	0.02	3	2	1
42836	220,308	6,638,360	<5	<0.1	39	4	<0.02	3	2	2
42835	220,555	6,638,361	<5	<0.1	56	4	<0.02	4	3	2
42349	220,808	6,638,360	<5	<0.1	32	4	0.06	4	5	3
43016	221,308	6,638,360	<5	<0.1	25	3	<0.02	3	2	1
43123_A	221,808	6,638,360	<5	0.4	25	4	<0.02	4	3	2
43123_B	221,808	6,638,360	<5	0.4	23	4	<0.02	4	3	2
43123_C	221,808	6,638,360	<2	<0.4	26	<5	<5	<0.1	<5	<5
43041	218,558	6,638,610	<5	0.3	21	3	<0.02	3	2	1
42342	219,058	6,638,610	<5	<0.1	22	4	0.02	4	3	3
42341	219,559	6,638,610	<5	<0.1	32	4	<0.02	3	4	2
42340	219,808	6,638,613	<5	<0.1	37	4	<0.02	4	4	2
42339	220,058	6,638,613	<5	<0.1	44	4	<0.02	4	4	3
42338	220,308	6,638,610	<5	<0.1	31	3	<0.02	3	3	2
42335	220,558	6,638,610	<5	<0.1	23	3	<0.02	3	3	3
42334	220,808	6,638,610	<5	<0.1	23	3	<0.02	4	4	3
43017	221,308	6,638,610	<5	<0.1	100	4	0.02	3	6	1

Interpretation

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
43126_A	221,808	6,638,610	<5	0.3	22	3	<0.02	3	2	1
43126_B	221,808	6,638,610	<5	0.3	21	3	<0.02	3	1	1
43126_C	221,808	6,638,610	<2	<0.4	23	<5	<5	<0.1	<5	<5
42326	219,058	6,638,860	<5	<0.1	32	4	<0.02	4	2	3
42329	219,558	6,638,860	<5	<0.1	23	3	<0.02	4	3	2
42330	219,808	6,638,860	<5	<0.1	30	3	<0.02	4	3	3
43176	220,058	6,638,860	<5	0.7	53	2	<0.02	3	3	2
42331	220,308	6,638,860	<5	<0.1	47	5	<0.02	4	7	3
42332	220,558	6,638,859	<5	<0.1	37	4	<0.02	3	5	3
42333	220,808	6,638,860	<5	<0.1	43	5	<0.02	4	7	3
43018	221,308	6,638,860	<5	<0.1	32	2	<0.02	2	2	<1
43129_A	221,808	6,638,860	<5	0.4	25	3	<0.02	3	2	1
43129_B	221,808	6,638,860	<5	0.3	22	2	<0.02	3	2	1
43129_C	221,808	6,638,860	<2	<0.4	28	<5	<5	<0.1	<5	<5
43039	218,558	6,639,110	<5	0.3	20	3	<0.02	2	2	1
42325	219,058	6,639,110	<5	<0.1	20	2	<0.02	3	2	2
42324	219,560	6,639,108	<5	<0.1	20	2	<0.02	2	2	2
42321	219,805	6,639,111	<5	<0.1	27	4	0.02	4	6	4
42318	220,058	6,639,110	<5	<0.1	18	2	<0.02	2	3	2
42315	220,308	6,639,112	<5	<0.1	27	4	0.02	4	5	5
42310	220,558	6,639,114	<5	<0.1	30	4	<0.02	4	4	3
42307	220,807	6,639,111	<5	<0.1	45	3	0.02	3	3	1
43019	221,308	6,639,110	<5	<0.1	28	2	<0.02	2	1	<1
43132_A	221,808	6,639,110	<5	0.3	21	2	<0.02	2	1	1
43132_B	221,808	6,639,110	<5	0.3	22	2	<0.02	2	1	1
43132_C	221,808	6,639,110	<2	<0.4	22	<5	<5	<0.1	<5	<5

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
43038	218,558	6,639,360	<5	0.3	20	3	<0.02	3	2	2
42304	219,058	6,639,360	<5	<0.1	26	3	0.02	3	2	2
42323	219,558	6,639,360	<5	<0.1	22	2	<0.02	2	2	2
42320	219,808	6,639,362	<5	<0.1	21	3	<0.02	3	2	2
42317	220,056	6,639,361	<5	<0.1	20	2	<0.02	3	3	3
42314	220,310	6,639,360	<5	<0.1	22	2	<0.02	3	3	3
42309	220,558	6,639,360	<5	<0.1	19	2	<0.02	2	2	1
42306	220,808	6,639,360	<5	<0.1	36	3	0.02	3	2	2
43022	221,308	6,639,360	<5	0.3	19	3	0.06	2	1	<1
43135_A	221,808	6,639,360	<5	0.3	22	3	<0.02	3	2	2
43135_B	221,808	6,639,360	<5	0.3	20	3	<0.02	3	2	1
43135_C	221,808	6,639,360	<2	<0.4	20	<5	<5	<0.1	<5	<5
43037	218,558	6,639,610	<5	0.3	19	3	<0.02	3	2	2
42303	219,056	6,639,609	<5	<0.1	25	3	0.03	3	2	2
42322	219,558	6,639,610	<5	<0.1	21	3	<0.02	2	2	2
42319	219,810	6,639,610	<5	<0.1	19	3	<0.02	2	2	2
42316	220,058	6,639,610	<5	<0.1	20	2	<0.02	2	2	2
42311	220,308	6,639,610	<5	<0.1	21	4	<0.02	2	5	2
42308	220,558	6,639,607	<5	<0.1	19	2	<0.02	2	2	1
42305	220,805	6,639,610	<5	<0.1	29	3	0.03	3	2	1
43023	221,308	6,639,610	<5	0.2	16	3	<0.02	2	1	1
43138_A	221,808	6,639,610	<5	0.3	19	2	<0.02	2	<1	1
43138_B	221,808	6,639,610	<5	0.2	14	1	<0.02	2	<1	<1
43138_C	221,808	6,639,610	<2	<0.4	18	<5	<5	<0.1	<5	<5
43034	218,558	6,639,860	<5	0.3	19	3	0.02	3	2	1
42302	219,058	6,639,860	<5	0.2	16	2	<0.02	1	1	1

Interim Results

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
42266	219,561	6,639,856	<5	0.3	17	2	0.04	3	2	2
43198	219,808	6,639,860	<5	0.3	19	1	<0.02	3	1	2
43197	220,058	6,639,860	<5	0.3	19	1	<0.02	3	1	1
43196	220,308	6,639,859	<5	0.3	20	1	<0.02	2	<1	1
43030	220,558	6,639,860	<5	0.3	19	3	<0.02	3	2	2
43029	220,808	6,639,860	<5	0.3	20	3	<0.02	3	2	1
43024	221,308	6,639,860	<5	0.2	15	2	<0.02	2	1	<1
43141_A	221,808	6,639,860	<5	0.3	23	3	<0.02	3	1	2
43141_B	221,808	6,639,860	<5	0.3	17	2	<0.02	2	1	1
43141_C	221,808	6,639,860	<2	<0.4	22	<5	<5	<0.1	<5	<5
43033	218,558	6,640,110	<5	0.3	19	3	<0.02	3	2	1
42301	219,060	6,640,111	<5	0.2	16	2	<0.02	2	1	1
43200	219,558	6,640,110	<5	0.3	26	2	<0.02	3	2	2
43199	219,807	6,640,110	<5	0.3	22	1	<0.02	3	1	2
43195	220,058	6,640,111	<5	0.3	22	2	<0.02	3	2	2
43194	220,307	6,640,110	<5	0.3	20	2	<0.02	2	2	1
43031	220,558	6,640,110	<5	0.3	22	3	<0.02	2	2	1
43026	220,808	6,640,110	<5	0.2	16	3	<0.02	2	1	1
43025	221,308	6,640,110	<5	0.2	15	3	<0.02	2	1	<1
43144_A	221,808	6,640,110	<5	0.3	20	2	<0.02	3	1	2
43144_B	221,808	6,640,110	<5	0.3	17	2	<0.02	3	1	1
43144_C	221,808	6,640,110	<2	<0.4	21	<5	<5	<0.1	<5	<5
43147	221,808	6,640,110	<5	0.2	12	1	<0.02	2	<1	<1
43148	221,808	6,640,110	<5	0.2	14	2	<0.02	2	<1	1
43032	218,558	6,640,360	<5	0.4	23	4	<0.02	3	2	1
43009	219,058	6,640,360	<5	<0.1	44	3	<0.02	2	3	1

Interpretation

Heavy Metals										
Sample ID	Easting (m)	Northing (m)	As	Ca	Cr	Cu	Hg	Ni	Pb	Zn
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			5	0.1	1	1	0.02	1	1	1
43008	219,558	6,640,360	<5	<0.1	38	3	<0.02	3	2	1
43007	219,808	6,640,360	<5	<0.1	34	3	<0.02	3	2	1
43006	220,058	6,640,360	<5	<0.1	40	3	<0.02	3	2	<1
43005	220,308	6,640,360	<5	<0.1	30	2	<0.02	2	1	<1
43004	220,558	6,640,360	<5	<0.1	30	2	<0.02	2	1	<1
43003	220,808	6,640,360	<5	<0.1	27	2	<0.02	2	1	<1
43002	221,308	6,640,360	<5	<0.1	21	2	<0.02	2	1	<1
43001_A	221,808	6,640,360	<2	<0.4	22	<5	<5	<0.1	<5	<5
43001_B	221,808	6,640,360	<5	0.3	20	1	<0.02	2	1	1
43001_C	221,808	6,640,360	<5	0.3	17	1	<0.02	2	1	1

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	0.01	0.1				0.1	0.01	0.1
SS01	244,691	6,544,663	5.2	0.06	0.3	43049	218,558	6,637,610	7	0.01	0.3
SS02	243,932	6,547,002	6.2	0.03	0.1	42813	219,059	6,637,607	7	0.03	
SS03	243,603	6,549,396	6	0.46	0.7	42814_A	219,308	6,637,610	5.4	0.01	0.4
SS04	244,373	6,551,714	5.8	0.06	0.4	42814_B	219,308	6,637,610	5.6	0.01	
SS05	243,583	6,553,961	7.9	2.1	0.5	42814_C	219,308	6,637,610	5	0.013	
SS06	242,428	6,556,071	9	0.57	0.3	42823	219,554	6,637,609	5.8	<0.01	
SS07	241,857	6,558,399	6.5	2.2	0.3	42824	219,808	6,637,611	5.9	0.01	
SS08	241,906	6,560,891	4.9	0.42	0.3	43156_A	220,308	6,637,614	5.3	0.02	0.8
SS09	241,959	6,563,384	5.7	0.16	0.4	43156_B	220,308	6,637,614	5.5	<0.01	
SS10	242,011	6,565,876	7.7	1.3	0.4	43156_C	220,308	6,637,614	4.9	0.023	
SS11	242,127	6,568,359	7.9	1.2	0.8	42825	220,557	6,637,610	5.2	0.02	

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	**0.01**	**0.1**				**0.1**	**0.01**	**0.1**
SS12	243,044	6,570,605	6.8	0.34	0.5	42826	220,808	6,637,609	5.1	0.03	
SS13	243,975	6,572,845	6.3	0.32	0.3	42347	221,058	6,637,610	5.4	0.04	
SS14	244,905	6,575,086	5.2	0.14	0.3	43013	221,308	6,637,610	6.1	0.01	
SS15_A	245,835	6,577,326	6.9	0.05	0.1	43114	221,808	6,637,610	7.2	0.03	
SS16	246,092	6,579,688	5.6	0.6	0.7	43044_A	218,558	6,637,860	7.5	0.02	
SS17	245,396	6,582,053	7.2	0.3	0.3	43044_B	218,558	6,637,860	7.3	0.12	
SS18	244,700	6,584,418	8.2	1.6	0.4	43044_C	218,558	6,637,860	7.4	0.03	
SS19	244,007	6,586,784	7.9	0.53	0.2	42345	219,058	6,637,860	6.1	<0.01	
SS20	243,414	6,589,186	6.7	0.28	0.2	43188	219,559	6,637,855	5.7	<0.01	
SS21	242,596	6,591,460	6.7	0.22	0.4	42827	219,808	6,637,862	6.5	0.02	0.4
SS22	240,744	6,592,735	5.1	0.24	0.5	42828	220,056	6,637,861	5.6	0.01	
SS23	238,852	6,593,942	6.5	0.05	0.3	42829	220,307	6,637,859	5.3	0.01	
SS24_A	237,396	6,595,655	5.7	0.18	0.3	43181	220,556	6,637,864	5.6	0.05	
SS25_A	237,323	6,598,146	8.2	0.28	0.8	42830	220,808	6,637,859	6.2	0.04	
SS25_B	237,323	6,598,146	7.8	0.66	0.9	42348	221,058	6,637,860	5.9	0.02	0.5
SS26	237,261	6,600,639	7.1	0.2	0.3	43014	221,308	6,637,860	5.1	0.04	
SS27	237,198	6,603,132	7.2	0.16	0.6	43117_A	221,808	6,637,860	6.5	0.02	
SS28	237,024	6,605,605	6.7	0.08	0.5	43117_B	221,808	6,637,860	6.6	0.02	1
SS29	235,774	6,607,643	6.3	0.04	0.5	43117_C	221,808	6,637,860	6.1	0.034	
SS30	234,483	6,609,651	8.2	0.09	0.2	43043	218,558	6,638,110	5.1	0.01	
SS31	233,191	6,611,659	6.7	0.02	0.1	42344	219,056	6,638,110	5.3	0.02	
SS32	232,049	6,613,765	7.7	0.05	0.2	42831	219,557	6,638,110	5.2	0.01	
SS33	231,222	6,616,075	7.3	0.15	0.4	43171	219,807	6,638,112	5.8	<0.01	
SS34	230,395	6,618,385	7.8	0.02	0.2	42832	220,057	6,638,110	5.4	0.01	
SS35_A	229,569	6,620,696	5.5	<0.01	0.2	42834	220,308	6,638,110	5.8	0.02	
SS36	228,742	6,623,006	6.1	0.01	0.2	42833	220,557	6,638,110	6.4	0.05	0.7

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	**0.01**	**0.1**				**0.1**	**0.01**	**0.1**
SS37	227,915	6,625,317	5	0.03	0.5	42350	220,808	6,638,110	5.1	0.03	
SS38	227,092	6,627,628	4.8	0.12	1	43015	221,308	6,638,110	6.8	0.03	
SS39	226,263	6,629,939	4.9	0.09	0.5	43120_A	221,808	6,638,110	6.2	0.02	
SS40_A	225,716	6,632,030	5.1	0.02	0.8	43120_B	221,808	6,638,110	6.5	0.01	
SS40_B	225,716	6,632,030	5.2	0.02	0.7	43120_C	221,808	6,638,110	6.1	0.035	
SS41	224,852	6,632,036	4.9	0.02	0.7	43042	218,558	6,638,360	5.1	0.02	
SS42	223,987	6,632,043	4.9	0.02	0.8	42343	219,057	6,638,360	5.4	0.01	
SS43	223,122	6,632,049	5.9	0.01	0.6	42839	219,558	6,638,360	5.4	<0.01	0.9
SS44	222,258	6,632,056	5.2	0.01	0.6	42838	219,808	6,638,360	6.2	0.02	
SS45_A	221,662	6,632,414	6.8	0.08	0.4	42837	220,058	6,638,360	5.2	0.02	
SS45_B	221,662	6,632,414	6.7	0.07	0.6	42836	220,308	6,638,360	5.9	0.01	
SS46	221,663	6,633,412	5.1	0.03	0.7	42835	220,555	6,638,361	5.3	0.01	
SS47	221,663	6,634,409	6.8	0.02	0.3	42349	220,808	6,638,360	5.6	0.01	
SS48	221,661	6,635,407	9.4	0.25	0.4	43016	221,308	6,638,360	5.8	<0.01	4
43267	219,309	6,635,859	6.7	0.02		43123_A	221,808	6,638,360	5.4	0.01	
43268	219,555	6,635,858	6.2	0.01		43123_B	221,808	6,638,360	5.4	0.01	
43270	219,808	6,635,857	6.5	0.01	0.4	43123_C	221,808	6,638,360	5.3	0.027	
43273	220,058	6,635,859	6	0.01		43041	218,558	6,638,610	5.5	<0.01	
43275	220,308	6,635,859	6.3	0.02		42342	219,058	6,638,610	5.2	0.01	1.3
43052	220,558	6,635,860	7.2	0.09		42341	219,559	6,638,610	5.3	0.02	
43277	220,810	6,635,860	5.2	0.01		42340	219,808	6,638,613	5.2	0.01	
43311	221,058	6,635,860	5.3	0.01	0.5	42339	220,058	6,638,613	5	0.01	
42251	221,308	6,635,860	5.5	0.02		42338	220,308	6,638,610	5.1	0.02	
43308_A	221,558	6,635,860	5.8	<0.01		42335	220,558	6,638,610	6.1	0.03	
43308_B	221,558	6,635,860	5.8	<0.01		42334	220,808	6,638,610	7.4	0.05	0.3
43308_C	221,558	6,635,860	5.4	0.015		43017	221,308	6,638,610	4.9	0.03	

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	0.01	0.1				0.1	0.01	0.1
43307	221,808	6,635,860	6.2	<0.01		43126_A	221,808	6,638,610	5.3	0.01	
42256	219,308	6,636,110	6.4	0.02		43126_B	221,808	6,638,610	5.3	0.01	0.4
43269	219,557	6,636,111	7.2	0.04		43126_C	221,808	6,638,610	5.4	0.014	
43271	219,807	6,636,110	6.1	0.02		42326	219,058	6,638,860	5.1	0.01	0.8
43272	220,058	6,636,111	5.9	<0.01		42329	219,558	6,638,860	5	0.09	
43274	220,308	6,636,110	5.9	<0.01		42330	219,808	6,638,860	5.4	0.02	
43051	220,558	6,636,110	6.6	0.02		43176	220,058	6,638,860	5	0.02	
43276	220,806	6,636,110	5.3	0.01	0.3	42331	220,308	6,638,860	6	0.04	
43278	221,058	6,636,112	5.9	0.21		42332	220,558	6,638,859	5.3	0.01	
43304_A	221,308	6,636,110	5	0.01		42333	220,808	6,638,860	5.1	0.02	
43304_B	221,308	6,636,110	4.9	0.01		43018	221,308	6,638,860	5.1	<0.01	
43304_C	221,308	6,636,110	4.8	0.016		43129_A	221,808	6,638,860	4.8	0.02	
43303	221,559	6,636,110	5.2	<0.01	0.4	43129_B	221,808	6,638,860	5.3	0.01	
43302	221,808	6,636,111	5.1	<0.01		43129_C	221,808	6,638,860	5.1	0.018	
42282	219,055	6,636,361	6.4	0.02		43039	218,558	6,639,110	5.1	0.01	0.7
42281	219,309	6,636,358	6	<0.01		42325	219,058	6,639,110	6.2	0.03	
42280	219,560	6,636,361	6.1	0.02		42324	219,560	6,639,108	6.3	0.02	
42279	219,811	6,636,358	5	<0.01		42321	219,805	6,639,111	6.5	0.06	
42278	220,058	6,636,359	4.8	0.01	0.5	42318	220,058	6,639,110	5.8	<0.01	
42277	220,308	6,636,363	5.1	0.02		42315	220,308	6,639,112	6.5	0.03	
42276	220,558	6,636,360	5.1	0.01		42310	220,558	6,639,114	5.3	0.02	
42273_A	220,809	6,636,358	4.9	0.04		42307	220,807	6,639,111	4.6	0.06	0.6
42273_B	220,809	6,636,358	5.1	0.04		43019	221,308	6,639,110	5.9	0.02	
42273_C	220,809	6,636,358	4.9	0.028		43132_A	221,808	6,639,110	5	<0.01	
42272	221,062	6,636,355	5.1	0.01		43132_B	221,808	6,639,110	5	<0.01	
42271	221,308	6,636,360	5.3	0.01	0.9	43132_C	221,808	6,639,110	4.8	0.0096	

