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Memo

To	Enrico Chedid/Adam Parker	**Company**	Mineral Resources Ltd (MRL)
From	Brieland	**Job No.**	326C
Date	07/07/2021	**Doc No.**	006 b
Subject	Lamb Creek Surface Water Monitoring Installation and Monitoring Data Review – December 2020 to February 2021		

Enrico,

Please find below a technical memo documenting the installation of surface water monitoring stations at Lamb Creek and our subsequent review of the monitoring data collected for the period of December 2020 to April 2021.

1. OVERVIEW

MRL proposed to install a surface water monitoring network at the proposed Lamb Creek mine site to collect Baseline hydrological information at the site. AQ2 assisted with identification of potential surface water monitoring locations based on a desktop review of the proposed mining layout and topography information.

In December 2020, AQ2 completed a site visit at Lamb Creek to complete the following activities:

- Ground truth proposed surface water monitoring station installation locations.
- Install two new surface water monitoring stations consisting of a pressure transducer and water quality mounting kit.

In February 2021, water samples from the mounting kits were collected and data from the loggers was downloaded. This memo summarizes the activities completed and provides a high-level review of the collected data.

2. MONITORING STATION INSTALLATION

2.1 Planning, Access and Logistics

Prior to attending site, the following tasks were completed:

- Desktop review of installation locations for planning purposes based on mine layout plans and site topography information.
- Concept design of monitoring stations (refer Figure 1).
- Procurement and fabrication of equipment not provided by MRL (monitoring station housings).
- Inductions and health, safety and environment planning for the site visit.

Exploration activities at Lamb Creek began in July 2020. At the time of the visit to install the surface water monitoring stations, multiple drill rigs were present on site, though they did not impact site access to the surface water monitoring installation locations.

AQ2 completed all required inductions under the supervision of Daniel Thomson (Exploration Supervisor) and was escorted by a field technician to complete the installations.

2.2 Monitoring Station Locations

The location of the two monitoring stations that were installed at the Lamb Creek project area are shown in Figure 2. The stations were positioned such that Lamb Creek South is positioned within the main drainage line close to the lease boundary on the upstream side of the project and can be used for reference water quality/flow information. Lamb Creek North was positioned in the same drainage line but at the lease boundary downstream of the proposed project development. Lamb Creek North would provide water quality/flow information at a point where the proposed operations have the potential to impact the surface water regime. Note that the mine layout includes some infrastructure which is located downstream of the Lamb Creek North gauging site, but it was not possible to install a gauging site on the creek line further downstream within the tenement boundary.

A separate barologger was installed in proximity to the Exploration office approximately 2km from the surface water installation locations.

Each monitoring station consists of a housing unit for a pressure transducer (with inbuilt data logger) and passive water sample collection system. Further details are provided below.

2.2.1 Monitoring Station Equipment

Each pressure transducer was installed within a fabricated steel housing mounted to a star picket, with Nalgene water quality mounting kits attached to the outside of the steel housing.

Each housing included the following (refer Figure 1):

- One star picket driven into the creek bed and connected to a steel housing unit.
- A further star picket installed ~1m upstream to attempt to protect the housing from debris.
- Steel housing which consisted of a 50mm square tube with slots cut to allow water entry.
- Within the steel housing, a capped PVC pipe was installed with holes drilled to allow water entry. Filter sock was wrapped around the PVC to prevent ingress of sediment to the PVC pipe.
- An In Situ Level Troll 400 pressure transducer installed within the PVC pipe (see further information below).
- 2 x 400mm lengths of rebar hammered into creek bed at 45-degree angle.
- 1 x 20kg bag of cement poured around the star picket, steel housing and rebar protruding further into the creek bed to provide further stability to the installation.

Mounting kits (with sample bottles inside) were attached to the same star picket as the logger housing at a height of approximately 300mm above the base of the creek. An installation summary is shown below in Table 1, with photos of the installations shown in Photos 1 and 2.