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	0.01	0.1				0.1	0.01	0.1
43301	221,558	6,636,360	5.4	<0.01		43038	218,558	6,639,360	4.9	0.01	
42283	218,808	6,636,608	8.7	0.18		42304	219,058	6,639,360	5.5	0.01	
42284	219,058	6,636,609	8	0.18	1.1	42323	219,558	6,639,360	6	0.01	
42285	219,308	6,636,609	5.6	0.02		42320	219,808	6,639,362	5.6	<0.01	0.5
42286	219,557	6,636,613	5.4	0.01		42317	220,056	6,639,361	5.9	0.01	
42289	219,807	6,636,610	5.8	0.02		42314	220,310	6,639,360	5.7	<0.01	0.7
42290	220,058	6,636,611	4.8	0.03		42309	220,558	6,639,360	5.1	0.03	
42291_A	220,307	6,636,610	5.1	0.02		42306	220,808	6,639,360	4.8	0.01	
42291_B	220,307	6,636,610	4.9	0.01	0.5	43022	221,308	6,639,360	5.2	0.01	
42291_C	220,307	6,636,610	4.8	0.019		43135_A	221,808	6,639,360	5.2	0.02	
42294	220,554	6,636,611	4.8	0.01		43135_B	221,808	6,639,360	5.3	0.02	0.5
42295	220,806	6,636,608	4.8	0.06		43135_C	221,808	6,639,360	5.3	0.021	
42296	221,056	6,636,610	5.1	0.02		43037	218,558	6,639,610	5	0.02	
43101	221,308	6,636,610	5.2	<0.01		42303	219,056	6,639,609	4.8	0.01	
43102	221,558	6,636,610	5	<0.01		42322	219,558	6,639,610	5.8	<0.01	
42841	218,559	6,636,862	7.4	0.04		42319	219,810	6,639,610	5.9	0.06	
42840	218,813	6,636,858	7.9	0.14		42316	220,058	6,639,610	5.2	<0.01	
42812	219,057	6,636,859	6	<0.01		42311	220,308	6,639,610	5.9	0.07	
42811	219,308	6,636,862	6	<0.01		42308	220,558	6,639,607	5.1	<0.01	
42808_A	219,559	6,636,858	5.4	0.01		42305	220,805	6,639,610	4.8	<0.01	
42808_B	219,559	6,636,858	5.1	0.01		43023	221,308	6,639,610	5.4	<0.01	
42808_C	219,559	6,636,858	4.9	0.012		43138_A	221,808	6,639,610	5	0.02	
42807	219,807	6,636,862	6.4	0.02	0.8	43138_B	221,808	6,639,610	5	0.01	
42806	220,056	6,636,859	5.2	0.01		43138_C	221,808	6,639,610	5	0.085	
42805	220,310	6,636,860	5.5	0.01		43034	218,558	6,639,860	5.1	<0.01	
42804	220,558	6,636,861	5.6	0.02		42302	219,058	6,639,860	5.7	0.04	

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	0.01	0.1				0.1	0.01	0.1
42299	220,808	6,636,861	5.1	0.01		42266	219,561	6,639,856	5.7	0.06	
42297	221,057	6,636,860	5.3	0.07		43198	219,808	6,639,860	5.3	0.01	
43191	221,304	6,636,860	5.2	<0.01	0.4	43197	220,058	6,639,860	5.4	0.01	
42846	218,309	6,637,106	7.1	0.05		43196	220,308	6,639,859	5.7	0.01	
42842	218,558	6,637,110	7.3	0.11		43030	220,558	6,639,860	5.3	0.01	
42261	218,806	6,637,110	6.2	0.01		43029	220,808	6,639,860	4.9	0.01	
42847	219,058	6,637,107	6.2	0.06		43024	221,308	6,639,860	5.3	0.01	0.5
42848	219,307	6,637,111	5.5	0.01		43141_A	221,808	6,639,860	5.2	0.02	
42849	219,559	6,637,112	7.1	0.17		43141_B	221,808	6,639,860	5.4	0.02	
42850	219,810	6,637,110	5.7	0.01		43141_C	221,808	6,639,860	4.9	0.011	
43251	220,057	6,637,111	5.1	<0.01		43033	218,558	6,640,110	4.9	0.01	
43252	220,308	6,637,108	4.9	0.01		42301	219,060	6,640,111	4.8	0.02	0.6
43253	220,557	6,637,111	5.4	<0.01		43200	219,558	6,640,110	5	<0.01	
43254	220,809	6,637,109	5.3	0.02		43199	219,807	6,640,110	5.5	0.01	0.7
43255	221,059	6,637,111	5.4	0.05	1.2	43195	220,058	6,640,111	5.3	0.01	
43108_A	221,308	6,637,110	5.5	0.01		43194	220,307	6,640,110	5.3	<0.01	
43108_B	221,308	6,637,110	5.4	0.02		43031	220,558	6,640,110	5.4	<0.01	0.5
43108_C	221,308	6,637,110	5.3	0.018		43026	220,808	6,640,110	5.2	<0.01	
43105	221,808	6,637,110	5.2	0.01	0.4	43025	221,308	6,640,110	5.6	0.01	
42845	218,308	6,637,361	6.8	0.06	0.9	43144_A	221,808	6,640,110	5.6	0.01	
42843	218,559	6,637,360	7.1	0.06		43144_B	221,808	6,640,110	5.4	<0.01	0.5
42844	218,808	6,637,360	5.2	0.01		43144_C	221,808	6,640,110	5.2	0.013	
43265	219,061	6,637,362	5.1	0.01		43147	221,808	6,640,110	5.7	<0.01	
43266	219,308	6,637,361	6	0.02		43148	221,808	6,640,110	5.5	0.02	
43264	219,558	6,637,359	6.3	0.02	0.3	43032	218,558	6,640,360	5.1	<0.01	
43263	219,806	6,637,357	5.3	0.03		43009	219,058	6,640,360	5.1	0.02	

Interim Results

Inorganics											
Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC	Sample ID	Easting (m)	Northing (m)	$pH_{1:5}$	$EC_{1:5}$	TOC
			pH units	mS/cm	%				pH units	mS/cm	%
			0.1	0.01	0.1				0.1	0.01	0.1
43260	220,059	6,637,360	5.2	0.01		43008	219,558	6,640,360	5.2	0.01	1
43257_A	220,306	6,637,359	5.1	0.01		43007	219,808	6,640,360	6.3	<0.01	
43257_B	220,306	6,637,359	5.2	<0.01		43006	220,058	6,640,360	5.3	0.01	
43257_C	220,306	6,637,359	5	0.012		43005	220,308	6,640,360	5.5	<0.01	
43256	220,558	6,637,360	5.2	0.01		43004	220,558	6,640,360	5.4	<0.01	
43151	220,807	6,637,362	5.5	0.02		43003	220,808	6,640,360	5.3	0.02	
42346	221,058	6,637,360	5.8	0.07		43002	221,308	6,640,360	6.4	<0.01	0.4
43012	221,308	6,637,360	6.3	0.02		43001_A	221,808	6,640,360	5.3	0.01	
43111	221,808	6,637,360	4.8	0.02		43001_B	221,808	6,640,360	5.1	<0.01	
43050	218,308	6,637,610	7.4	0.06		43001_C	221,808	6,640,360	5.3	<0.01	
43279	218,808	6,637,610	6.5	0.03							

Radionuclides								
Sample ID	Easting (m)	Northing (m)	Am 241	Cs 134	Cs 137	Co 60	Sr 90	Ra 226
			Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg
							0.01	0.002
SS01	244,691	6,544,663						
SS07	241,857	6,558,399						
SS19	244,007	6,586,784						
SS21	242,596	6,591,460						
SS24_A	237,396	6,595,655						
SS24_B	237,396	6,595,655						
SS40_A	225,716	6,632,030						
SS45_A	221,662	6,632,414						
42252	221,308	6,635,860	<1		<1	<1	<1	7.7
42257	219,308	6,636,110	<1		<1	<1	<1	13.6

Interim Results

Radionuclides								
Sample ID	Easting (m)	Northing (m)	Am 241	Cs 134	Cs 137	Co 60	Sr 90	Ra 226
			Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg	Bq/kg
							0.01	0.002
42287	219,557	6,636,613	<1		<1	<1	<1	<1
43103	221,558	6,636,610	<1		<1	<1	<1	13.3
42300	220,808	6,636,861	<1		<1	<1	<1	<1
42262	218,806	6,637,110	<1		<1	<1	<1	12.7
43261	220,059	6,637,360	<1		6.6	<1	<1	10.3
43152	220,807	6,637,362	<1		<1	<1	<1	8.5
42817_A	219,308	6,637,610	<1		7.8	<1	<1	8.4
42817_B	219,308	6,637,610	<1		13.2	<1	<1	16.7
42817_C	219,308	6,637,610	<1	<1	10.2	<1	<1	9.6
43159_A	220,308	6,637,614	<1		7.4	<1	<1	14.9
43159_B	220,308	6,637,614	<1		6.2	<1	<1	15
43159_C	220,308	6,637,614	<1	<1	<1	<1	<1	2.8
43046	218,558	6,637,860	<1		<1	<1	<1	66
43172	219,807	6,638,112	<1		6.7	<1	<1	14.6
42336	220,558	6,638,610	<1		14.2	<1	<1	<1
42327	219,058	6,638,860	<1		<1	<1	<1	2.7
43177	220,058	6,638,860	<1		<1	<1	<1	21.3
43020	221,308	6,639,110	<1		<1	<1	<1	6.8
42312	220,308	6,639,610	<1		<1	<1	<1	<1
43035	218,558	6,639,860	<1		<1	<1	<1	9.6
42267	219,561	6,639,856	<1		<1	<1	<1	2.9
43027	220,808	6,640,110	<1		<1	<1	<1	10.7
43147	221,808	6,640,110	<1		<1	<1	<1	13.1

Interim Results

Sandy Ridge Facility 2019 Baseline Soil sampling results

Reference	Sample Description	Sample Date	Sample Matrix	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	pH	Conductivity	TOC
Units			Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pH units	mS/cm	%
PQL			PQL	5	0.1	1	1	0.02	1	1	1	0.1	0.01	0.1
Method			Method	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403	ARL No. 406	ARL No. 401/403	ARL No. 401/403	ARL No. 401/403	ARL No. 138	ARL No. 140	ARL No. 064
							Guideline Levels							
			HIL-A	100	20	100*	6000	10#	400	300	7400			
			HIL-B	500	150	500*	30000	30#	1200	1200	60000			
			HIL-C	300	90	300*	17000	13#	1200	600	30000			
			HIL-D	3000	900	3600*	240000	180#	6000	1500	400000			
			EIL-1	40	-	60[1]	20[2]	-	5[2]	470[3]	15[2]			
			EIL-2	100	-	190[1]	60[2]	-	30[2]	1100[3]	70[2]			
			EIL-3	160	-	310[1]	85[2]	-	55[2]	1800[3]	110[2]			
						* denotes limit for hexavalent chromium; # denotes limit for methyl mercury									
19-05583-1	42291	10/04/2019 0:00	Soil	<5	0.8	71	5	0.25	4	5	3	5.1	0.02	
19-05583-2	42251	10/04/2019 0:00	Soil	<5	0.3	19	2	0.1	3	2	1	5.5	0.02	
19-05583-5	42256	10/04/2019 0:00	Soil	<5	0.3	17	2	0.07	5	5	3	6.4	0.02	
19-05583-8	42261	10/04/2019 0:00	Soil	<5	0.5	29	4	0.06	6	4	3	6.2	0.01	
19-05583-11	42266	10/04/2019 0:00	Soil	<5	0.3	17	2	0.04	3	2	2	5.7	0.06	
19-05583-14	42271	10/04/2019 0:00	Soil	<5	0.2	14	2	0.03	3	1	1	5.3	0.01	0.9
19-05583-15	42272	10/04/2019 0:00	Soil	<5	0.3	18	2	0.03	3	2	1	5.1	0.01	
19-05583-16	42273	10/04/2019 0:00	Soil	<5	0.4	24	2	0.04	3	3	1	4.9	0.04	
19-05583-17	42274	10/04/2019 0:00	Soil	<5	0.3	19	2	0.03	2	2	2	5.1	0.04	
19-05583-18	42276	10/04/2019 0:00	Soil	<5	0.3	15	2	0.02	2	2	2	5.1	0.01	
19-05583-19	42277	10/04/2019 0:00	Soil	<5	0.4	33	3	0.02	3	3	2	5.1	0.02	
19-05583-20	42278	10/04/2019 0:00	Soil	<5	0.4	22	3	<0.02	4	3	2	4.8	0.01	0.5
19-05583-21	42279	10/04/2019 0:00	Soil	<5	0.3	17	2	<0.02	4	2	2	5	<0.01	
19-05583-22	42280	10/04/2019 0:00	Soil	<5	0.4	22	3	0.02	5	4	2	6.1	0.02	
19-05583-23	42281	10/04/2019 0:00	Soil	<5	0.3	22	3	<0.02	5	4	2	6	<0.01	
19-05583-24	42282	10/04/2019 0:00	Soil	<5	0.4	23	3	0.04	5	4	3	6.4	0.02	
19-05583-25	42283	10/04/2019 0:00	Soil	<5	0.4	27	4	0.03	10	3	5	8.7	0.18	
19-05583-26	42284	10/04/2019 0:00	Soil	<5	0.6	28	4	0.03	11	5	8	8	0.18	1.1
19-05583-27	42285	10/04/2019 0:00	Soil	<5	0.3	22	3	0.03	5	3	2	5.6	0.02	
19-05583-28	42286	10/04/2019 0:00	Soil	<5	0.2	18	2	<0.02	3	2	2	5.4	0.01	
19-05583-31	42289	10/04/2019 0:00	Soil	<5	0.1	14	2	<0.02	3	1	1	5.8	0.02	
19-05583-32	42290	10/04/2019 0:00	Soil	<5	0.2	34	4	<0.02	3	2	1	4.8	0.03	
19-05583-33	42292	10/04/2019 0:00	Soil	<5	0.1	26	3	<0.02	2	2	1	4.9	0.01	0.5
19-05583-34	42294	10/04/2019 0:00	Soil	<5	0.1	53	4	<0.02	2	1	1	4.8	0.01	
19-05583-35	42295	10/04/2019 0:00	Soil	<5	<0.1	16	2	<0.02	1	<1	<1	4.8	0.06	
19-05583-36	42296	10/04/2019 0:00	Soil	<5	<0.1	15	2	<0.02	1	<1	<1	5.1	0.02	
19-05583-37	42297	10/04/2019 0:00	Soil	<5	0.1	13	1	<0.02	2	<1	<1	5.3	0.07	
19-05583-39	42299	10/04/2019 0:00	Soil	<5	<0.1	11	1	<0.02	2	<1	<1	5.1	0.01	
19-05583-41	42301	10/04/2019 0:00	Soil	<5	0.2	16	2	<0.02	2	1	1	4.8	0.02	0.6
19-05583-42	42302	10/04/2019 0:00	Soil	<5	<0.1	12	<1	<0.02	1	<1	<1	5.6	0.04	
19-05583-43	42303	10/04/2019 0:00	Soil	<5	<0.1	25	3	0.03	3	2	2	4.8	0.01	
19-05583-44	42304	10/04/2019 0:00	Soil	<5	<0.1	26	3	0.02	3	2	2	5.5	0.01	
19-05583-45	42305	10/04/2019 0:00	Soil	<5	<0.1	29	3	0.03	3	2	1	4.8	<0.01	
19-05583-46	42306	10/04/2019 0:00	Soil	<5	<0.1	36	3	0.02	3	2	2	4.8	0.01	
19-05583-47	42307	10/04/2019 0:00	Soil	<5	<0.1	45	3	0.02	3	3	1	4.6	0.06	0.6

19-05583-48	42308	10/04/2019 0:00	Soil	<5	<0.1	19	2	<0.02	2	2	1	5.1	<0.01	
19-05583-49	42309	10/04/2019 0:00	Soil	<5	<0.1	19	2	<0.02	2	2	1	5.1	0.03	
19-05583-50	42310	10/04/2019 0:00	Soil	<5	<0.1	30	4	<0.02	4	4	3	5.3	0.02	
19-05583-51	42311	10/04/2019 0:00	Soil	<5	<0.1	21	4	<0.02	2	5	2	5.9	0.07	
19-05583-54	42314	10/04/2019 0:00	Soil	<5	<0.1	22	2	<0.02	3	3	3	5.7	<0.01	0.7
19-05583-55	42315	10/04/2019 0:00	Soil	<5	<0.1	27	4	0.02	4	5	5	6.5	0.03	
19-05583-56	42316	10/04/2019 0:00	Soil	<5	<0.1	20	2	<0.02	2	2	2	5.2	<0.01	
19-05583-57	42317	10/04/2019 0:00	Soil	<5	<0.1	20	2	<0.02	3	3	3	5.9	0.01	
19-05583-58	42318	10/04/2019 0:00	Soil	<5	<0.1	18	2	<0.02	2	3	2	5.8	<0.01	
19-05583-59	42319	10/04/2019 0:00	Soil	<5	<0.1	19	3	<0.02	2	2	2	5.9	0.06	
19-05583-60	42320	10/04/2019 0:00	Soil	<5	<0.1	21	3	<0.02	3	2	2	5.6	<0.01	0.5
19-05583-61	42321	10/04/2019 0:00	Soil	<5	<0.1	27	4	0.02	4	6	4	6.5	0.06	
19-05583-62	42322	10/04/2019 0:00	Soil	<5	<0.1	21	3	<0.02	2	2	2	5.8	<0.01	
19-05583-63	42323	10/04/2019 0:00	Soil	<5	<0.1	22	2	<0.02	2	2	2	6	0.01	
19-05583-64	42324	10/04/2019 0:00	Soil	<5	<0.1	20	2	<0.02	2	2	2	6.3	0.02	
19-05583-65	42325	10/04/2019 0:00	Soil	<5	<0.1	20	2	<0.02	3	2	2	6.2	0.03	
19-05583-66	42326	10/04/2019 0:00	Soil	<5	<0.1	32	4	<0.02	4	2	3	5.1	0.01	0.8
19-05583-69	42329	10/04/2019 0:00	Soil	<5	<0.1	23	3	<0.02	4	3	2	5	0.09	
19-05583-70	42330	10/04/2019 0:00	Soil	<5	<0.1	30	3	<0.02	4	3	3	5.4	0.02	
19-05583-71	42331	10/04/2019 0:00	Soil	<5	<0.1	47	5	<0.02	4	7	3	6	0.04	
19-05583-72	42332	10/04/2019 0:00	Soil	<5	<0.1	37	4	<0.02	3	5	3	5.3	0.01	
19-05583-73	42333	10/04/2019 0:00	Soil	<5	<0.1	43	5	<0.02	4	7	3	5.1	0.02	
19-05583-74	42334	10/04/2019 0:00	Soil	<5	<0.1	23	3	<0.02	4	4	3	7.4	0.05	0.3
19-05583-75	42335	10/04/2019 0:00	Soil	<5	<0.1	23	3	<0.02	3	3	3	6.1	0.03	
19-05583-78	42338	10/04/2019 0:00	Soil	<5	<0.1	31	3	<0.02	3	3	2	5.1	0.02	
19-05583-79	42339	10/04/2019 0:00	Soil	<5	<0.1	44	4	<0.02	4	4	3	5	0.01	
19-05583-80	42340	10/04/2019 0:00	Soil	<5	<0.1	37	4	<0.02	4	4	2	5.2	0.01	
19-05583-81	42341	10/04/2019 0:00	Soil	<5	<0.1	32	4	<0.02	3	4	2	5.3	0.02	
19-05583-82	42342	10/04/2019 0:00	Soil	<5	<0.1	22	4	0.02	4	3	3	5.2	0.01	1.3
19-05583-83	42343	10/04/2019 0:00	Soil	<5	<0.1	16	2	<0.02	2	2	2	5.4	0.01	
19-05583-84	42344	10/04/2019 0:00	Soil	<5	<0.1	24	4	0.02	5	3	2	5.3	0.02	
19-05583-85	42345	10/04/2019 0:00	Soil	<5	<0.1	21	3	0.02	3	3	2	6.1	<0.01	
19-05583-86	42346	10/04/2019 0:00	Soil	<5	<0.1	22	2	0.06	3	2	2	5.8	0.07	
19-05583-87	42347	10/04/2019 0:00	Soil	<5	<0.1	19	2	0.03	2	2	2	5.4	0.04	
19-05583-88	42348	10/04/2019 0:00	Soil	<5	<0.1	25	3	0.02	3	2	6	5.9	0.02	0.5
19-05583-89	42349	10/04/2019 0:00	Soil	<5	<0.1	32	4	0.06	4	5	3	5.6	0.01	
19-05583-90	42350	10/04/2019 0:00	Soil	<5	<0.1	18	3	0.03	3	2	2	5.1	0.03	
19-05583-91	42804	10/04/2019 0:00	Soil	<5	<0.1	18	2	0.02	3	2	1	5.6	0.02	
19-05583-92	42805	10/04/2019 0:00	Soil	<5	<0.1	26	2	0.02	3	2	2	5.5	0.01	
19-05583-93	42806	10/04/2019 0:00	Soil	<5	<0.1	24	2	<0.02	4	2	1	5.2	0.01	
19-05583-94	42807	10/04/2019 0:00	Soil	<5	<0.1	30	3	0.02	4	4	3	6.4	0.02	0.8
19-05583-95	42808	10/04/2019 0:00	Soil	<5	<0.1	29	4	<0.02	4	5	2	5.4	0.01	
19-05583-96	42809	10/04/2019 0:00	Soil	<5	<0.1	31	4	<0.02	4	4	2	5.1	0.01	
19-05583-97	42811	10/04/2019 0:00	Soil	<5	<0.1	26	4	<0.02	5	4	3	6	<0.01	
19-05583-98	42812	10/04/2019 0:00	Soil	<5	<0.1	33	4	<0.02	4	5	3	6	<0.01	
19-05583-99	42813	10/04/2019 0:00	Soil	<5	<0.1	24	4	<0.02	6	5	3	7	0.03	
19-05583-100	42814	10/04/2019 0:00	Soil	<5	<0.1	22	3	<0.02	4	4	2	5.4	0.01	0.4
19-05583-101	42815	10/04/2019 0:00	Soil	<5	<0.1	21	3	<0.02	4	4	2	5.6	0.01	
19-05583-106	42823	10/04/2019 0:00	Soil	<5	<0.1	21	3	<0.02	3	3	1	5.8	<0.01	
19-05583-107	42824	10/04/2019 0:00	Soil	<5	<0.1	23	3	0.02	3	2	2	5.9	0.01	
19-05583-108	42825	10/04/2019 0:00	Soil	<5	<0.1	18	3	<0.02	2	3	2	5.2	0.02	
19-05583-109	42826	10/04/2019 0:00	Soil	<5	<0.1	21	3	0.02	3	2	2	5.1	0.03	

19-05583-110	42827	10/04/2019 0:00	Soil	<5	<0.1	22	3	<0.02	3	2	1	6.5	0.02	0.4	
19-05583-111	42828	10/04/2019 0:00	Soil	<5	<0.1	29	3	<0.02	3	2	2	5.6	0.01		
19-05583-112	42829	10/04/2019 0:00	Soil	<5	<0.1	34	3	0.04	2	1	1	5.3	0.01		
19-05583-113	42830	10/04/2019 0:00	Soil	<5	<0.1	31	3	0.03	2	2	1	6.2	0.04		
19-05583-114	42831	10/04/2019 0:00	Soil	<5	<0.1	47	4	0.03	3	2	1	5.2	0.01		
19-05583-115	42832	10/04/2019 0:00	Soil	<5	<0.1	41	3	0.02	2	2	<1	5.4	0.01		
19-05583-116	42833	10/04/2019 0:00	Soil	<5	<0.1	36	3	0.03	3	2	2	6.4	0.05	0.7	
19-05583-117	42834	10/04/2019 0:00	Soil	<5	<0.1	41	4	0.02	3	2	2	5.8	0.02		
19-05583-118	42835	10/04/2019 0:00	Soil	<5	<0.1	56	4	<0.02	4	3	2	5.3	0.01		
19-05583-119	42836	10/04/2019 0:00	Soil	<5	<0.1	39	4	<0.02	3	2	2	5.9	0.01		
19-05583-120	42837	10/04/2019 0:00	Soil	<5	<0.1	45	3	0.02	3	2	1	5.2	0.02		
19-05583-121	42838	10/04/2019 0:00	Soil	<5	<0.1	49	4	<0.02	4	3	2	6.2	0.02		
19-05583-122	42839	10/04/2019 0:00	Soil	<5	<0.1	53	4	<0.02	4	3	2	5.4	<0.01	0.9	
19-05583-123	42840	10/04/2019 0:00	Soil	<5	<0.1	43	5	0.02	8	7	6	7.9	0.14		
19-05583-124	42841	10/04/2019 0:00	Soil	<5	<0.1	52	5	0.02	8	6	6	7.4	0.04		
19-05583-125	42842	10/04/2019 0:00	Soil	<5	<0.1	61	5	<0.02	8	7	6	7.3	0.11		
19-05583-126	42843	10/04/2019 0:00	Soil	<5	<0.1	44	3	<0.02	6	6	4	7.1	0.06		
19-05583-127	42844	10/04/2019 0:00	Soil	<5	<0.1	63	6	<0.02	5	6	3	5.2	0.01		
19-05583-128	42845	10/04/2019 0:00	Soil	<5	<0.1	54	5	<0.02	7	6	4	6.8	0.06	0.9	
19-05583-129	42846	10/04/2019 0:00	Soil	<5	<0.1	70	5	<0.02	6	6	5	7.1	0.05		
19-05583-130	42847	10/04/2019 0:00	Soil	<5	<0.1	43	4	<0.02	5	3	2	6.2	0.06		
19-05583-131	42848	10/04/2019 0:00	Soil	<5	<0.1	45	5	<0.02	6	4	2	5.5	0.01		
19-05583-132	42849	10/04/2019 0:00	Soil	<5	<0.1	39	3	0.02	4	3	2	7.1	0.17		
19-05583-133	42850	10/04/2019 0:00	Soil	<5	<0.1	33	3	<0.02	3	2	2	5.7	0.01		
19-05583-134	43002	10/04/2019 0:00	Soil	<5	<0.1	21	2	<0.02	2	1	<1	6.4	<0.01	0.4	
19-05583-135	43003	10/04/2019 0:00	Soil	<5	<0.1	27	2	<0.02	2	1	<1	5.3	0.02		
19-05583-136	43004	10/04/2019 0:00	Soil	<5	<0.1	30	2	<0.02	2	1	<1	5.4	<0.01		
19-05583-137	43005	10/04/2019 0:00	Soil	<5	<0.1	30	2	<0.02	2	1	<1	5.5	<0.01		
19-05583-138	43006	10/04/2019 0:00	Soil	<5	<0.1	40	3	<0.02	3	2	<1	5.3	0.01		
19-05583-139	43007	10/04/2019 0:00	Soil	<5	<0.1	34	3	<0.02	3	2	1	6.3	<0.01		
19-05583-140	43008	10/04/2019 0:00	Soil	<5	<0.1	38	3	<0.02	3	2	1	5.2	0.01	1.0	
19-05583-141	43009	10/04/2019 0:00	Soil	<5	<0.1	44	3	<0.02	2	3	1	5.1	0.02		
19-05583-142	43012	10/04/2019 0:00	Soil	<5	<0.1	30	2	<0.02	2	1	1	6.3	0.02		
19-05583-143	43013	10/04/2019 0:00	Soil	<5	<0.1	29	2	<0.02	3	2	1	6.1	0.01		
19-05583-144	43014	10/04/2019 0:00	Soil	<5	<0.1	30	3	<0.02	2	2	1	5.1	0.04		
19-05583-145	43015	10/04/2019 0:00	Soil	<5	<0.1	26	3	<0.02	2	2	2	6.8	0.03		
19-05583-146	43016	10/04/2019 0:00	Soil	<5	<0.1	25	3	<0.02	3	2	1	5.8	<0.01	4.0	
19-05583-147	43017	10/04/2019 0:00	Soil	<5	<0.1	100	4	0.02	3	6	1	4.9	0.03		
19-05583-148	43018	10/04/2019 0:00	Soil	<5	<0.1	32	2	<0.02	2	2	<1	5.1	<0.01		
19-05583-149	43019	10/04/2019 0:00	Soil	<5	<0.1	28	2	<0.02	2	1	<1	5.9	0.02		
19-05583-152	43022	10/04/2019 0:00	Soil	<5	0.3	19	3	0.06	2	1	<1	5.2	0.01		
19-05583-153	43023	10/04/2019 0:00	Soil	<5	0.2	16	3	<0.02	2	1	1	5.4	<0.01		
19-05583-154	43024	10/04/2019 0:00	Soil	<5	0.2	15	2	<0.02	2	1	<1	5.3	0.01	0.5	
19-05583-155	43025	10/04/2019 0:00	Soil	<5	0.2	15	3	<0.02	2	1	<1	5.6	0.01		
19-05583-156	43026	10/04/2019 0:00	Soil	<5	0.2	16	3	<0.02	2	1	1	5.2	<0.01		
19-05583-159	43029	10/04/2019 0:00	Soil	<5	0.3	20	3	<0.02	3	2	1	4.9	0.01		
19-05583-160	43030	10/04/2019 0:00	Soil	<5	0.3	19	3	<0.02	3	2	2	5.3	0.01		
19-05583-161	43031	10/04/2019 0:00	Soil	<5	0.3	22	3	<0.02	2	2	1	5.4	<0.01	0.5	
19-05583-162	43032	10/04/2019 0:00	Soil	<5	0.4	23	4	<0.02	3	2	1	5.1	<0.01		
19-05583-163	43033	10/04/2019 0:00	Soil	<5	0.3	19	3	<0.02	3	2	1	4.9	0.01		
19-05583-164	43034	10/04/2019 0:00	Soil	<5	0.3	19	3	0.02	3	2	1	5.1	<0.01		
19-05583-167	43037	10/04/2019 0:00	Soil	<5	0.3	19	3	<0.02	3	2	2	5	0.02		

19-05583-168	43038	10/04/2019 0:00	Soil	<5	0.3	20	3	<0.02	3	2	2	4.9	0.01	
19-05583-169	43039	10/04/2019 0:00	Soil	<5	0.3	20	3	<0.02	2	2	1	5.1	0.01	0.7
19-05583-171	43041	10/04/2019 0:00	Soil	<5	0.3	21	3	<0.02	3	2	1	5.5	<0.01	
19-05583-172	43042	10/04/2019 0:00	Soil	<5	0.4	23	4	<0.02	4	3	2	5.1	0.02	
19-05583-173	43043	10/04/2019 0:00	Soil	<5	0.5	32	4	<0.02	5	3	3	5.1	0.01	
19-05583-174	43044	10/04/2019 0:00	Soil	<5	0.4	30	6	<0.02	10	5	5	7.5	0.02	
19-05583-177	43048	10/04/2019 0:00	Soil	<5	0.5	32	7	<0.02	10	6	6	7.4	0.03	
19-05583-178	43049	10/04/2019 0:00	Soil	<5	0.5	35	6	<0.02	9	6	5	7	0.01	0.3
19-05583-179	43050	10/04/2019 0:00	Soil	<5	0.6	40	5	<0.02	8	5	5	7.4	0.06	
19-05583-180	43051	10/04/2019 0:00	Soil	<5	0.6	35	6	<0.02	8	5	3	6.6	0.02	
19-05583-181	43052	10/04/2019 0:00	Soil	6	0.2	18	5	<0.02	5	3	5	7.2	0.09	
19-05583-182	43101	10/04/2019 0:00	Soil	<5	0.3	19	3	<0.02	3	2	1	5.2	<0.01	
19-05583-183	43102	10/04/2019 0:00	Soil	<5	0.2	17	3	<0.02	3	1	1	5	<0.01	
19-05583-186	43105	10/04/2019 0:00	Soil	<5	0.3	15	2	<0.02	2	2	1	5.2	0.01	0.4
19-05583-187	43108	10/04/2019 0:00	Soil	<5	0.3	17	2	<0.02	2	<1	1	5.5	0.01	
19-05583-188	43109	10/04/2019 0:00	Soil	<5	0.2	15	2	<0.02	2	1	1	5.4	0.02	
19-05583-189	43111	10/04/2019 0:00	Soil	<5	0.3	17	3	<0.02	3	2	1	4.8	0.02	
19-05583-190	43114	10/04/2019 0:00	Soil	<5	0.4	26	6	<0.02	7	3	6	7.2	0.03	
19-05583-191	43117	10/04/2019 0:00	Soil	<5	0.2	13	2	<0.02	2	1	2	6.5	0.02	
19-05583-192	43118	10/04/2019 0:00	Soil	<5	0.2	16	3	<0.02	3	2	2	6.6	0.02	1.0
19-05583-193	43121	10/04/2019 0:00	Soil	<5	0.3	16	3	<0.02	3	2	2	6.5	0.01	
19-05583-194	43123	10/04/2019 0:00	Soil	<5	0.4	25	4	<0.02	4	3	2	5.4	0.01	
19-05583-195	43124	10/04/2019 0:00	Soil	<5	0.4	23	4	<0.02	4	3	2	5.4	0.01	
19-05583-196	43126	10/04/2019 0:00	Soil	<5	0.3	22	3	<0.02	3	2	1	5.3	0.01	
19-05583-197	43127	10/04/2019 0:00	Soil	<5	0.3	21	3	<0.02	3	1	1	5.3	0.01	0.4
19-05583-198	43120	10/04/2019 0:00	Soil	<5	0.3	22	4	<0.02	4	2	3	6.2	0.02	
19-05583-199	43129	10/04/2019 0:00	Soil	<5	0.4	25	3	<0.02	3	2	1	4.8	0.02	
19-05583-200	43130	10/04/2019 0:00	Soil	<5	0.3	22	2	<0.02	3	2	1	5.3	0.01	
19-05583-201	43191	10/04/2019 0:00	Soil	<5	0.3	24	3	<0.02	4	1	2	5.2	<0.01	0.4
19-05583-202	43132	10/04/2019 0:00	Soil	<5	0.3	21	2	<0.02	2	1	1	5	<0.01	
19-05583-203	43133	10/04/2019 0:00	Soil	<5	0.3	22	2	<0.02	2	1	1	5	<0.01	
19-05583-204	43135	10/04/2019 0:00	Soil	<5	0.3	22	3	<0.02	3	2	2	5.2	0.02	
19-05583-205	43136	10/04/2019 0:00	Soil	<5	0.3	20	3	<0.02	3	2	1	5.3	0.02	0.5
19-05583-206	43138	10/04/2019 0:00	Soil	<5	0.3	19	2	<0.02	2	<1	1	5	0.02	
19-05583-207	43139	10/04/2019 0:00	Soil	<5	0.2	14	1	<0.02	2	<1	<1	5	0.01	
19-05583-208	43141	10/04/2019 0:00	Soil	<5	0.3	23	3	<0.02	3	1	2	5.2	0.02	
19-05583-209	43142	10/04/2019 0:00	Soil	<5	0.3	17	2	<0.02	2	1	1	5.4	0.02	
19-05583-210	43144	10/04/2019 0:00	Soil	<5	0.3	20	2	<0.02	3	1	2	5.6	0.01	
19-05583-211	43145	10/04/2019 0:00	Soil	<5	0.3	17	2	<0.02	3	1	1	5.4	<0.01	0.5
19-05583-212	43147	10/04/2019 0:00	Soil	<5	0.2	12	1	<0.02	2	<1	<1	5.7	<0.01	
19-05583-213	43148	10/04/2019 0:00	Soil	<5	0.2	14	2	<0.02	2	<1	1	5.5	0.02	
19-05583-214	43149	10/04/2019 0:00	Soil	<5	0.3	20	1	<0.02	2	1	1	5.1	<0.01	
19-05583-215	43150	10/04/2019 0:00	Soil	<5	0.3	17	1	<0.02	2	1	1	5.3	<0.01	
19-05583-216	43151	10/04/2019 0:00	Soil	<5	0.3	20	1	<0.02	3	1	1	5.5	0.02	
19-05583-219	43156	10/04/2019 0:00	Soil	<5	0.2	16	1	<0.02	2	1	1	5.3	0.02	0.8
19-05583-220	43157	10/04/2019 0:00	Soil	<5	0.2	18	2	<0.02	3	1	2	5.5	<0.01	
19-05583-225	43171	10/04/2019 0:00	Soil	<5	0.3	26	2	<0.02	3	2	1	5.8	<0.01	
19-05583-228	43176	10/04/2019 0:00	Soil	<5	0.7	53	2	<0.02	3	3	2	5	0.02	
19-05583-231	43181	10/04/2019 0:00	Soil	<5	0.3	23	2	<0.02	4	2	3	5.6	0.05	
19-05583-232	43188	10/04/2019 0:00	Soil	<5	0.3	20	2	<0.02	3	1	1	5.7	<0.01	
19-05583-233	43194	10/04/2019 0:00	Soil	<5	0.3	20	2	<0.02	2	2	1	5.3	<0.01	
19-05583-234	43195	10/04/2019 0:00	Soil	<5	0.3	22	2	<0.02	3	2	2	5.3	0.01	