Table 1: Installation Summary

Site ID	Easting, Northing	Type	Depth To Sensor (mm)[1]	Installation Date
Lamb_Creek_North	691431, 7477358	Level and Quality	565	09/12/2020
Lamb_Creek_South	691234, 7475634	Level and Quality	550	09/12/2020

1-reference measurement taken from the bottom of the PVC cap to the point at which pressure readings are taken.

2.2.2 Transducer Setup

In Situ Level Troll 400 pressure transducers were installed to measure water pressure at each of the monitoring stations. Prior to installation, loggers for each site were programmed with the following data logging parameters:

- 5-minute data-collection intervals. Given the likely flashy behaviour of runoff in the catchment, a longer data-collection interval may miss important creek flow information. A finer collection interval would fill the data logger memory too quickly (see below).
- Linear sampling mode, whereby once the logger memory is full, new readings are logged by writing-over the oldest readings. With 5-minute data-collection intervals, the loggers are anticipated to have capacity to store approximately 12 months of readings.

All loggers were installed with the pressure sensor approximately level with the creek bed, with a reference measurement obtained from the top of the PVC cap to the level sensor (refer Table 1).

3. DATA COLLECTION – FEBRUARY 2021

3.1.1 Logger Downloads

The data loggers from each site were removed by Rapallo in February 2021 and provided to AQ2 for data download and validation. The barologger was located on site and the data was downloaded; it was not removed.

3.1.2 Water Sampling

In February 2021, Rapallo was engaged by MRL to retrieve water samples from the two monitoring stations. AQ2 provided instructions on sample retrieval, storage and submission to the nominated laboratory (ChemCentre). Samples were taken on 23 February and delivered to the laboratory on 04 March.

The following parameters were measured by the laboratory:

- Aluminium, total (mg/L)
- Iron, total (mg/L)
- Manganese, total (mg/L)
- Zinc, total (mg/L)
- Electrical Conductivity (mS/m)
- Nitrogen, total (mg/L)
- Turbidity (NTU)

4. DATA PROCESSING

4.1 Barometric Pressure Correction of Water Pressure Data

As the pressure transducers are non-vented, the measured values account for both the barometric pressure as well as any water pressure occurring from streamflow events. To correct the water pressure measurements for changes in atmospheric pressure, local barometric pressure records from the installed Barologger were removed from the water pressure dataset. The resulting water pressure dataset was then converted to a water depth based on an assumed density of water. AQ2 reviewed the barometric pressure data and resulting water depth datasets to ensure the measurements looked believable (see Data Validation below).

5. DATA VALIDATION

5.1 Water Pressure Data

A brief assessment of the logger data from both monitoring locations was completed to validate the logger data against rainfall data from BoM's Karijini North weather station. The Karijini North weather station is located 36km away from the Project site and the recorded rainfall may not represent site rainfall conditions.

The corrected water depths from each monitoring station are plotted against rainfall from Karijini North weather station in Figures 3 and 4. Small flow events appeared to be measured between 1st and 17th January, with three separate flow peaks appearing to occur on 01/01, 06/01 and

17/01/2021. These flow responses were consistent between the North and South monitoring station locations, with peak flow depths of about 0.12m recorded on 06/01/2021 at both stations. While the flow responses were not a result of the largest rainfall events recorded at Karijini North (75mm on 11 December 2020 and 68mm on 2 February 2021), they do coincide with smaller events that may have been more pronounced near the Lamb Creek project area.

The variability in the measured water levels that can be seen during December 2020 is indicative of the accuracy of the measurements completed. The measurements (when corrected for barometric pressure variability) oscillate with a magnitude of around 0.02m; the accuracy of the depth measurements is likely to be in the range of +/- 0.02m. This level of noise is relatively significant for the events measured (which were minor flow events) but would be less significant when the larger runoff events are recorded.