19-05583-235	43196	10/04/2019 0:00	Soil	<5	0.3	20	1	<0.02	2	<1	1	5.7	0.01	
19-05583-236	43197	10/04/2019 0:00	Soil	<5	0.3	19	1	<0.02	3	1	1	5.4	0.01	
19-05583-237	43198	10/04/2019 0:00	Soil	<5	0.3	19	1	<0.02	3	1	2	5.3	0.01	
19-05583-238	43199	10/04/2019 0:00	Soil	<5	0.3	22	1	<0.02	3	1	2	5.5	0.01	0.7
19-05583-239	43200	10/04/2019 0:00	Soil	<5	0.3	26	2	<0.02	3	2	2	5	<0.01	
19-05583-240	43251	10/04/2019 0:00	Soil	<5	0.2	14	1	<0.02	2	1	<1	5.1	<0.01	
19-05583-241	43252	10/04/2019 0:00	Soil	<5	0.2	16	1	<0.02	2	1	<1	4.9	0.01	
19-05583-242	43253	10/04/2019 0:00	Soil	<5	0.2	16	1	<0.02	2	1	1	5.4	<0.01	
19-05583-243	43254	10/04/2019 0:00	Soil	<5	0.3	26	1	<0.02	2	2	1	5.3	0.02	
19-05583-244	43255	10/04/2019 0:00	Soil	<5	0.2	13	1	<0.02	2	1	<1	5.4	0.05	1.2
19-05583-245	43256	10/04/2019 0:00	Soil	<5	0.3	22	1	<0.02	3	2	1	5.2	0.01	
19-05583-246	43257	10/04/2019 0:00	Soil	<5	0.2	18	1	<0.02	2	1	1	5.1	0.01	
19-05583-247	43258	10/04/2019 0:00	Soil	<5	0.2	16	1	<0.02	2	1	<1	5.2	<0.01	
19-05583-248	43260	10/04/2019 0:00	Soil	<5	0.3	25	1	<0.02	3	2	2	5.2	0.01	
19-05583-251	43263	10/04/2019 0:00	Soil	<5	0.3	24	2	<0.02	4	2	2	5.3	0.03	
19-05583-252	43264	10/04/2019 0:00	Soil	<5	0.3	22	1	<0.02	4	2	2	6.3	0.02	0.3
19-05583-253	43265	10/04/2019 0:00	Soil	<5	0.4	35	3	<0.02	5	3	2	5.1	0.01	
19-05583-254	43266	10/04/2019 0:00	Soil	<5	0.3	28	2	<0.02	4	2	1	6	0.02	
19-05583-255	43267	10/04/2019 0:00	Soil	<5	0.3	33	2	<0.02	5	3	3	6.7	0.02	
19-05583-256	43268	10/04/2019 0:00	Soil	<5	0.4	38	5	<0.02	9	5	5	6.2	0.01	
19-05583-257	43269	10/04/2019 0:00	Soil	<5	0.4	35	3	<0.02	7	4	3	7.2	0.04	
19-05583-258	43270	10/04/2019 0:00	Soil	<5	0.3	27	1	<0.02	5	2	3	6.5	0.01	0.4
19-05583-259	43271	10/04/2019 0:00	Soil	<5	0.3	28	2	<0.02	4	2	2	6.1	0.02	
19-05583-260	43272	10/04/2019 0:00	Soil	<5	0.2	22	1	<0.02	3	2	1	5.9	<0.01	
19-05583-261	43273	10/04/2019 0:00	Soil	<5	0.2	15	1	<0.02	3	2	3	6	0.01	
19-05583-262	43274	10/04/2019 0:00	Soil	<5	0.3	22	<1	<0.02	3	2	2	5.9	<0.01	
19-05583-263	43275	10/04/2019 0:00	Soil	<5	0.2	18	1	<0.02	3	3	3	6.3	0.02	
19-05583-264	43276	10/04/2019 0:00	Soil	<5	0.3	23	2	<0.02	3	2	1	5.3	0.01	0.3
19-05583-265	43277	10/04/2019 0:00	Soil	<5	0.4	29	2	<0.02	5	3	2	5.2	0.01	
19-05583-266	43278	10/04/2019 0:00	Soil	<5	0.3	26	2	0.02	4	2	1	5.9	0.21	
19-05583-267	43279	10/04/2019 0:00	Soil	<5	0.5	38	4	<0.02	7	5	4	6.5	0.03	
19-05583-268	43301	10/04/2019 0:00	Soil	<5	0.3	21	1	<0.02	3	1	1	5.4	<0.01	
19-05583-269	43302	10/04/2019 0:00	Soil	<5	0.3	24	2	<0.02	3	2	1	5.1	<0.01	
19-05583-270	43303	10/04/2019 0:00	Soil	<5	0.3	26	2	0.08	3	1	2	5.2	<0.01	0.4
19-05583-271	43304	10/04/2019 0:00	Soil	<5	0.3	24	1	<0.02	3	1	1	5	0.01	
19-05583-272	43305	10/04/2019 0:00	Soil	<5	0.3	25	2	<0.02	3	2	1	4.9	0.01	
19-05583-273	43307	10/04/2019 0:00	Soil	<5	0.3	24	1	<0.02	4	2	2	6.2	<0.01	
19-05583-274	43308	10/04/2019 0:00	Soil	<5	0.3	23	1	<0.02	4	2	1	5.8	<0.01	
19-05583-275	43309	10/04/2019 0:00	Soil	<5	0.3	21	1	<0.02	4	2	1	5.8	<0.01	
19-05583-276	43311	10/04/2019 0:00	Soil	<5	0.4	30	3	<0.02	4	2	1	5.3	0.01	0.5

Health investigation levels (HILs) have been developed for a broad range of metals and organic substances. The HILs are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions should determine the depth to which HILs apply for other land uses.

HIL A - Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.
HIL B - Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
HIL C - Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate.
HIL D - Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.
EIL 1 - Ecological investigation limit: Area of ecological significance (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater)
EIL 2 - Ecological investigation limit:Urban residential and public open space (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater)

EIL 3 - Ecological investigation limit:Commerical and industrial (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater)

[1] SS ACL Cr - Soil-specific (added contaminant limit) for ecological investigation limit (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater). Based on Cr III and the lowest value has been used as a precaution

[2] SS ACL - Soil-specific (added contaminant limit) for ecological investigation limit (NEPM, Schedule B 1 - Guideline on Investigation Levels for Soil and Groundwater). The lowest value has been used as a precaution.

[3] ACL Pb - Generic added contaminant limits for lead in soils irrespective of their physicochemical properties

- Denotes no NEPM guidelines available

TELLUS

Sandy Ridge
Groundwater Monitoring Well Network
Depth To Groundwater - Register To date

Well ID		SRMB146	SRMB147	SRMB148	SRMB149	SRMB150	SRMB151	SRMB152	SRMB153	SRMB154	SRMB155	SRMB156	SRMB157	SRMB158	SRMB159	SRMB160	SRMB161	SRMB162	SRMB163	SRMB164	SRMB165	SRMB167	SRMB168	SRMB169	SRMB170	SRMB171
Well Information [1]																										
Location from Site [3]		<1km	<1km	<1km	<1km	>1km	<1km	<1km	<1km	<1km	<1km	>1km	>1km	>1km	>1km	>1km	>1km	<1km	>1km	>1km	<1km	<1km	<1km	<1km	<1km	<1km
East (Zone 51J mE)		219890	219890	219700	220236	219368	219680	219499	219743	219835	219772	219826	219964	219961	220413	220498	220411	220806	219232	218372	219420	220094	220427	220306	220223	220326
North (Zone 51J mN)		6637792	6638004	6637805	6637885	6638390	6638401	6637603	6637943	6638124	6638249	6638611	6638705	6638807	6637626	6637576	6637530	6637037	6636050	6637287	6638085	6638350	6637578.73	6637512.04	6637561.38	6637630.02
RLGL (DTM, m AHD)		463.21	462.97	461.36	468.79	461.42	462.47	460.00	461.52	463.17	463.15	465.00	467.12	469.56	470.30	470.30	469.70	469.50	457.40	462.40	459.70	-	469.52	469.47	469.26	469.59
Date Drilled		28/02/2015	14/03/2015	16/03/2015	16/03/2015	17/03/2015	17/03/2015	17/03/2015	16/04/2016	16/04/2016	22/04/2016	22/04/2016	23/04/2016	23/04/2016	11/12/2017	11/12/2017	11/12/2017	11/12/2017	11/12/2017	11/12/2017	11/12/2017	31/03/2020	1/04/2020	2/04/2020	4/04/2020	3/04/2020
Drill Method		Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Aircore	Diamond	Diamond	Diamond	Diamond	Diamond
Installation BoC (m btoc)		30.41	20.65	24.18	23.03	47.50	44.91	35.25	43.18	45.10	44.00	26.11	30.43	28.92	28.00	35.50	22.00	43.00	36.20	44.50	39.55	102.30	29.12	35.48	33.70	35.80
Casing Size		50	50	50	50	50	50	50	37	37	37	37	37	37	37	37	37	37	37	37	37	50	50	50	50	50
Stickup - PVC (m agl)		0.66	0.88	0.89	1.06	0.92	0.55	0.54	0.56	0.47	0.56	0.51	0.51	0.62	0.34	0.38	0.48	0.44	0.63	0.55	0.38	0.62	0.66	0.68	0.72	0.63
Stickup - Steel (m agl)		0.88	0.88	1.00	1.15	1.07	0.55	0.56	0.63	0.54	0.59	0.54	0.53	0.65	0.65	0.60	0.62	0.66	0.80	0.80	0.61	0.76	0.68	0.71	0.78	0.87
Groundwater Level (GWL) - m btoc																										
Date Gauged	Gauged By	Installed 2015																								
2015-05-06	MI	Dry	Dry (20.61)	Dry	Dry	36.10	36.65	34.35																		
2015-07-30	MI	Dry	Dry (20.61)	23.95	23.02	35.90	36.52	34.14																		
2015-10-19	MI	Dry	Dry (20.62)	23.82	Dry	35.99	36.65	34.22																		
2016-02-12	-	30.28	20.47	23.71	22.79	35.78	36.55	34.19																		
2016-04-13	-	30.28	20.49	23.70	22.79	35.83	36.59	34.22	Installed 2016																	
2016-08-18	-	30.28	20.48	23.71	22.80	35.84	36.61	34.10	35.54	37.19	37.21	Dry (26.11)	Dry (30.43)	Dry (28.87)												
2016-08-18	-					35.83	36.59		35.53	37.18	37.16	Dry (26.11)	Dry (30.43)	Dry (28.87)												
2016-12-15	-	30.28	20.48	23.70		35.82	36.57	34.18	35.53	37.17	37.15	Dry (26.11)	Dry (30.43)	Dry (28.87)												
2017-07-21	MW	30.29	20.48	23.59	22.90	? 25.09	36.56	34.20	35.48	?35.4	? 36.78	? 22.49	? 28.34	Dry (28.88)												
2017-08-30	MW	30.34	20.58	23.88	22.80	35.77	36.55	34.19	35.50	37.12	37.13	Dry (26.11)	Dry (30.43)	Dry (28.88)				Installed 2017								
2017-12-11	MW	30.29	20.49	23.71	22.85	35.74	36.51	34.18	35.50	37.13	37.10	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.37	29.37	? 36.33	33.89					
2018-04-11	MW	30.24	20.49	? 24.74	22.78	35.76	36.63	34.30	35.56	37.11	37.17	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.27	29.20	34.32	33.71					
2018-07-05	MW	30.28	20.50	23.72	22.79	35.83	36.64	34.33	35.55	37.23	37.24	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.19	29.26	34.40	33.73					
2019-02-06	MW	30.34	20.51	23.72	22.82	35.73	36.66	? 34.83	35.53	37.13	37.14	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.10	29.24	34.45	33.61					
2019-04-06	MW	30.23	20.46	23.74	22.82	35.83	36.72	34.32	35.62	37.23	37.25	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.10	29.28	34.43	33.80					
2019-10-29	TW	30.31	20.48	23.78	22.78	35.84	36.68	34.25	35.55	37.24	37.22	Dry (26.11)	Dry (30.43)	Dry (28.92)	Dry (28.00)	Dry (35.50)	Dry (22.00)	42.14	? 36.2	34.48	? 41.8					
2019-11-30	TW	30.40		23.72	22.80			34.22													-					
2020-02-04	TW	30.31	20.52	23.82	22.98			34.23	35.60	37.24			30.41								? 34.61					
2020-04-07	AD					35.73	36.58				37.20				Decommissioned 2020 [2]							Installed 2020				
2020-04-18	VM	30.34	20.50	23.81	22.48	35.84	36.68	34.20	35.60	37.24	37.25	Dry (26.11)	30.41	Dry (28.92)				42.20	29.40	34.65	33.65	39.90	Dry	?36.8	?35.93	Dry
2020-04-21	AD																						Dry (29.12)	35.41	33.12	Dry (35.80)
2020.04.28	AD		20.50	23.74				33.88		37.37																
2020.04.30	AD						36.72	33.90	35.73	37.38	37.31										33.81	39.89				
GWL Summary (excl. outliers) - m btoc																										
N° Entries		15	15	17	15	17	19	19	14	14	13	0	2	0	0	0	0	7	6	6	7	2	0	1	1	0
Average - GWL		30.30	20.50	23.75	22.81	35.83	36.61	34.19	35.56	37.21	37.19	Dry	30.41	Dry	Dry	Dry	Dry	42.20	29.29	34.46	33.74	39.90	Dry	35.41	33.12	Dry
Average - Water Column (m)		0.11	0.15	0.43	0.21	11.67	8.30	1.06	7.62	7.89	6.81	-	0.02	-	-	-	-	0.81	6.91	10.05	5.81	62.41	-	0.07	0.58	-
High		30.40	20.58	23.95	23.02	36.10	36.72	34.35	35.73	37.38	37.31	-	30.41	-	-	-	-	42.37	29.40	34.65	33.89	39.90	-	35.41	33.12	-
Low		30.23	20.46	23.59	22.48	35.73	36.51	33.88	35.48	37.11	37.10	-	30.41	-	-	-	-	42.10	29.20	34.32	33.61	39.89	-	35.41	33.12	-
Range (High - Low)		0.17	0.12	0.36	0.54	0.37	0.21	0.47	0.25	0.27	0.21	-	0.00	-	-	-	-	0.27	0.20	0.33	0.28	0.01	-	0.00	0.00	-
LMMP Sample Plan																										
<1km from Cell 1 ?		<1km	<1km	<1km	<1km	>1km	<1km	<1km	<1km	<1km	<1km	>1km	>1km	>1km	>1km	>1km	>1km	<1km	>1km	>1km	<1km	<1km	<1km	<1km	<1km	<1km
>1m water present?		0.11	0.15	0.43	0.21	11.67	8.30	1.06	7.62	7.89	6.81	-	0.02	-	-	-	-	0.81	6.91	10.05	5.81	62.41	-	0.07	0.58	-
Well to be Sampled?							Y	Y	Y	Y	Y										Y	Y				

Note: SRMB166 is located 'offsite' and is associated with the groundwater abstraction bore and not the 'site' groundwater monitoring network.

[1] *Refer to Groundwater Monitoring Well Construction Logs for further information, if required.*

[2] *SRMB159 to SRMB161 decommissioned due to being located within the Cell 1 construction footprint. However, these bores were replaced with SRMB168-SRMB171 (installed in 2020 and which surround Cell 1)'..*

[3] *LMMP requires wells within 1km of site to be sampled, if sufficient water is present*

Outlier, presumed anomalous (i.e. human error)

Range >0.5m

Range >1.0m

APPENDIX F: GROUNDWATER MONITORING PROCEDURE

TELLUS

Management Standard

MS08 – Process Control and Delivery

Sandy Ridge Groundwater Sampling

OPERATIONAL PROCEDURE

SANDY RIDGE GROUNDWATER MONITORING

Tellus Holdings Ltd

April 20

Approval

The signatures below certify that this procedure has been reviewed and accepted and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.

	Name	Position	Sign-off Status	Effective Date
Document Owner	Adam Donegan	Environmental Scientist		23/04/2020
Document Reviewer	Richard Phillips	GM HSECQ		
Document Approver	Tellus_IT Innovation & Strategy	GM HSECQ		

Amendment Record

This procedure is reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or omissions is given below:

Page No.	Context	Version	Date

Company Proprietary Information

The electronic version of this procedure is the latest version. It is the responsibility of the individual to ensure that any paper material is the current version. The printed version of this procedure is uncontrolled.

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Appendix A Chain of Custody Form
Appendix B Groundwater Sampling Field Sheet

1 APPLICABILITY

This groundwater sampling procedure developed by Tellus Holdings Ltd (**Tellus** or the **Company**) is applicable to the Sandy Ridge site (**the Site**).

The sites groundwater well network is typically characterised by:

- Bottom of casing (**BoC**, base of well) ranging from approximately 20 to 50 metres below ground level (**mbgl**).
- Well casing diameters ranging from standard 50 mm uPVC to narrow 37 mm uPVC (piezometer wells).
- Water depths ranging from approximately 20 to 35 mbgl.
- Very low recharge rate.
- Water columns ranging from 0m (dry) to 11 m.
- Limited purging has resulted from some wells having a very shallow water column (i.e. less than 1 m), these wells typically have a high sediment content in the water column making sampling difficult.

As presented in the Public Environmental Review (PER), groundwater at Sandy Ridge was found to be relict water trapped more than 20 m below the ground surface in the undulations of unweathered bedrock (Rockwater 2015, Appendix A.11 to the PER). Over 200 drill holes drilled in the area indicate the water is restricted to a pocket in the western portion of the site. Further, the groundwater is held in 70-million year old weathered kaolinised granite with an extremely low permeability similar to concrete (Cymod 2016, Appendix A.12 to the PER). Therefore, groundwater at Sandy Ridge is extremely unlikely to be affected by seasonality, change with time and is not prone to moving location.

With consideration of the above, a review of available sample methods was completed to identify the preferred sample method. A summary of the review outcome is provided in Table 1.

Table 1: Summary of Sample Method Review

		Suitability Criteria					Preference
		A 'Low Flow' sample method?	Suitable for sampling wells >20m bgl?	Suitable for PFAS sampling?	Suitable for sampling a 50mm diameter well?	Suitable for sampling a 37mm diameter well?	
Sample Method	Low Flow Pump: Standard	Yes	Yes	Yes	Yes	No	3
	Low Flow Pump: Narrow (valve)	Yes	Yes	Yes	Yes	Yes	1
	Low Flow Pump: Narrow (bladder)	Yes	Yes	Possibly [1]	Yes	Yes	3
	Peristaltic Pump	Yes	No	Yes	Yes	Yes	-
	HydraSleeve	No	Possibly [2]	Yes	Yes	Possibly [2]	-
	Bailer: Standard	No	Yes	Yes	Yes	No	3
	Bailer: Narrow / Unweighted	No	Difficult to Sample	Yes	Yes	Yes	3
	Bailer: Narrow / Weighted [3]	No	Yes	Yes	Yes	Yes	2

[1] To date the most suitable pump known to Tellus still contains LDPE bladders which are not ideal, therefore 'valve' pumps are preferred.

[2] There is concern with the tendency for these sleeves to expand and resist being pulled out of a deep and/or narrow wells, repetitive use with possible abrasive silty water could quickly deteriorate the sleeves and increase the risk of sample loss and possibly torn sections of the sleeve being lost in the well.

[3] *Weighted 'disposable' bailer or stainless-steel reusable narrow bailer (which inherently has a greater weight than a disposable bailer)*

Based on the above, the preferred sample methods include:

- Primary sample method: Low Flow Pump (narrow gauge, double valve); and
- Secondary sample method: Weighted Narrow Bailer. To be adopted if sample difficulties arise from using the primary method.

Whilst it is acknowledged 50 mm diameter wells could be sampled using 'standard' as well as 'narrow' gauge equipment; 37 mm diameter wells can only be sampled using narrow gauge equipment. Therefore, the preference is to utilise narrow gauge equipment for all wells (regardless if they are 50 mm or 37 mm) to ensure a consistent approach to all wells sampled.

Tellus is mindful to minimise interchanging between primary and secondary sample methods over time and between wells, this 'may' result in a variability in results. Therefore, after initial sampling, the most effective sample method will be identified and utilised thereafter to attempt to maintain a constant sample method.

Both sample methods are described within this document in the following parts:

- Part A: Primary Sample Method (Low Flow)
- Part B: Secondary Sample Method (Bailer)

2 PURPOSE AND SCOPE

The purpose of this procedure is to provide the methodology actions required to collect a water sample from a groundwater well.

This procedure applies to personnel deemed competent in groundwater sampling. Competency will be assessed by the HSECQ Department.

The following documents have been used to assist in the development of this procedure:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999.*
- *PFAS National Environmental Management Plan (NEMP) (HEPA, January 2018).*
- *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) (DER WA, January 2017).*
- *National Environmental Protection (Assessment of Site Contamination) Amendment Measure. National Environmental Protection Council, May 2013 (NEPM 2013).*
- *AS/NZS 5667.1:1998 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*
- *AS/NZS 5667.10:1998 and ISO 5667-10:1992 Water Quality—Sampling Part 10: Guidance on Sampling of Waste Waters.*

3 RESPONSIBILITIES

Environment Manager (Perth)	• Document review and approval.
Environmental Scientist (Perth)	• Document preparation and review.
Site supervisor	• Certifies the procedure is carried out in accordance with what is written.
Field scientist/technician	• Follows the procedure. If in doubt, seek assistance from Environment Manager.