Lamb Creek South had two pressure spikes in February 2021 where one-off high-pressure measurements were recorded. These are not considered to be runoff events given the measurements did not persist for longer than one record period and were not recorded at Lamb Creek North. These data points should be removed from the baseline data set.

Given the measured flow responses at both monitoring stations were consistent and occurred during periods where rainfall was recorded in the region, the data appears reasonable. However, the measured flow depth of 0.12m would not be large enough for a streamflow event to fill the water quality sampling unit, which was positioned 0.5m above the creek bed (and pressure transducer measurement point). Given a water sample was collected from the sample bottle, there is inconsistency with the collected data.

To review these discrepancies, the following was completed:

- Test of pressure transducers.
- Inspection of water quality mounting kits and sample bottles.
- Review of water sample laboratory results.

5.2 Pressure Transducer Tests

The pressure transducers were tested to verify their operation. Each pressure transducer was submerged in a bucket of water and the recorded data (corrected for barometric pressure) was checked against measured water depths in the bucket. The test indicated that both pressure transducers were operating accurately.

5.3 Condition/Field Test of Mounting Kits/Sample Bottles

From previous experience deploying and retrieving the mounting kits and sample bottles in drainage channels in the Pilbara, there are generally high levels of sediment and debris trapped in bottles and mounting kits following runoff events. In both locations at Lamb Creek, water collected within the sample bottle when logger data indicated the intake level was not reached. Simple field tests of the kits and sample bottles indicated that water accumulation (from rainfall) on the top of the mounting kit is likely to enter the bottle. If a long-duration, low-intensity rainfall was to occur, it could potentially fill the bottle.

5.4 Water Sample Laboratory Results

The results of the laboratory water quality analysis completed on the samples collected from the water quality sampling units are shown in Figures 5 and 6, with the lab report provided in Appendix A. The results indicate that the water samples retrieved had low EC, TDS and turbidity levels. This is generally not characteristic of runoff through ephemeral creeks in the Pilbara, which often have high sediment levels.

Based on the laboratory results, it is likely that the water that collected in the sample bottles was from direct rainfall rather than from creek inflow.

5.5 Sample Collection Mounting Kit and Bottle Test

The retrieved mounting kit and collection bottle were tested by tipping a bucket of water over the top of the unit and seeing if water collected in the sample bottle. The units are supposed to only fill by water rising up from the bottom of the sample kit, but it was evident from the testing that leaks through the top and side of the unit (which could occur in a rainfall event) may fill the sample bottle.

Subsequently, we have trialled placing silicon around key points of the mounting kit and have found that this prevents ingress of water poured on the top of the mounting from filling the sample bottle.

5.6 Conclusions

Minor flow responses were observed at both Lamb Creek monitoring station locations. Based on the above validation procedures, the following conclusions were made:

- Pressure transducer appears to be recording data accurately, as testing of both loggers indicate they are recording accurate pressures when submerged at set water depths.
- While not definitive, we have concluded that it is likely that the water samples collected in the recent sampling visit were representative of rainfall rather than creek flow. It is likely that rainfall directly entered the bottle through the top of the mounting kit. This conclusion was based on the following:
    - Low EC, TDS and turbidity in water samples.
    - No sign of sediment or debris in sample bottle filter.
    - Mounting kit free any of any debris.
    - Pressure transducers measuring water levels that are not high enough to fill the sample collection bottle.

Table 2 provides a data validation summary for both locations, with Figures 5 and 6 showing water depth (adjusted for barometric pressure) vs. rainfall for the data collection period.

Table 2: Lamb Creek Water Depth Data Validation Summary

Site ID	Distance to Barologger (km)	Noted Rainfall Response	Maximum Depth (m)	Validation
Lamb_Creek_North	1.5	Likely	0.12	Yes – matches South and transducer tested
Lamb_Creek_South	1.9	Likely	0.12	Yes – matches North and transducer tested

It is felt that the water quality samples that were analysed are not representative of a sample from a creek flow event, but rather reflect the water quality of a rainfall event. At this stage, the laboratory analysis data should not be used as part of the baseline water quality set for the site as it may lead to water quality trigger values for the site being set which are unrealistic. If further samples collected (with more confidence) validate the water quality results collected to date, then the results from the current laboratory samples could be used.