4 COMPETENCYQUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

4.1 Field Quality Assurance (QA) and Quality Control (QC)

QA/QC samples are collected to provide reassurance and reliability of the robustness of the data set collected. During each monitoring event the following QA/QC samples will be collected:

Field Duplicate (Dup)	Identify any variation in analyte concentrations between samples collected from the same sampling point. The relative percentage difference (RPD) between primary and duplicate 'split' samples should in general be within 50% for low level duplicates and 30% for high level duplicates for all analytes.	1 in 20 primary samples [1]
Field Triplicate (Trip)	Identify any variation in analyte concentrations between laboratories. The RPD % difference between primary and triplicate 'split' samples should in general be within 50% for low level triplicates and 30% for high level triplicates for all analytes.	1 in 20 primary samples [1]
Rinsate Blank (RB)	Rinsate samples are collected by running deionised water (DI) over a piece of equipment used on all wells after the final decontamination rinse. Collected in the field to validate the cleanliness of the sampling devices and to confirm the quality of field decontamination procedures.	1 per field day

[1] *With 6 primary samples collected per monitoring event, this means on average one Dup and one Trip will be collect every 4 monitoring events.*

QA/QC samples will be analysed for a minimum of 'two' of the below suites (which represent most primary sample analyte suites), with the intention for all QA/QC samples to have been tested for at least one of the suites.

- Metals.
- TRH/BTEXN.
- PAHs.
- PFAS.
- OC/Ops.
- PCBs.

With only 6 primary samples collected each monitoring event it is considered unrealistic to have every QA/QC sample analysed for all analytical suites during each monitoring event.

4.2 Laboratory QA/QC

Tellus aims for all analytical testing laboratories and their methodologies to be accredited by the National Association of Testing Authorities (NATA).

As part of internal QA/QC, Tellus requires these laboratories to conduct regular audits on their analyses using reagent blanks, analysis of surrogate spikes, repeat duplicates and verification of recoveries.

5 PFAS SPECIFIC SAMPLING REQUIREMENTS

The Sandy Ridge Facility is approved under the Australian Government *Environmental Biodiversity Conservation Act 1999*. A condition of consent related to that approval is for the Sandy Ridge Facility to adhere to the National PFAS NEMP.

Accordingly, PFAS will be sampled for during groundwater monitoring. PFAS is found in everyday products which can contaminate sample equipment and the sample.

Whilst the following Part A and B sample methods have been developed to mitigate the possibility of sample contamination (Inclusive of PFAS). The below extract from the *Interim Guideline on the Assessment and Management of PFAS,* has been provided as it provides a clear distinction on 'common' equipment which can and cannot be used when sampling for PFAS.

Consult with the HSECQ Department if you have any further queries or refer to this guideline and the *PFAS National Environmental Management Plan* for further information.

Product	Mitigation practice	Alternative product or practice when PFAS sampling is to be undertaken
Clothing and food		
New clothing	Not to be used/consumed by sampling personnel[1]	Wash all field clothing a minimum of six times after purchase to remove surface coatings before using at the site.
Clothing with stain-resistant, rain-resistant, or waterproof coatings/ treated fabric (for example GORE-TEX®)		Avoid sampling during rain if possible; polyethylene rain gear (for example disposable LDPE), vinyl or polyvinyl chloride (PVC) clothing are acceptable.
Tyvek® clothing		None
Fast food wrappers and containers		Use rigid plastic containers or bags or stainless steel containers for all food brought to site.
Pre-wrapped foods and snacks (for example chocolate bars, energy bars, granola bars and potato chips		Use plastic (rigid containers or bags) or stainless steel containers to bring food to site.
Sampling equipment and containers		
Teflon® containing or coated field equipment (tubing, bailers, tape and plumbing paste)	Do not use at site[2]	High Density Polyethylene (HDPE) or silicone tubing, and HDPE or polypropylene field equipment recommended. Concawe (2016) reports that although high purity Teflon tubing does not cause 'blank contamination' in contrast to common Teflon tubing, some researchers have found that Teflon could adsorb PFAS.
Teflon® lined lids on containers (for example sample containers, rinsate water storage containers)	Do not use at site[2]	Polypropylene lids[3] for sample containers and polypropylene or HDPE containers for rinsate.

Product	Mitigation practice	Alternative product or practice when PFAS sampling is to be undertaken
Glass sample containers with lined lids	Do not use	Use polypropylene or HDPE for sample containers[3] (PFAS adsorb strongly to glass).
Other products		
Aluminium foil	Do not use[1]	Thin HDPE sheeting (commonly used as drop cloths for painting or home improvement) can be used.
Self-sticking notes and similar office products (for example 3M Post-It notes)	Do not use at site[2]	Avoid the use of these products at the site.
Waterproof paper, notebooks, and labels	Do not use at site[2]	Standard paper and paper labels.
Drilling fluid containing PFAS	Do not use at site[2]	PFAS-free drilling fluids or use alternative techniques (for example sonic drilling) which do not require drilling fluids.
Detergents and decontamination solutions (for example Decon 90® Decontamination Solution)	Do not use	Follow water-only decontamination approach.
Reusable chemical or gel ice packs (for example BlueIce®)	Do not use	Ice contained in plastic (polyethylene) bags (double bagged).

Notes

[1] Sampling personnel includes all personnel who:

- are directly involved in the collection, handling and/or processing of samples prior to the samples leaving the site;
- handle any part of well development equipment that directly contacts bore water being sampled;
- handle any part of equipment that directly contacts surface water or aquatic sediment;
- are within 2–3m of the borehole during soil sampling; or
- are within 2–3m of the collection and processing area on aquatic vessels during sediment or surface water sampling.

Personnel are not included as sampling personnel if they remain at least 2–3m away from sample collection areas prior to and during sampling.

[2] Entire sample collection and processing area, including vehicles used by sampling personnel.

[3] USEPA and ASTM method for the analysis of PFAS in solid and liquids specify polypropylene or HDPE with polypropylene lids. Check with the laboratory with regards to preference for polypropylene or HPDE.

6 PART A: PRIMARY SAMPLE METHOD (LOW FLOW)

6.1 Equipment

- Sampling bottles pre-ordered from NATA accredited laboratory based on the analytes listed in the Leachate Monitoring and Management Plan (**LMMP**) and Deep Groundwater Monitoring and Management Plan (**DGMMP**).
- Waterproof permanent marker.
- Filters (pore size of around 0.45 um) one per well.
- Sampling records from previous sampling event.
- Groundwater well location plan.
- Eskies.
- Ice.
- Deionised water for QA/QC samples (DI).
- Decontamination station (PFAS free)
    - Detergent (i.e. Liquanox)
    - Buckets
    - Potable water
    - DI
- Chain of Custody (**CoC**) Form – Appendix A.

- Field Sample Sheet (if unable to complete electronically) – Appendix B.
- Water level dipper or 'IP' probe.
- 12V standalone battery or car battery.
- Water quality meter that measures pH, temperature, electrical conductivity (EC), redox potential (Eh), dissolved oxygen (DO) (i.e. YSI).
- Low Flow Pump (narrow gauge, double valve).
- Control box.
- Air Compressor.
- ¼" Tubing for air and water.
- Flow through cell/bucket.
- Wire line to secure pump to surface.
- Secondary sample method equipment (i.e. bailer and string) for if the primary method fails. Refer to PART B.

Figures 1.1 and 1.2 provide illustrations of basic low flow sample set up and pump components.

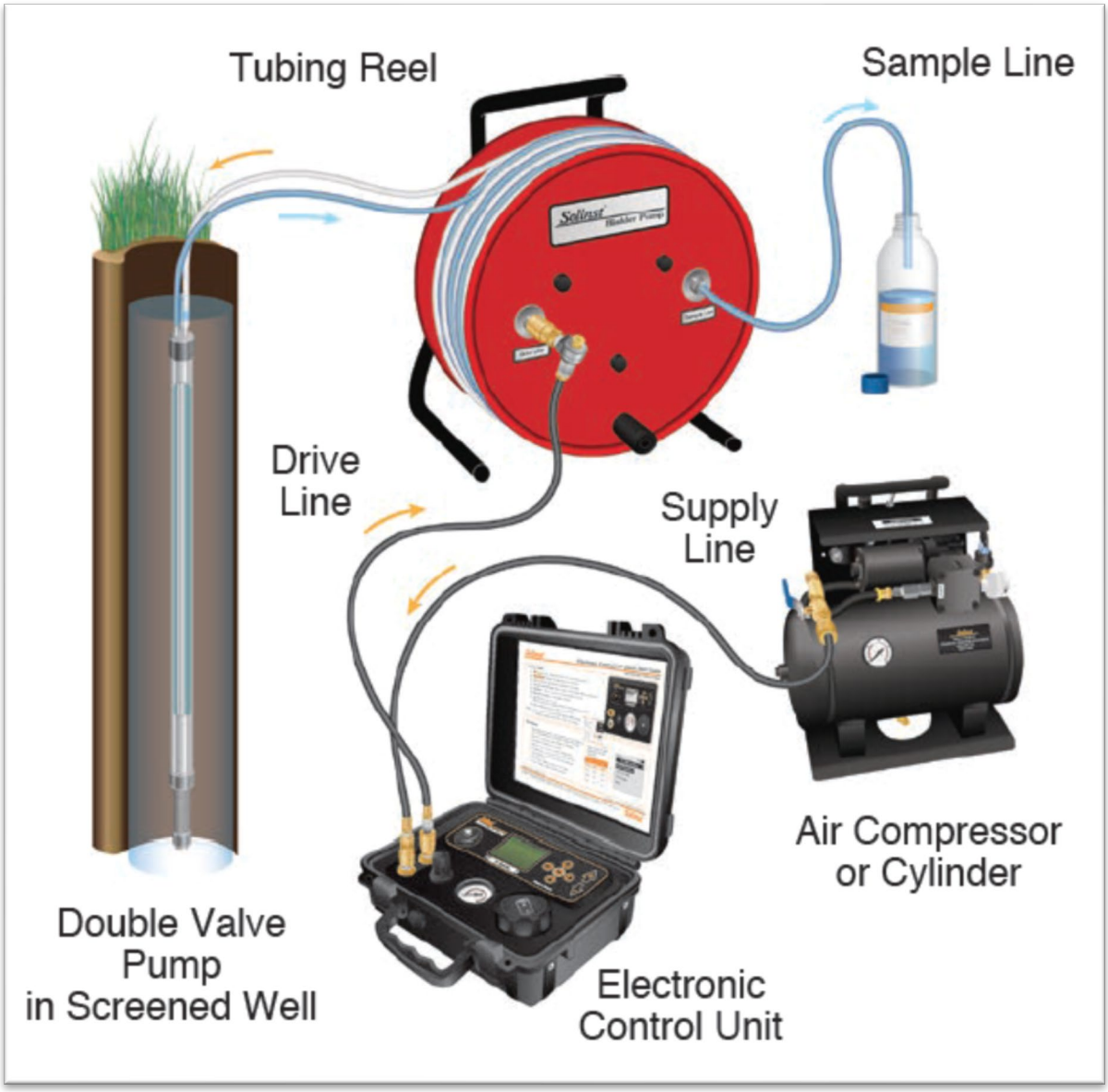

Figure 1-1 Low Flow 'Basic' Set-up

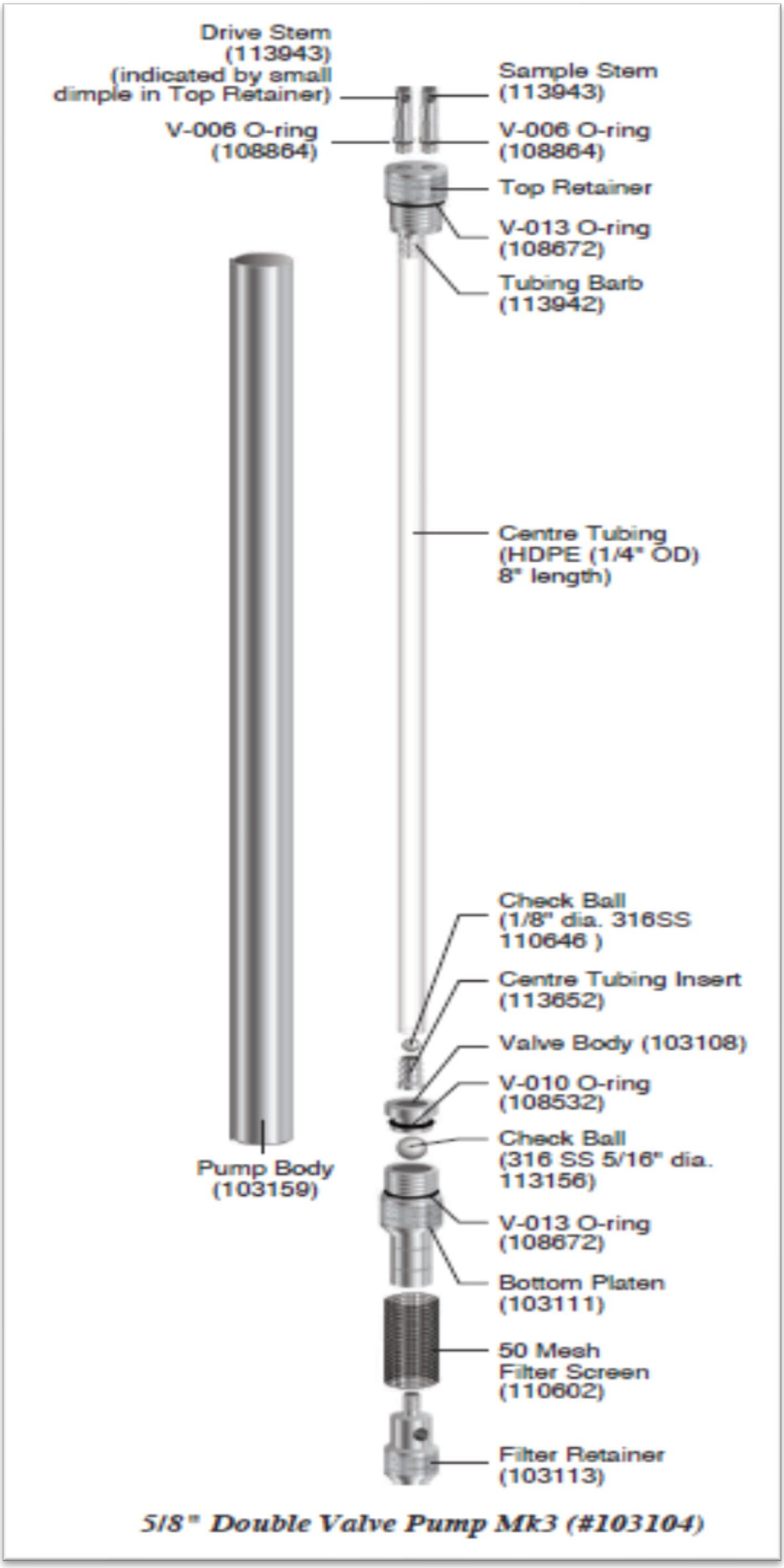

Figure 1-2 Low Flow Pump (narrow gauge, double valve) Components

6.2 Sample Method

Table 2 below provides the sample methodology using a Low Flow Pump (narrow gauge, double valve).

Table 2: Primary Sample Methodology

Step		Tasks	✓
1	Planning	You 1. Have completed Tellus pre-work procedures/requirements (i.e. JHA, Safe Work Method Statement, Take 5, vehicle daily check, etc.) 2. Are washed with clean clothes. 3. Are free of sunscreen, insect repellents, deodorants, etc. 4. Are free of PFAS incompatible clothing or materials (refer to PFAS section as a guide). You have: 1. Been deemed competent to complete this procedure by the HSECQ Department: Environmental sector. 2. Reviewed this procedure, the YSI calibration procedure and the LMMP. 3. Discussed the sample monitoring programme and preparations completed with your supervisor prior.	
		Calibrate water quality meter at beginning and end of each sampling round (refer to Tellus YSI calibration procedure).	
		Ensure equipment is fully charged/fuelled and operational.	
		Check all equipment is not damaged/dirty/suitable for use.	
		Ensure all disposable equipment is new and suitably sealed to ensure it remains clean. All disposable equipment is to be PFAS free (i.e. HDPE tubing)	
2	Decontaminate Equipment	Use a NEW set of nitrile gloves between each wash/rinse. Decontaminate all reusable equipment between each location and when visibly dirty.	
		Equipment to be decontaminated prior to use using a four-stage decontamination process: 1. Wash using a water/detergent solution [PFAS free i.e. Liquanox]). 2. Wash using potable water. 3. Wash with Deionised water. 4. Final wash with Deionised water.	
From this point onwards a **NEW** set of nitrile gloves must be worn each time an activity is completed where contact or indirect contact is made with sample equipment (i.e. pump, tubing, IP, sample bottles, etc.).			
3	Groundwater Sampling field sheet	Ensure all details are filled in correctly and as you progress through the sampling event.	
4	Establish depth to groundwater	Prior to sampling, using the IP probe each well is to be gauged from meter below top of casing (m btoc) for: 1. Depth to groundwater. 2. Depth to BoC. If the water column is shallow (<2m) there is likely insufficient water to collect a sample using low flow methods. This is due to the following reasons; Volume of sample required [multiple litres], slow recharge rate and likely settled silt in the well. There is likely to be insufficient water available without lowering the pump close to the BoC which would then draw up settled silts and likely block the pump. Therefore, attempts should be made using the secondary (bailer) method to collect a sample (refer to PART B of this procedure for bailer methodology).	
5	Connect compressor / control unit / power	**Vehicle car battery** – where appropriate (non hazardous areas), use vehicle for power source. Ensure vehicle is off before attaching the negative (black) line then the positive (red) line to the battery. When starting vehicle, be in sitting/driving position with foot on brake and ensure handbrake is on.	

Step		Tasks	✓
		Or using **12V stand alone car battery** – ensure battery is on a stable surface near to the compressor. Attach the negative (black) line then the positive (red) line to the battery. Only use dry cell batteries.	
		Connect the compressor air line to the control unit air inlet. Turn the compressor on.	
6	Lowering the Low Flow Pump	Connect low flow pump to wire line and air/water tubing and carefully lower the pump to sit at mid point in the screen interval (pump inlet to be at least 1m above the base of the well) and secure with clamp. Use the IP probe to ensure the pump is situated at the correct depth.	
		Ensure discharge (water) and air tubing lines are securely fitted to the pump. Ensure the other end of the air tubing line is securely fitted to the control air outlet.	
		Care must be taken when lowering the pump to prevent tangling of line and tubing.	
		Double check that the wire line is connected securely to prevent loss of pump down the well.	
Typically, during groundwater sampling, field physiochemical parameters (i.e. pH, EC, Temp, DO) are collected (via YSI) over a purge cycle until stabilisation of these parameters has been established before a sample is collected for laboratory analysis. This process can take from 5 to 15 minutes which can significantly drawdown on the limited water in the well column. Furthermore, with consideration to the hydrogeological chacteristics known to date (refer to Section 1): • Trapped relict water; • Extremely low permeability like concrete; and • Groundwater to be extremely unlikely to be affected by seasonality, change with time and is not prone to moving location. Purging to confirm stabilisation is not to considered to be necessary and will more likely limit the possibility to collect a sufficient water sample. Therefore, priority is to 1. Collect a sufficient water sample to fill laboratory water bottles, 2. Collection of water for measuring field physiochemical parameters.			
7	Begin Pumping	Purge initially at the low flow rate used at the well during the previous sample event or otherwise at a low flow rate (100 to 500 mL/min). Adjust the flow rate as needed by increasing/decreasing pressure on flow control box or increasing/decreasing discharge time.	
8	Label Bottles	Should be labelled and include: 1. Date. 2. Sample ID (SRRMB XXX). 3. Company name. QA/QC Dup, Trip and RB samples to be labelled 'DUP', 'TRIP' and 'RB' respectively. Note where you collected the QA/QC samples on your field sheet.	
9	Collect a Sample	Bottles (glass and plastic) with no preservative: Fill completely.	
		Vials: No air bubbles to be within sample.	
		Bottles for parameters that require filtration (i.e. metals prior to filling filtered acid preserved bottle): Don't overflow.	
		PFAS bottle is to be zip locked with laboratory supplied zip lock to ensure it is not in contact with any PFAS materials.	
		Minimise aeration of sample during collection.	
10	Physiochemical parameter setup	If sufficient water remains in the well, collect physiochemical parameters from the YSI.	
		Connect discharge/water tubing to flow through cell or bucket and place YSI probes in flow through cell or bucket.	
		Ensure the water tubing is securely fitted to the flow cell tubing (ensure tap is not closing the line).	
		Place all YSI probes in their respective holes in the flow through cell or bucket.	
		Place YSI at an angle out of the sun to prevent overheating. The YI will turn off if it gets too hot.	