6. RECOMMENDATIONS

With respect to data collection and validation, the following actions are recommended:

- Reinstall the surface water monitoring stations to gather more baseline data. These stations should remain during the operations to allow monitoring of potential impact from the mining operations to be monitored. Additional data prior to site operation can assist in developing the baseline data set for the project.

- It is understood that on 10 June 2021, the stations were reinstalled in their original locations by Bennelongia, who were conducting field surveys at Lamb Creek. Installation equipment and instructions were provided to Bennelongia by AQ2 prior to Bennelongia mobilisation. Bennelongia were instructed to install the bottom of the water quality mounting kits approximately 100mm above the base of the creek to enable collection of water samples from lower creek flow events.
- The water quality sample data that was recorded should be discarded as it is likely to be representative of rainwater and not creek flow. If this data is used as a baseline water quality dataset for comparisons with future data collection, it will appear that MRL are having an adverse impact on the surface water quality when it is potentially not the case.
- The top of the mounting kit for the sample collection bottle should be sealed with silicon to ensure that future water samples which are collected are representative of creek flow rather than rainfall. Note that the sample bottles are configured to close once they are full, such that rainfall could fill the bottle before a creek flow event occurs. On 2 July 2021, MRL field personnel sealed the top of the mounting kits at both monitoring locations to stop future ingress of rainwater.
- The intake for the sample collection bottle has been lowered (as per instructions to Bennelongia) to increase the likelihood that a sample from a runoff event can be captured.
- Data from the pressure transducer logger should be retrieved periodically. Ideally, the data would be downloaded at 6-monthly intervals (pre and post wet season).
- On future visits to retrieve water samples and/or collect logger data, **field notes** are to be recorded and should include all relevant observations such as debris height, water depth, visible flow channels, condition of the mounting kits etc.
- Checking logger data immediately after download to **'reality check'** observed trends.
- If taking water samples, **instantaneous readings** of key parameters (i.e. pH, EC, temperature) should also be taken.
- **Installation of a rain gauge** and associated data logger could be considered at Lamb Creek, which would allow comparisons of rainfall to creek responses to be completed. Rainfall in the Pilbara is typically spatially variable such that actual rainfall on the creek catchment may not be represented by the Karijini North weather station. Unless direct correlations between rainfall and runoff are required for regulatory purposes, we feel that this would not be required to support data gathered from only 2 flow monitoring stations.

We trust that this memo meets your requirements. Please contact us if you have any questions or would like us to make any changes.

Regards,

Brieland Jones

Consulting Water Resources Engineer

Mark Nicholls

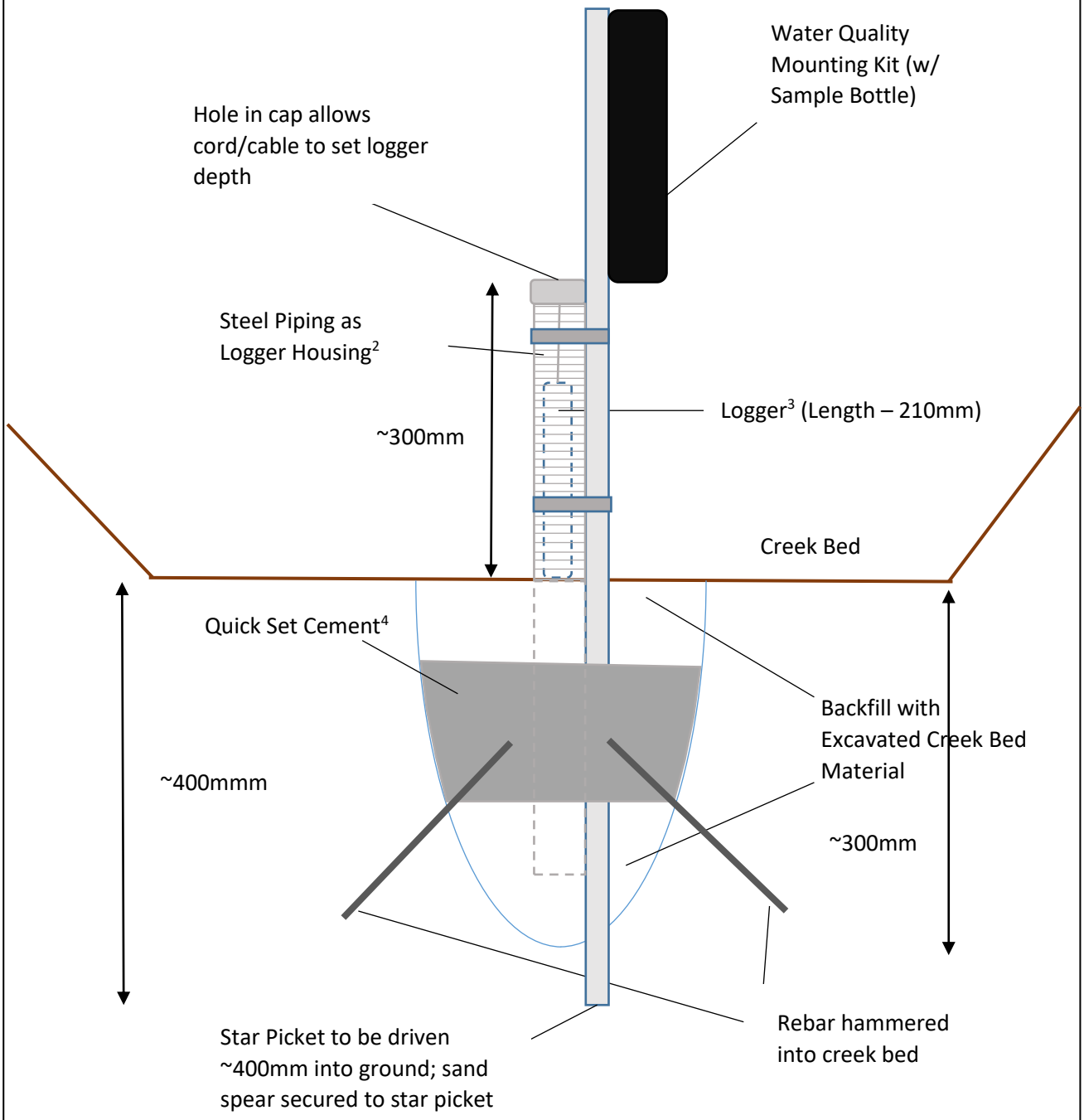
Consulting Water Resources Engineer

Attached:
Photos
Figures
Appendix A – Water Quality Report - ChemCentre

Author: BGJ (07/07/21)
Checked: MAN (07/07/21)
Reviewed: MAN (07/07/21)

PHOTOS

FIGURES



Notes

1 - Drawing not to scale.
2 – To be secured to star picket using band clamp.
3 – To be secured to sand spear using cord through cap; sensor to be placed level with creek bed.
4 - Approximately 1 x 20 kg bag of cement will be used per hole.

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Conceptual Drawing – Logger Installation FIGURE 1

Location Map

F:\326\4.GIS\Workspaces\SW\Proposed Surface Water Monitoring Locations.qgz

— Proposed Mine Infrastructure

● Surface Water Monitoring Location

AUTHOR: BJ

DRAWN: BJ

DATE: 06/07/2021

REPORT No: 006b

JOB No: 326

Coordinates: MGA Zone 50

Notes and Data Sources:

Aerial Imagery sourced from Google (2020)

Mine Infrastructure layout provided by MRL (July 2021)