Step		Tasks	✓
11	Sample Storage	Place filled bottles into chilled esky. Store samples in fridge if left overnight. If ice is used, ensure bottles aren't submerged in standing water. No Gel Ice packs permitted (refer to PFAS section) Ensure glass bottles are protected (i.e. bubble wrap).	
12	CoC Form	A prefilled CoC form is to be collected (prior to sampling) from the the HSECQ Department. On completion of monitoring, ensure the CoC form remains relevant, correct and complete.	
13	Transport of Samples	Transport the samples to the laboratory chilled and with the relevant CoC form.	
14	Record Keeping	At the completion of the sampling event ALL field sheets are to be scanned (if relevant), filed and the HSECQ Department notified via email of the monitoring event success and location of filed documents.	
Unable to collect a sample using low flow methods?		If a well is unable to be sampled using the low flow method (PART A), a sample is to be attempted to be collected using the bailer method as detailed in PART B.	

7 PART B: SECONDARY SAMPLE METHOD (BAILER)

7.1 Equipment

- Sampling bottles pre-ordered from NATA accredited laboratory based on the analytes listed in the Leachate Monitoring and Management Plan (LMMP).
- Waterproof permanent marker.
- Filters (pore size of around 0.45 um) one per well.
- Sampling records from previous sampling event.
- Groundwater well location plan.
- Eskies.
- Ice.
- Deionised water for QA/QC samples (DI).
- Decontamination station (PFAS free)
    - Detergent (i.e. Liquanox)
    - Buckets
    - Potable water
    - DI
- Chain of Custody (CoC) Form – Appendix A.
- Field Sample Sheet (if unable to complete electronically) – Appendix B.
- Water level dipper or 'IP' probe.
- Water quality meter that measures pH, temperature, electrical conductivity (EC), redox potential (Eh), dissolved oxygen (DO) (i.e. YSI).
- Bailer:
    - Weighted Narrow Disposable Bailer (one for each well); and/or
    - Stainless Steel Narrow Reusable Bailer (decontaminate between wells)
- Bailer string/cord

7.2 Sample Method

Table 3 below provides the sample methodology using the bailer method.

Table 3: Secondary Sample Methodology

Step		Tasks	✓
1	Planning	You are: 1. Washed with clean clothes 2. Free of sunscreen, insect repellents, deodorants, etc. 3. Free of PFAS incompatible clothing or materials (refer to PFAS section as a guide) You have: 1. Been deemed competent to complete this procedure by the HSECQ Department: Environmental sector. 2. Reviewed this procedure, the YSI calibration procedure and the LMMP. 3. Discussed the sample monitoring programme and preparations completed with your supervisor prior. 4. Completed other relevant Tellus Holding pre-work procedures/requirements (i.e. JHA or take 5, vehicle daily check, etc.)	
		Calibrate water quality meter at beginning and end of each sampling round (refer to Tellus YSI calibration procedure).	
		Ensure equipment is fully charged/fuelled and operational.	
		Check all equipment is not damaged/dirty/suitable for use.	
		Ensure all disposable equipment is new and suitably sealed to ensure it remains clean. All disposable equipment is to be PFAS free (i.e. HDPE tubing)	
2	Decontaminate Equipment	Use a NEW set of nitrile gloves between each wash/rinse. Decontaminate all reusable equipment between each location and when visibly dirty.	
		Equipment to be decontaminated prior to use using a four-stage decontamination process: 1. Wash using a water/detergent solution [PFAS free i.e. Liquanox]) 2. Wash using potable water 3. Wash with Deionised water 4. Final wash with Deionised water	
From this point onwards a **NEW** set of nitrile gloves must be worn each time an activity is completed where contact or indirect contact is made with sample equipment (i.e. pump, tubing, IP, sample bottles, etc.).			
3	Groundwater Sampling field sheet	Ensure all details are filled in correctly and as you progress through the sampling event.	
4	Establish depth to groundwater	Prior to sampling, using the IP probe each well is to be gauged from meter below top of casing (m btoc) for: 1. Depth to groundwater. 2. Depth to BoC.	
5	Prepare bailer	Connect NEW string/twine to the bailer. If unsure of the strength/durability of the string/twine, attached a second string/twine which can recover the bailer if the primarily line fails. Ensure the end of the string/twine is tied to the surface.	
Typically, during groundwater sampling, field physiochemical parameters (i.e. pH, EC, Temp, DO) are collected (via YSI) during purging of the well until stabilisation of these parameters has been established before a sample is collected for laboratory analysis. This process can remove a lot of water from the well which will significantly drawdown on the limited water in the well column due to the very slow recharge rate. Therefore, stabilisation is not to be completed, as the priority is to be on collecting sufficient water (foremost) to fill laboratory water bottles, then collection of field physiochemical parameters.			
6	Label Bottles	Should be labelled and include: 1. Date 2. Sample ID (SRRMB XXX) 3. Company name QA/QC Dup, Trip and RB samples to be labelled 'DUP', 'TRIP' and 'RB' respectively. Note where you collected the QA/QC samples on your field sheet.	
7	Bailing	Lower the bailer to just over 1m below the top of the groundwater column.	

Step		Tasks	✓
		Minimise disturbance to the BoC as this will unsettle silts and possibly interfere with the bailing method and reduce recovery rates. Pour bailed water into the sample containers.	
8	Collect a Sample	Bottles (glass and plastic) with no preservative: Fill completely.	
		Vials: No air bubbles to be within sample.	
		Bottles for parameters that require filtration (i.e. metals prior to filling filtered acid preserved bottle): Don't overflow.	
		PFAS bottle is to be zip locked with laboratory supplied zip lock to ensure it is not in contact with any PFAS materials.	
		Minimise aeration of sample during collection.	
9	Physiochemical parameter setup	If sufficient water remains in the well, collect physiochemical parameters from the YSI.	
		Pour water into a clean bucket and place YSI probes into the bucket.	
		Place YSI at an angle out of the sun to prevent overheating. The YI will turn off if it gets too hot.	
10	Sample Storage	Place filled bottles into chilled esky. Store samples in fridge if left overnight. If ice is used, ensure bottles aren't submerged in standing water. No Gel Ice packs permitted (refer to PFAS section) Ensure glass bottles are protected (i.e. bubble wrap).	
11	CoC Form	A prefilled CoC form is to be collected (prior to sampling) from the the HSECQ Department. On completion of monitoring, ensure the CoC form remains relevant, correct and complete.	
12	Transport of Samples	Transport the samples to the laboratory chilled and with the relevant CoC form.	
13	Record Keeping	At the completion of the sampling event ALL field sheets are to be scanned (if relevant), filed and the HSECQ Department notified via email of the monitoring event success and location of filed documents.	
Unable to collect a sample using low flow methods?		If a well is unable to be sampled using the low flow method (PART A), a sample is to be attempted to be collected using the bailer method as detailed in PART B.	

8 COMPETENCY

Competency will be assessed by the HSECQ Department and involve internal training completed by the HSECQ – Environment sector.

9 RECORDS SUMMARY

This procedure will be reviewed internally as a minimum annually by the HSECQ Environment Manager (Perth).

10 REFERENCES

- *National Environment Protection (Assessment of Site Contamination) Measure 1999.*
- *PFAS National Environmental Management Plan (HEPA, January 2018).*
- *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (DER WA, January 2017).*
- *National Environmental Protection (Assessment of Site Contamination) Amendment Measure. National Environmental Protection Council, May 2013 (NEPM 2013).*
- *AS/NZS 5667.1:1998 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*

- *AS/NZS 5667.10:1998 and ISO 5667-10:1992 Water Quality—Sampling Part 10: Guidance on Sampling of Waste Waters.*

Appendix A: Chain of Custody

Appendix B: Groundwater Sample Sheet

APPENDIX G: SANDY RIDGE WASTE FACILITY DECOMMISSIONING AND CLOSURE PLAN

The Sandy Ridge Waste Facility Decommissioning and Closure Plan is a requirement of MS1078 and requires approval by DWER. The plan contains detail on the monitoring of cells, compliance obligations, waste decommissioning, rehabilitation and closure objectives.

The monitoring requirements for post closure monitoring of the cell caps made in the plan are summarised in the table below. However, the plan is subject to review and revision as required either by the Proponent or DWER as per condition 12-4 of MS1078.

The current document version should always be referenced and will be publicly available on the Proponents website.

Post-closure monitoring framework.

Closure Phase	Aspect	Proposed Monitored Parameter	Frequency	Trigger Value	Action
ICP Phase I (managed by Tellus)	Groundwater	Refer to LMMP and Deep Groundwater Monitoring and Management Plan			
	Cell Cap – first 10 years	Subsidence	Annual	7.5% of height measured at the time of cell cap installation	Backfill and compact
	Cell Cap - > 10 years	Subsidence	Every 4 years	As above	As above
	Rehabilitation Vegetation	Percentage cover Species composition	Every 3 years	To be determined upon setting completion criteria	Seed/plant with provenance correct species.
	Fauna	Fauna diversity in development envelope.	Every 5 years	Statistically significant increase in introduced species compared to baseline fauna studies.	Conduct feral fauna control.
	Air Quality - Radiation	Subject to Radiation Management Plan under the *Radiation Safety Act 1975*.			
	Security	Subject to terms of the Financial Assurance Deed for Crown Lease (to be finalised), likely to include:			
		Human Intrusion	Continuous seismic monitoring	Intrusion detected	Satellite observation, site visit.
		Site Inspection – signage, equipment, access.	Biannual	Damage detected	Repair/replace
ICP Phase II (managed by WA State Government)	Security	Human Intrusion	Continuous Seismic monitoring	Intrusion detected	Proposed: Satellite observation, site visit.

APPENDIX H1: GROUNDWATER ANALYSIS SUITES

The following analytes will be monitored in groundwater at Sandy Ridge during 'baseline' sampling. Refer to Section 2.4.2.6 regarding 'operational' analytical monitoring suite.

Chemical Group	Chemical Name	Unit [1]	Frequency [2]	Trigger [3]	Threshold [3]
Field Parameters	Conductivity	mS/cm	≥8	tbd	tbd
	Temperature	°C	≥8	tbd	tbd
	pH	pH units	≥8	tbd	tbd
	Redox Potential	mV	≥8	tbd	tbd
	Dissolved Oxygen	ppm	≥8	tbd	tbd
Metals	Aluminium	mg/L	≥8	tbd	tbd
	Arsenic	mg/L	≥8	tbd	tbd
	Barium	mg/L	≥8	tbd	tbd
	Beryllium	mg/L	≥8	tbd	tbd
	Boron	mg/L	≥8	tbd	tbd
	Cadmium	mg/L	≥8	tbd	tbd
	Chromium	mg/L	≥8	tbd	tbd
	Cobalt	mg/L	≥8	tbd	tbd
	Copper	mg/L	≥8	tbd	tbd
	Cyanide	mg/L	≥8	tbd	tbd
	Iron	mg/L	≥8	tbd	tbd
	Lead	mg/L	≥8	tbd	tbd
	Manganese	mg/L	≥8	tbd	tbd
	Mercury	mg/L	≥8	tbd	tbd
	Nickel	mg/L	≥8	tbd	tbd
	Selenium	mg/L	≥8	tbd	tbd
	Silver	mg/L	≥8	tbd	tbd
	Zinc	mg/L	≥8	tbd	tbd
TRH	TRH C6 - C9 Fraction	mg/L	≥8	tbd	tbd
	TRH C10 - C14 Fraction	mg/L	≥8	tbd	tbd
	TRH C15 - C28 Fraction	mg/L	≥8	tbd	tbd
	TRH C29 - C36 Fraction	mg/L	≥8	tbd	tbd
	TRH C6 - C10 Fraction F1	mg/L	≥8	tbd	tbd
	TRH C6 - C10 Fraction Less BTEX F1	mg/L	≥8	tbd	tbd
	TRH >C10 - C16 Fraction F2	mg/L	≥8	tbd	tbd

Chemical Group	Chemical Name	Unit [1]	Frequency [2]	Trigger [3]	Threshold [3]
	TRH >C16 - C34 Fraction F3	mg/L	≥8	tbd	tbd
	TRH >C34 - C40 Fraction F4	mg/L	≥8	tbd	tbd
BTEXN	Benzene	mg/L	≥8	tbd	tbd
	Toluene	mg/L	≥8	tbd	tbd
	Ethylbenzene	mg/L	≥8	tbd	tbd
	Xylene	mg/L	≥8	tbd	tbd
	Napthalene	mg/L	≥8	tbd	tbd
PAHs	PAH Suite	mg/L	≥8	tbd	tbd
EP231A: Perfluoroalkyl Sulfonic Acids	Perfluorobutane sulfonic acid (PFBS)	µg/L	≥8	tbd	tbd
	Perfluoropentane sulfonic acid (PFPeS)	µg/L	≥8	tbd	tbd
	Perfluorohexane sulfonic acid (PFHxS)	µg/L	≥8	tbd	tbd
	Perfluoroheptane sulfonic acid (PFHpS)	µg/L	≥8	tbd	tbd
	Perfluorooctane sulfonic acid (PFOS)	µg/L	≥8	tbd	tbd
	Perfluorodecane sulfonic acid (PFDS)	µg/L	≥8	tbd	tbd
EP231B: Perfluoroalkyl Carboxylic Acids	Perfluorobutanoic acid (PFBA)	µg/L	≥8	tbd	tbd
	Perfluoropentanoic acid (PFPeA)	µg/L	≥8	tbd	tbd
	Perfluorohexanoic acid (PFHxA)	µg/L	≥8	tbd	tbd
	Perfluoroheptanoic acid (PFHpA)	µg/L	≥8	tbd	tbd
	Perfluorooctanoic acid (PFOA)	µg/L	≥8	tbd	tbd
	Perfluorononanoic acid (PFNA)	µg/L	≥8	tbd	tbd
	Perfluorodecanoic acid (PFDA)	µg/L	≥8	tbd	tbd
	Perfluoroundecanoic acid (PFUnDA)	µg/L	≥8	tbd	tbd
	Perfluorododecanoic acid (PFDoDA)	µg/L	≥8	tbd	tbd
	Perfluorotridecanoic acid (PFTrDA)	µg/L	≥8	tbd	tbd
	Perfluorotetradecanoic acid (PFTeDA)	µg/L	≥8	tbd	tbd
EP231D: (n:2) Fluorotelomer Sulfonic Acids	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	≥8	tbd	tbd
	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	µg/L	≥8	tbd	tbd
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	≥8	tbd	tbd

Chemical Group	Chemical Name	Unit [1]	Frequency [2]	Trigger [3]	Threshold [3]
	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	≥8	tbd	tbd
EP231P: PFAS Sums	Sum of PFAS	µg/L	≥8	tbd	tbd
	Sum of PFHxS and PFOS	µg/L	≥8	tbd	tbd
	Sum of PFAS (WA DER List)	µg/L	≥8	tbd	tbd
OCs	a-BHC	mg/L	≥8	tbd	tbd
	Aldrin	mg/L	≥8	tbd	tbd
	b-BHC	mg/L	≥8	tbd	tbd
	d-BHC	mg/L	≥8	tbd	tbd
	DDD	mg/L	≥8	tbd	tbd
	DDE	mg/L	≥8	tbd	tbd
	DDT	mg/L	≥8	tbd	tbd
	Dieldrin	mg/L	≥8	tbd	tbd
	Endosulfan I	mg/L	≥8	tbd	tbd
	Endosulfan II	mg/L	≥8	tbd	tbd
	Endosulfan sulfate	mg/L	≥8	tbd	tbd
	Endrin	mg/L	≥8	tbd	tbd
	Endrin aldehyde	mg/L	≥8	tbd	tbd
	g-BHC	mg/L	≥8	tbd	tbd
	Heptachlor	mg/L	≥8	tbd	tbd
	Heptachlor epoxide	mg/L	≥8	tbd	tbd
OPs	Chlorpyriphos	mg/L	≥8	tbd	tbd
	Diazinon	mg/L	≥8	tbd	tbd
	Ethion	mg/L	≥8	tbd	tbd
	Fenitrothion	mg/L	≥8	tbd	tbd
	Malathion	mg/L	≥8	tbd	tbd
PCBs	Aroclor 1242	µg/L	≥8	tbd	tbd
	Aroclor 1254	µg/L	≥8	tbd	tbd
Radionuclides (natural)	Gross Alpha radiation	Bq/L	≥8	tbd	tbd
	Gross Beta radiation	Bq/L	≥8	tbd	tbd
	Lead 210	Bq/L	≥8	tbd	tbd
	Lead 212	Bq/L	≥8	tbd	tbd
	Radium 226	Bq/L	≥8	tbd	tbd
	Radium 228	Bq/L	≥8	tbd	tbd
	Thorium 228	Bq/L	≥8	tbd	tbd
	Thorium 230	Bq/L	≥8	tbd	tbd
	Thorium 232	Bq/L	≥8	tbd	tbd

Chemical Group	Chemical Name	Unit [1]	Frequency [2]	Trigger [3]	Threshold [3]
	Uranium 238	Bq/L	≥8	tbd	tbd
Radionuclides (other)	Americium-241	Bq/L	≥1	tbd	tbd
	Cobalt-60	Bq/L	≥1	tbd	tbd
	Caesium-137	Bq/L	≥1	tbd	tbd
	Hydrogen-3 (tritium)	Bq/L	≥1	tbd	tbd
	Krypton-85	Bq/L	≥1	tbd	tbd
	Nickel-63	Bq/L	≥1	tbd	tbd
	Lead-210	Bq/L	≥1	tbd	tbd
	Plutonium-238	Bq/L	≥1	tbd	tbd
	Plutonium-239	Bq/L	≥1	tbd	tbd
	Strontium-90	Bq/L	≥1	tbd	tbd
Other	Asbestos	mg/L	≥8	tbd	tbd
	Ammonia (as N)	mg/L	≥8	tbd	tbd
	Hardness (as CaCO3)	mg/L	≥8	tbd	tbd
	Nitrate - N	mg/L	≥8	tbd	tbd
	Nitrite - N	mg/L	≥8	tbd	tbd
	Sodium	mg/L	≥8	tbd	tbd
Major Cations and Anions	Calcium	mg/L	≥8	NA [4]	NA [4]
	Magnesium	mg/L	≥8	NA [4]	NA [4]
	Sodium	mg/L	≥8	NA [4]	NA [4]
	Potassium	mg/L	≥8	NA [4]	NA [4]
	Chloride	mg/L	≥8	NA [4]	NA [4]
	Sulfate	mg/L	≥8	NA [4]	NA [4]
	Nitrate	mg/L	≥8	NA [4]	NA [4]
	Alkalinity	mg/L	≥8	NA [4]	NA [4]

[1] Laboratory and reportable units.
[2] Number of monitoring events samples will be collected during the baseline monitoring programme
[3] Site based trigger and threshold criteria will be determined based on the baseline monitoring data (adjusted to a 95% confidence interval)
[4] Associated with establishing if the groundwater monitoring well water is interconnected/chemically comparable.

APPENDIX H2: LOW LEVEL RADIOACTIVE WASTE MONITORING REGIME

This Addendum has been developed in consultation with Radiation Health on behalf of the Radiological Council for inclusion in the LMMP (refer DWER Document Review Comments Sheet dated 3 April 2020). It relates to a monitoring regime for radionuclides at the Sandy Ridge Facility. However, Tellus notes that radiation monitoring and limits will continue to be developed with the Radiological Council in accordance with the *Radiation Safety Act 1975*.

PURPOSE

The purpose of this Addendum is to describe the strategy proposed by Tellus Holdings Ltd (Tellus) to determine baseline / naturally occurring background levels of radionuclides in potential groundwater during development, construction, operation, closure and during institutional control at the Sandy Ridge Facility.

SCOPE

This document covers:

- Baseline groundwater monitoring of radionuclides during development, construction and operation at the Sandy Ridge Facility.
- Radionuclides from radioactive wastes disposed at Sandy Ridge Facility whether by in-cell method or well-hole disposal (where approved).

This document does not cover:

- Baseline monitoring and operational monitoring for NORM as these are described in the Sandy Ridge Leachate Monitoring and Management Plan.

DEFINITIONS

Term	Definition
DWER	Department of Water and Environmental Regulation
MS 1078	Ministerial Statement No. 1078
NORM	naturally occurring radioactive material

BACKGROUND

Tellus has approval under Section 45 of the *Environmental Protection Act 1986* to develop and implement the Sandy Ridge Facility in accordance with Ministerial Statement No. 1078 (MS 1078). In accordance with condition 9 of MS 1078, Tellus submitted a Leachate Monitoring and Management Plan (LMMP) to the Department of Water and Environmental Regulation (DWER) for approval.

The LMMP includes information on proposed monitoring of radionuclides that are relevant for the current stage of operations, namely acceptance of NORM for aboveground storage as approved under works approval W6305/2019/1 and Registration RS 210/2018 30289 under the *Radiation Safety Act 1975*. Radium 226 and Radium 228 will be monitored to assess the isolation of bulk NORM in-cell.

Tellus offer isolation services for a range of low-level radioactive wastes (LLW), including sealed radioactive sources. At this stage of development, Tellus does not know what wastes future customers will seek to dispose.

Subsequent to submitting the LMMP to DWER, Tellus has liaised with Radiation Health (on behalf of the Radiological Council) to develop a strategy to monitor for radionuclides (in addition to those for NORM) that might be accepted in the future for disposal. This Addendum documents that strategy, with a view to including this information in the next iteration of the LMMP.

Note that Tellus will continue to liaise with the Radiological Council and Radiation Health to complete impact assessments and management documentation to support Tellus' applications for approval under the *Radiation Safety Act 1975.*

RADIONUCLIDES

The table below lists the radionuclides (referred to in the table as radioisotope) that Tellus propose to monitor in groundwater at Sandy Ridge Facility over the life of the project, where adequate sample volumes can be recovered.

These radionuclides are consistent with those proposed in Table 3.2 of the Sandy Ridge Post-closure Safety Assessment (AF Nuclear, 2019) which is under assessment under the *Radiation Safety Act 1975*. These radionuclides were selected based on the IAEA Generic Safety Assessment (GSA).

Radionuclides to be monitored in groundwater at Sandy Ridge Facility.

Radioisotope		Maximum Activity (Bq)	Half-Life(years)	Included/Excluded from GSA*
Am-241	Americium-241	1.20E+13	4.32E+02	Included
Co-60	Cobalt-60	2.90E+15	5.27E+00	Included
Cs-137	Caesium-137	7.50E+14	3.00E+01	Included
H-3	Hydrogen-3 (tritium)	2.80E+14	1.24E+01	Included
Kr-85	Krypton-85	6.30E+11	1.07E+01	Included
Ni-63	Nickel-63	2.10E+10	9.60E+01	Included
Pb-210	Lead-210	1.00E+07	2.23E+01	Included
Pu-238	Plutonium-238	2.00E+10	8.77E+01	Included
Pu-239	Plutonium-239	6.70E+11	2.41E+04	Included
Sr-90	Strontium-90	5.30E+11	2.91E+01	Included

** International Atomic Energy Agency Generic Safety Assessment.*

MONITORING SCHEDULE

Wells

Baseline

As outlined in Section 2.4.2 of the LMMP, existing monitoring wells located within 1 km of the mining/cells area (wells SRMB146, SRMB147, SRMB148, SRMB149, SRMB151 & SRMB152) will be sampled where sufficient water is able to be recovered and analysed in accordance with the suite provided in Table 1.

Operations

If free liquid is encountered in the monitoring wells located within 1 km of the mining/cells area (wells SRMB146, SRMB147, SRMB148, SRMB149, SRMB151 & SRMB152), a sample will be collected and analysed in accordance with the suite provided in Table 1.

In addition, if water in sufficient volume is recorded in future wells (wells installed at each waste cell), it will be monitored for radionuclides in Table 1, where wastes of that type have been disposed in the cell.

MONITORING FREQUENCY

Baseline

A baseline sample will be collected from each of the wells listed above prior to radioactive waste being disposed on site. The results of this baseline sampling will be used to develop trigger and threshold levels as outlined in Table 3-1 of the LMMP.

Consistent with Section 2.4.2 of the LMMP, all wells listed above will be sampled six-monthly where water in sufficient volumes is recorded.

NEXT STEPS

Review comments by Radiological Council and Radiation Health on the LMMP approve the information proposed in this Addendum. Tellus will add this Addendum to the LMMP and submit it to DWER for approval in accordance with condition 9-5 of MS 1078.

REFERENCES

Document Name
ÅF Nuclear 2019. *Post-Closure Radiological Safety Assessment of the Sandy Ridge Facility: Wellhole Disposal of Disused Sealed Radioactive Sources*. Unpublished report for Tellus Holdings Ltd.
Tellus Holdings Ltd 2020. Sandy Ridge Facility Leachate Monitoring and Management Plan. Version 2, dated 5 March 2020.

APPENDIX I: GROUNDWATER WELL CONSTRUCTION TECHNICAL SPECIFICATION

All future groundwater wells at Sandy Ridge will be constructed in accordance with:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999*
- *PFAS National Environmental Management Plan (HEPA, January 2018)*
- *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (DER WA, January 2017)*

For example, a 'typical' monitoring well installation/construction will include the following, however not limited to:

- Each monitoring well to be installed by advancing a wellhole using a mechanical drilling rig (typically using 'air core' advancement methods). The operator is to have experience in installing environmental monitoring wells.
- Equipment to be decontaminated prior to use using a four-stage decontamination process:
    - Step 1: Wash using a water/detergent solution [PFAS free i.e. Liquanox])
    - Step 2: Wash using potable water
    - Step 3: Wash with Deionised water
    - Step 4: Final wash with Deionised water
- The monitoring well construction materials are to be the following:
    - Class 18, 50 mm uPVC
    - Gravel filter pack (1.6-3.2mm)
    - Bentonite seal
    - Surface concrete seal
- A typical monitoring well design is as follows:
    - Six meters of slotted casing placed in the base of the well.
    - Solid casing used above the slotted casing and extending up to the ground surface.
    - The annulus surrounding the slotted section and extending approximately 1.0m above the slotted interval to be backfilled with a gravel filter pack.
    - Approximately 1.0m of bentonite seal to be placed above the gravel pack.
    - Clean soil arisings to be used to fill the remainder of the well to the surface.
    - The well to be completed at the surface by a concrete plug and finished with a protective steel riser.
    - If possible, upon completion of the monitoring well installation process, each well will be developed using submersible pump or 'air lift' methods.

TELLUS

GMW ID: SRMB146

Site: Sandy Ridge, WA
Date Drilled: 28/02/2015
GPS: 219,890mE 6,637,792mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.66 m agl
BoC: 29.84 m bgl (30.5 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.**
1		2		
2	GMW Construction		LAT	**2-3: LATERITE.** Ferricrete/iron rich zone +/- pisolites
3	1. Concrete: 0.0 - 0.2 m bgl		-	
4	2. Backfill: 0.2 - 18.64 m bgl		-	
5	3. Bentonite Seal: 18.64 - 22.64 m bgl		-	
6	4. Graded Gravel Pack[2]: 22.64 - 29.84 m bgl		SLCT	**6-7: SILCRETE.** Siliceous zone
7	5. Blank Casing: 0.0 - 23.84 m bgl		KAOL	**7-10: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
8	6. Slotted Casing: 23.84 - 28.84 m bgl			
9	7. SWL: Nil after installed (6/5/15: Nil)			
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)		KAOL	**10-26: KAOLINISED GRANITE. C**lay rich saprolite zone. White
11				
12				
13				
14				
15				
16				
17				
18		3		
19				
20				
21		4	5	
22			6	
23				
24				
25				
26			SPRK	**26-29: SAPROCK.** Strongly weathered zone with some original feldspar, non-white
27				
28	BoC: 28.84 m bgl			
29	EoH: 30.34 m bgl	8	GRT	**29-EoH: GRANITE**. Moderately weathered to fresh granite
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB147

Site: Sandy Ridge, WA
Date Drilled: 15/03/2015
GPS: 219,890mE 6,638,004mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.88 m agl
BoC: 19.94 m btoc (20.34 m bgl)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.**
1		2		
2	GMW Construction		LAT	**2-3: LATERITE.** Ferricrete/iron rich zone +/- pisolites
3	1. Concrete: 0.0 - 0.2 m bgl		-	
4	2. Backfill: 0.2 - 8.84 m bgl		-	
5	3. Bentonite Seal: 8.84 - 12.84 m bgl		-	
6	4. Graded Gravel Pack[2]: 12.84 - 19.94 m bgl		KAOL	**6-8: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
7	5. Blank Casing: 0.0 - 13.94 m bgl			
8	6. Slotted Casing: 13.94 - 19.94 m bgl		KAOL	**8-EoH: KAOLINISED GRANITE. C**lay rich saprolite zone. White
9	7. SWL: Nil after installed (6/5/15: Nil)	3		
10	8. Unrecoverable in-situ bore cuttings (~0.4 m)			
11				
12		4 5		
13		6		
14				
15				
16				
17				
18				
19	BoC: 19.94 m bgl			
20	EoH: 20.34 m bgl	8		
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB148

Site: Sandy Ridge, WA
Date Drilled: 16/03/2015
GPS: 219,700mE 6,637,805mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.89 m agl
BoC: 24.3 m btoc (23.41 m bgl)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.**
1		2		
2	GMW Construction		-	
3	1. Concrete: 0.0 - 0.2 m bgl		-	
4	2. Backfill: 0.2 - 11.41 m bgl		-	
5	3. Bentonite Seal: 11.41 - 15.41 m bgl		-	
6	4. Graded Gravel Pack[2]: 15.41 - 23.41 m bgl		KAOL	**6-12: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
7	5. Blank Casing: 0.0 - 17.41 m bgl			
8	6. Slotted Casing: 17.41 - 23.41 m bgl			
9	7. SWL: Nil after installed (6/5/15: Nil).			
10				
11				
12		3	KAOL	**12-EoH: KAOLINISED GRANITE.** White With minor to major medium to coarse grained angular quartz with trace black minerals, moderately hard to hard, trace vugs, @ 18 m slightly damp
13				
14				
15				
16		4 5		
17		6		
18				
19				
20				
21				
22	BoC: 23.41 m bgl			
23	EoH: 23.41 m bgl			
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

TELLUS

GMW ID: SRMB149

Site: Sandy Ridge, WA
Date Drilled: 16/03/2015
GPS: 219,368mE 6,637,885mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 50mm Class 9 uPVC [1]
Stickup: 1.06 m agl
BoC: 22.9 m btoc (21.97 m bgl)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.** Red/orange
1		2		
2	GMW Construction		LAT	**2-3: LATERITE GRAVEL.** Red/brown
3	1. Concrete: 0.0 - 0.2 m bgl		SLCT	**3-6: SILCRETE.** Off white to pink/grey. Moderately weathered
4	2. Backfill: 0.2 - 10.44 m bgl			
5	3. Bentonite Seal: 10.44 - 14.44 m bgl			
6	4. Graded Gravel Pack[2]: 14.44 - 21.97 m bgl		KAOL	**6-9: KAOLINISED GRANITE (MOTTLED)**
7	5. Blank Casing: 0.0 - 15.84 m bgl			
8	6. Slotted Casing: 15.84 - 21.84 m bgl			
9	7. SWL: Nil after installed (6/5/15: Nil).		SPRK	**9-20: SAPROCK.** Kaolinised granite with incompleted weathered
10		3		feldspar
11				
12				
13				
14		4	5	
15			6	
16				
17				
18				
19				
20	BoC: 21.84 m bgl			
21	EoH: 21.97 m bgl		7	GRT **20-EoH: GRANITE.**
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB150

Site: Sandy Ridge, WA
Date Drilled: 17/03/2015
GPS: 219,368mE 6,638,390mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.92 m agl
BoC: 48.34 m bgl (49.0 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Red / Brown
1		2	LAT	**1-2: LATERITE GRAVEL.** Red/brown
2	GMW Construction		SLCT	**2-8: SILCRETE.** Light Grey / Brown
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 34.08 m bgl			
5	3. Bentonite Seal: 34.08 - 38.08 m bgl			
6	4. Graded Gravel Pack[2]: 38.08 - 48.08 m bgl			
7	5. Blank Casing: 0.0 - 39.08 m bgl			
8	6. Slotted Casing: 39.08 - 48.08 m bgl			
9	7. SWL: Nil after installed (6/5/15: 36.1 m btoc)		KAOL	**8-18: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite Light Orange//Yellow/Grey/Brown
10				
11				
12				
13				
14				
15				
16				
17				
18			SPRK	**18-44: SAPROCK.** Kaolinised granite with incompleted weathered feldspar. Light grey to light orange
19				
20				
21				
22				
23				
24				Dark grey to light brown from 24 m bgl
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35		3		
36		7		
37				
38				
39		4	5	
40			6	
41				
42				Brown from 4 m bgl
43				
44				
45			GRT	**44-EoH: GRANITE**. Light brown to grey
46				
47	BoC: 48.08 m bgl			
48	EoH: 48.08 m bgl			
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB151

Site: Sandy Ridge, WA
Date Drilled: 17/03/2015
GPS: 219,499mE 6,637,603mN
Drill Method: Aircore
Driller:
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.54 m agl
BoC: 44.7 m bgl (45.28 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-0.5: SAND.** Red / Brown
1		2	LAT	**0.5-3: LATERITE GRAVEL.** Red/Brown
2	GMW Construction			
3	1. Concrete: 0.0 - 0.2 m bgl		-	
4	2. Backfill: 0.2 - 22.77 m bgl		-	
5	3. Bentonite Seal: 22.77 - 26.77 m bgl		-	
6	4. Graded Gravel Pack[2]: 26.77 - 33.77 m bgl		KAOL	**6-9: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite Grey/Pink
7	5. Blank Casing: 0.0 - 27.77 m bgl			
8	6. Slotted Casing: 27.77 - 33.77 m bgl			
9	7. SWL: Nil after installed (30/7/15: 34.14 m btoc)			
10	(~0.2 m)			
11	8. Unrecoverable in-situ bore cuttings (~4.2 m)			
12				
13				
14				
15				
16				
17			KAOL	**9-31 KAOLINISED GRANITE.** Clay rich saprolite zone. White
18				
19				
20				
21				
22				
23		3		
24				
25				
26		4 5		
27		6		
28				
29				Light grey from 29 m bgl
30				
31			SPRK	**31-EoH: SAPROCK.** Kaolinised granite with incompleted weathered feldspar. Light grey.
32				
33		7		
34				
35				Light green to grey from 35 m bgl
36	BoC: 33.77 m bgl			
37	EoH: 38.0 m bgl	8		
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

Inferred Log: Based on available data and nearest bore (SRAC022) geology

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB152

Site: Sandy Ridge, WA
Date Drilled: 17/03/2015
GPS: 219,680mE 6,638,401mN
Drill Method: Aircore
Driller:
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.58 m agl
BoC: 44.7 m bgl (45.28 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Red / Brown
1		2	LAT	**1-3: LATERITE GRAVEL.** Red/Brown
2	GMW Construction			
3	1. Concrete: 0.0 - 0.2 m bgl		-	
4	2. Backfill: 0.2 - 33.7 m bgl		-	
5	3. Bentonite Seal: 33.7 - 37.7 m bgl		-	
6	4. Graded Gravel Pack[2]: 37.7 - 44.7 m bgl		-	
7	5. Blank Casing: 0.0 - 38.7 m bgl		-	
8	6. Slotted Casing: 38.7 - 44.7 m bgl		KAOL	**8-17: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
9	7. SWL: Nil after installed (6/5/15: 36.65 m btoc)			Yellow/Orange/Pink
10				
11				
12				
13				
14				
15				
16				
17			KAOL	**17-21 KAOLINISED GRANITE.** Clay rich saprolite zone. Grey-Yellow
18				
19				White from 19 m bgl
20				
21			SPRK	**20-37: SAPROCK.** Kaolinised granite with incompleted weathered
22				feldspar. Grey-Yellow.
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				Olive from 32 m bgl
33				
34		3		
35				
36		7		
37		4 5		
38		6	-	
39			-	
40			-	
41			-	
42			-	
43	BoC: 44.7 m bgl		-	
44	EoH: 44.5 m bgl		-	
45				
46				
47				
48				
49				
50				

Inferred Log: Based on available data and nearest bore (SRAC051) geology

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB153

Site: Sandy Ridge, WA
Date Drilled: 16/04/2016
GPS: 219,743mE 6,637,943mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.58 m agl
BoC: 42.55 m bgl (43.13 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Brown
1		2	LAT	**1-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-6: SILCRETE.** Tan/Pale Brown
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 28.55 m bgl			
5	3. Bentonite Seal: 28.55 - 32.55 m bgl			
6	4. Graded Gravel Pack[2]: 32.55 - 42.55 m bgl			
7	5. Blank Casing: 0.0 - 33.55 m bgl		KAOL	**6-20: KAOLINISED GRANITE.** Clay rich saprolite zone. White
8	6. Slotted Casing: 33.55 - 42.55 m bgl			
9	7. SWL: Nil after installed (18/08/16: 35.54 m btoc			
10	8. Unrecoverable in-situ bore cuttings (~1.5 m)			
11				
12				
13				
14				
15				
16				
17				
18				
19				
20			SPRK	**20-39.9: SAPROCK.** Kaolinised granite with incompleted weathered feldspar. Pale green.
21				
22				
23				
24				
25				
26				
27				
28				
29		3		
30				
31				
32		4 5		
33		6		
34				
35		7		Pink from 35 m bgl
36				
37				
38				
39				
40				Grey from 40 m bgl
41				
42				Brown from 42 m bgl
43	BoC: 42.55 m bgl	8		
44	EoH: 44.0 m bgl		GRT	**39.9-EoH: GRANITE**. Brown
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB154

Site: Sandy Ridge, WA
Date Drilled: 16/04/2016
GPS: 219,835mE 6,638,124mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.51 m agl
BoC: 44.35 m bgl (44.86 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.** Brown
1		2		
2	GMW Construction		LAT	**2-3: LATERITE GRAVEL.** Brown
3	1. Concrete: 0.0 - 0.2 m bgl		SLCT	**3-7: SILCRETE.** Cream
4	2. Backfill: 0.2 - 30.35 m bgl			
5	3. Bentonite Seal: 30.35 - 34.35 m bgl			
6	4. Graded Gravel Pack[2]: 34.35 - 44.35 m bgl			
7	5. Blank Casing: 0.0 - 35.35 m bgl		KAOL	**7-13: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
8	6. Slotted Casing: 35.35 - 44.35 m bgl			Cream
9	7. SWL: ~42 m bgl (18/08/16: 37.19m btoc).			
10	8. Unrecoverable in-situ bore cuttings (~1.5 m)			Orange from 10 m bgl
11				
12				
13			KAOL	**13-43: KAOLINISED GRANITE.** Clay rich saprolite zone. Off White
14				
15				
16				
17				
18				
19				
20				Cream from 20 m bgl
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31		3		
32				
33				
34		4	5	
35			6	
36				
37			7	
38				
39				
40				
41				
42				
43			SPRK	**43-45: SAPROCK.** Kaolinised granite with incompleted weathered
44				Grey
45	BoC: 44.35 m bgl		8	Brown from 45 m bgl
46	EoH: 46.0 m bgl		GRT	**45-EoH: GRANITE**. Brown
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB154

Site: Sandy Ridge, WA
Date Drilled: 22/04/2016
GPS: 219,772mE 6,638,249mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.56 m agl
BoC: 43.53 m bgl (44.09 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.** Brown
1		2		
2	GMW Construction		LAT	**2-3: LATERITE GRAVEL.** Brown
3	1. Concrete: 0.0 - 0.2 m bgl		SLCT	**3-6: SILCRETE.** Tan
4	2. Backfill: 0.2 - 29.53 m bgl			
5	3. Bentonite Seal: 29.53 - 33.53 m bgl			
6	4. Graded Gravel Pack[2]: 33.53 - 43.53 m bgl			
7	5. Blank Casing: 0.0 - 34.53 m bgl		KAOL	**6-28: KAOLINISED GRANITE.** Clay rich saprolite zone. White
8	6. Slotted Casing: 34.53 - 43.53 m bgl			
9	7. SWL: ~39 m bgl (18/08/16: 37.21m btoc).			
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)			
11				
12				
13				
14				
15				
16				
17				
18				Very pale yellow from 18 m bgl
19				
20				
21				
22				
23				
24				
25				
26				
27				
28			SPRK	**28-43: SAPROCK.** Kaolinised granite with incompleted weathered
29				Off White
30		3		
31				
32				
33		4 5		Grey from 33 m bgl
34		6		
35				
36		7		Brown from 36 m bgl
37				
38				
39				
40				
41				
42	BoC: 43.53 m bgl			
43	EoH: 44.0 m bgl	8	GRT	**43-EoH: GRANITE**. Brown
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB156

Site: Sandy Ridge, WA
Date Drilled: 22/04/2016
GPS: 219,826mE 6,638,611mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.51 m agl
BoC: 25.6 m bgl (26.11 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-0.5: SAND.** Brown
1		2	LAT	**0.5-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-4: SILCRETE.** Cream
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 14.6 m bgl		KAOL	**4-5: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite.
5	3. Bentonite Seal: 14.6 - 18.6 m bgl		KAOL	**5-22: KAOLINISED GRANITE.** Clay rich saprolite zone. White
6	4. Graded Gravel Pack[2]: 18.6 - 25.6 m bgl			
7	5. Blank Casing: 0.0 - 19.6 m bgl			
8	6. Slotted Casing: 19.6 - 25.6 m bgl			
9	7. SWL: Nil after installed (18/8/16: Nil).			
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)			
11				
12				
13				
14		3		
15				
16				
17				
18		4	5	
19			6	
20				
21				
22			SPRK	**22-25.5: SAPROCK.** Kaolinised granite with incompleted weathered
23				Off White
24				
25	BoC: 25.6 m bgl		7	Brown from 24.5 m bgl
26	EoH: 26.0 m bgl	8	GRT	**25.5-EoH: GRANITE**. Brown
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB157

Site: Sandy Ridge, WA
Date Drilled: 23/04/2016
GPS: 219,964mE 6,638,705mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.50 m agl
BoC: 29.91 m bgl (30.41 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-0.5: SAND.** Brown
1		2	LAT	**0.5-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-4: SILCRETE.** Tan
3	1. Concrete: 0.0 - 0.2 m bgl			Cream from 3 m bgl
4	2. Backfill: 0.2 - 18.91 m bgl		KAOL	**4-5: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite.
5	3. Bentonite Seal: 18.91 - 22.91 m bgl		KAOL	**5-7: KAOLINISED GRANITE. C**lay rich saprolite zone. White
6	4. Graded Gravel Pack[2]: 22.91 - 29.91 m bgl			
7	5. Blank Casing: 0.0 - 23.91 m bgl		KAOL	**7-9: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite.
8	6. Slotted Casing: 23.91 - 29.91 m bgl			
9	7. SWL: Nil after installed (18/8/16: 30.43 m btoc).		KAOL	**9-17: KAOLINISED GRANITE.** Clay rich saprolite zone. White
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)			
11				
12				Off White from 12 m bgl
13				
14				
15				
16				
17			CLY	**17-25: CLAY.** Green
18				
19		3		
20				
21				
22				
23		4	5	
24			6	
25			SPRK	**25-30: SAPROCK.** Kaolinised granite with incompleted weathered
26				Off White
27				Brown from 27 m bgl
28				
29	BoC: 29.91 m bgl		7	
30	EoH: 30.2 m bgl	8	GRT	**30-EoH: GRANITE**. Brown
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB158

Site: Sandy Ridge, WA
Date Drilled: 23/04/2016
GPS: 219,961mE 6,638,807mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.62 m agl
BoC: 28.3 m bgl (29.92 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-0.5: SAND.** Brown
1		2	LAT	**0.5-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-4: SILCRETE.** Tan
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 17.3 m bgl		KAOL	**4-7: KAOLINISED GRANITE. C**lay rich saprolite zone. Off White
5	3. Bentonite Seal: 17.3 - 21.3 m bgl			
6	4. Graded Gravel Pack[2]: 21.3 - 28.3 m bgl			
7	5. Blank Casing: 0.0 - 22.3 m bgl		KAOL	**7-8: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite.
8	6. Slotted Casing: 22.3 - 28.3 m bgl		KAOL	**8-24: KAOLINISED GRANITE.** Clay rich saprolite zone. White
9	7. SWL: Nil after installed (18/8/16: 28.87 m btoc).			
10	8. Unrecoverable in-situ bore cuttings (~0.7 m)			
11				
12				
13				
14				
15				
16				
17		3		
18				
19				
20				Off White from 20 m bgl
21		4 5		
22		6		
23				
24			SPRK	**24-28.9: SAPROCK.** Kaolinised granite with incompleted weathered
25				Off White
26				
27	BoC: 28.3 m bgl	7		Brown from 28 m bgl
28	EoH: 29.0 m bgl	8	GRT	**28.9-EoH: GRANITE**. Brown
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB159

(Decommissioned: 2020)

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 220,413mE 6,637,626mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.34 m agl
BoC: 27.66 m btoc (28.0 m bgl)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-0.5: SAND.** Red/orange
1		2	LAT	**0.5-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-5: SILCRETE.** Cream
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 16.66 m bgl			
5	3. Bentonite Seal: 16.66 - 20.66 m bgl		KAOL	**5-7: KAOLINISED GRANITE (MOTTLED).** Pink/Cream
6	4. Graded Gravel Pack[2]: 20.66 - 27.66 m bgl			
7	5. Blank Casing: 0.0 - 21.66 m bgl			
8	6. Slotted Casing: 21.66 - 27.66 m bgl			
9	7. SWL: Nil after installed (11/12/17: Nil).		KAOL	**7-14: KAOLINISED GRANITE.** Clay rich saprolite zone. White
10	8. Unrecoverable in-situ bore cuttings (~0.3 m)			
11				
12				
13				
14			KAOL	**14-15: KAOLINISED GRANITE (MOTTLED).** Pale Orange
15			KAOL	**15-21: KAOLINISED GRANITE.** Clay rich saprolite zone. White
16				
17		3		
18				
19				
20				
21		4 5	SPRK	**21-27.5: SAPROCK.** Kaolinised granite with incomplete weathered
22		6		Cream
23				
24				
25				
26				
27	BoC: 27.66 m bgl	7		
28	EoH: 28.0 m bgl	8	GRT	**27.5-EoH: GRANITE**. White
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49	* SRMB159 to SRMB161 (installed 2017, recorded as dry during all monitoring events) were decommissioned in 2020 due to being located within the			
50	Cell 1 construction footprint. However, these bores were replaced with SRMB168-SRMB171 (installed in 2020 and which surround Cell 1)'.			

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB160

(Decommissioned: 2020)

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 220,498mE 6,637,576mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.38 m agl
BoC: 35.12 bgl (35.5 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Brown
1		2	LAT	**1-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-8: SILCRETE.** Brown to cream
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 24.12 m bgl			
5	3. Bentonite Seal: 24.12 - 28.12 m bgl			
6	4. Graded Gravel Pack[2]: 28.12 - 35.5 m bgl			
7	5. Blank Casing: 0.0 - 29.12 m bgl			
8	6. Slotted Casing: 29.12 - 35.5 m bgl		KAOL	**8-24: KAOLINISED GRANITE.** Clay rich saprolite zone. Cream
9	7. SWL: Nil (11/04/18: Nil).			White from 9 m bgl
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24		3	SPRK	**24-35: SAPROCK.** Kaolinised granite with incomplete weathered
25				Cream
26				
27				
28		4 5		
29		6		
30				
31				
32				
33				
34	BoC: 35.12 m bgl			Brown from 35 m bgl
35	EoH: 35.5 m bgl		GRT	**35-EoH: GRANITE**. Brown
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49	* SRMB159 to SRMB161 (installed 2017, recorded as dry during all monitoring events) were decommissioned in 2020 due to being located within the Cell 1 construction footprint. However, these bores were replaced with SRMB168-SRMB171 (installed in 2020 and which surround Cell 1)'.			
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB161

(Decommissioned: 2020)

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 220,411mE 6,637,530mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.48 m agl
BoC: 21.52 m btoc (22.0 m bgl)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-3: SAND.** Brown
1		2		
2	GMW Construction			
3	1. Concrete: 0.0 - 0.2 m bgl		SLCT	**3-5.5: SILCRETE.** Cream
4	2. Backfill: 0.2 - 10.52 m bgl			
5	3. Bentonite Seal: 10.52 - 14.52 m bgl		KAOL	**5.5-6.5: KAOLINISED GRANITE (MOTTLED).** Pink
6	4. Graded Gravel Pack[2]: 14.52 - 21.52 m bgl		SLCT	**6.5-7: SILCRETE.** Cream
7	5. Blank Casing: 0.0 - 15.52 m bgl		KAOL	**7-9: KAOLINISED GRANITE (MOTTLED).** Orange/Pale Orange
8	6. Slotted Casing: 15.52 - 21.52 m bgl			
9	7. SWL: Nil after installed (11/12/17: Nil).		KAOL	**9-20: KAOLINISED GRANITE.** Clay rich saprolite zone. White
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)	3		
11				
12				
13				
14		4 5		
15		6		
16				
17				
18				
19				
20			SPRK	**20-21.5: SAPROCK.** Kaolinised granite with incomplete weathered
21	BoC: 21.52 m bgl	7		Cream
22	EoH: 22.0 m bgl	8	GRT	**21.5-EoH: GRANITE**. Orange
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49	* SRMB159 to SRMB161 (installed 2017, recorded as dry during all monitoring events) were decommissioned in 2020 due to being located within the			
50	Cell 1 construction footprint. However, these bores were replaced with SRMB168-SRMB171 (installed in 2020 and which surround Cell 1)'.			

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB162

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 220,806mE 6,637,037mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.44 m agl
BoC: 42.56 m bgl (43.0 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Brown
1		2	LAT	**1-2: LATERITE GRAVEL.** Brown
2	GMW Construction		SLCT	**2-8: SILCRETE.** Cream/Brown
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 31.56 m bgl			
5	3. Bentonite Seal: 31.56 - 35.56 m bgl			
6	4. Graded Gravel Pack[2]: 35.56 - 42.56 m bgl			
7	5. Blank Casing: 0.0 - 36.56 m bgl			
8	6. Slotted Casing: 36.56 - 42.56 m bgl		KAOL	**8-41: KAOLINISED GRANITE.** Clay rich saprolite zone. Off White
9	7. SWL: 42.37 m btoc (0.63 m).			
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)			White from 10 m bgl
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31		3		
32				
33				
34				
35		4	5	
36			6	
37				
38				
39				
40				
41	BoC: 42.56 m bgl		7 SPRK	**41-42.5: SAPROCK.** Kaolinised granite with incompleted weathered
42	EoH: 43.0 m bgl		8 GRT	**42.5-EoH: GRANITE**. Brown
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

TELLUS

GMW ID: SRMB163

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 219,232mE 6,636,050mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.63 m agl
BoC: 35.57 m bgl (36.2 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-4: SAND.** Brown
1		2		
2	GMW Construction			
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 24.57 m bgl		CLY	**4-5: CLAY.** Cream
5	3. Bentonite Seal: 24.57 - 28.57 m bgl		SLCT	**5-9: SILCRETE.** Cream
6	4. Graded Gravel Pack[2]: 28.57 - 35.57 m bgl			
7	5. Blank Casing: 0.0 - 29.57 m bgl			
8	6. Slotted Casing: 29.57 - 35.57 m bgl			
9	7. SWL: 29.37 m btoc (~6.8 m).		CLY	**9-13: CLAY.** Cream
10	8. Unrecoverable in-situ bore cuttings (~0.6 m)			
11				
12				
13			KAOL	**13-17: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
14				Pale Pink / Pale Orange
15				
16				
17			KAOL	**17-30: KAOLINISED GRANITE.** Clay rich saprolite zone. Cream
18				
19				
20				White from 20 m bgl
21				
22				
23				
24		3		
25				
26				
27				
28		4	5	
29			6	
30			SPRK	**30-36: SAPROCK.** Kaolinised granite with incompleted weathered
31				Pale Pink
32				
33				
34				
35	BoC: 35.57 m bgl		7	
36	EoH: 36.2 m bgl	8	GRT	**36-EoH: GRANITE**. White
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB164

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 218,372mE 6,637,287mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.55 m agl
BoC: 43.95 m bgl (44.5 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-2: SAND.** Brown
1		2	CLY	**2-7: CLAY.** Brown
2	GMW Construction			
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 32.95 m bgl			
5	3. Bentonite Seal: 32.95 - 36.95 m bgl			
6	4. Graded Gravel Pack[2]: 36.95 - 43.95 m bgl			
7	5. Blank Casing: 0.0 - 37.95 m bgl		SLCT	**7-20: SILCRETE.** Cream
8	6. Slotted Casing: 37.95 - 43.95 m bgl			
9	7. SWL: 11/04/2018, 34.32 m btoc (~10.1 m).			
10	8. Unrecoverable in-situ bore cuttings (~0.5 m)			
11				
12				
13				
14				
15				
16				
17				
18				
19				
20			KAOL	**20-44: KAOLINISED GRANITE.** Clay rich saprolite zone. White
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32		3		
33				
34				
35				
36		4 5		
37		6		
38				
39				
40				
41				
42				
43	BoC: 43.95 m bgl	7		
44	EoH: 44.5 m bgl	8	GRT	**44-EoH: GRANITE**. White
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB165

Site: Sandy Ridge, WA
Date Drilled: 11/12/2017
GPS: 219,420mE 6,638,085mN
Drill Method: Aircore
Driller: Wallis Drilling
Casing: 37 mm PVC
Stickup: 0.32 m agl
BoC: 41.48 m bgl (41.8 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-4: SAND.** Brown
1		2		
2	GMW Construction			Tan from 2.5 m bgl
3	1. Concrete: 0.0 - 0.2 m bgl			
4	2. Backfill: 0.2 - 30.48 m bgl		SLCT	**4-9: SILCRETE.** Cream
5	3. Bentonite Seal: 30.48 - 34.48 m bgl			
6	4. Graded Gravel Pack[2]: 34.48 - 41.48 m bgl			
7	5. Blank Casing: 0.0 - 35.48 m bgl			
8	6. Slotted Casing: 35.48 - 41.48 m bgl			
9	7. SWL: 11/12/2017, 33.89 m btoc (~7.9 m).		KAOL	**9-13: KAOLINISED GRANITE.** Clay rich saprolite zone. Off White
10	8. Unrecoverable in-situ bore cuttings (~0.3 m)			
11				
12				
13			KAOL	**13-15: KAOLINISED GRANITE (MOTTLED).** Iron oxide stained saprolite
14				
15			KAOL	**15-30: KAOLINISED GRANITE.** Clay rich saprolite zone. White
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30		3	SPRK	**30-41.5: SAPROCK.** Kaolinised granite with incompleted weathered
31				Cream
32				
33				
34		4 5		
35		6		
36				
37				
38				
39				
40	BoC: 41.48 m bgl	7		
41	EoH: 41.8 m bgl	8	GRT	**41.5-EoH: GRANITE**. Cream
42				
43				
44				
45				
46				
47				
48				
49				
50				

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*

GMW ID: SRMB167 (DEEP WELL)

Site: Sandy Ridge, WA
Date Drilled: 27/03/2020
GPS: 220,094mE 6,638,350mN
Drill Method: Diamond Core/Mud Rota
Driller: Soil Mechanics
Casing: 50mm Class 9 uPVC [1]
Stickup: 0.64 m agl
BoC: 100 m bgl (100.64 m btoc)

Depth (m bgl)	Comments / Observations	GMW Construction	Graphical Log	Lithology
0	No impacts observed / suspected.	1	SND	**0-1: SAND.** Yellow-Brown
2		2	LAT	**1-1.5: LATERITE GRAVEL.** Orange-Brown
4	GMW Construction		SLCT	**1.5-11.5: SILCRETE.** White
6	1. Concrete: 0.0 - 0.2 m bgl			
8	2. Backfill: 0.2 - 36 m bgl			White-Pink between 7-8 m bgl
10	3. Bentonite Seal: 36 - 37 m bgl			
12	4. Graded Gravel Pack[2]: 37 - 100 m bgl		KAOL	**11.5-26.5: KAOLINISED GRANITE.** Clay rich saprolite zone.
14	5. Blank Casing: 0.0 - 38 m bgl			White-Gey
16	6. Slotted Casing: 38 - 100 m bgl			
18	7. SWL: ~40 m bgl (~60 m).			Grey-White from 18m bgl
20				
22				Yellow-brown from 22 m bgl
24				
26			GRT	**26.5-EoH: GRANITE**. Grey
28				
30				
32				
34				
36		3	5	
38			6	
40			7	
42				
44				
46				
48				
50				
52				
54				
56				
58				
60				
62				
64				
66				
68				
70	70.6: Maximum depth at which there is localised iron staining around fractures in the rock			0-70.6 m bgl: Rock fractures
72				70.6-EoH: Absence of rock fractures
74				
76				
78				
80				
82				
84				
86				
88				
90				
92				
94				
96				
98	BoC: 100 m bgl			
100	EoH: 100 m bgl			

GMW: Groundwater Monitoring Well. m bgl: meters below ground level. M btoc: meters below top of casing. ToC: Top of Casing. EoH: End of Hole.
SWL: Static Water Level: [1] *51mm Inner Diameter x 60.2mm Outer Diameter.* [2] *1.6-3.2mm. - No sample returned. m agl: meters above ground level.*