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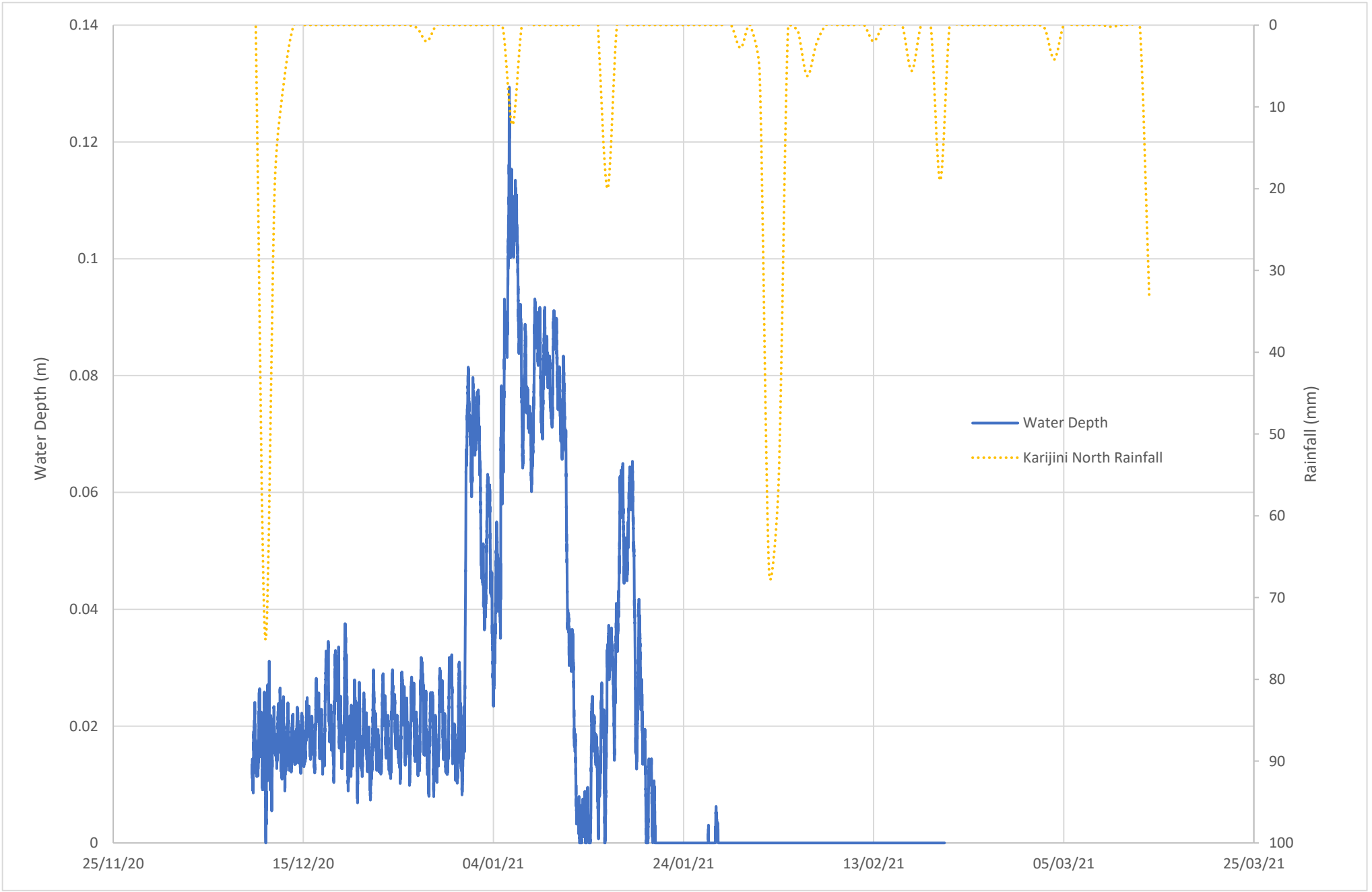
Figure 2

Surface Water Monitoring Locations



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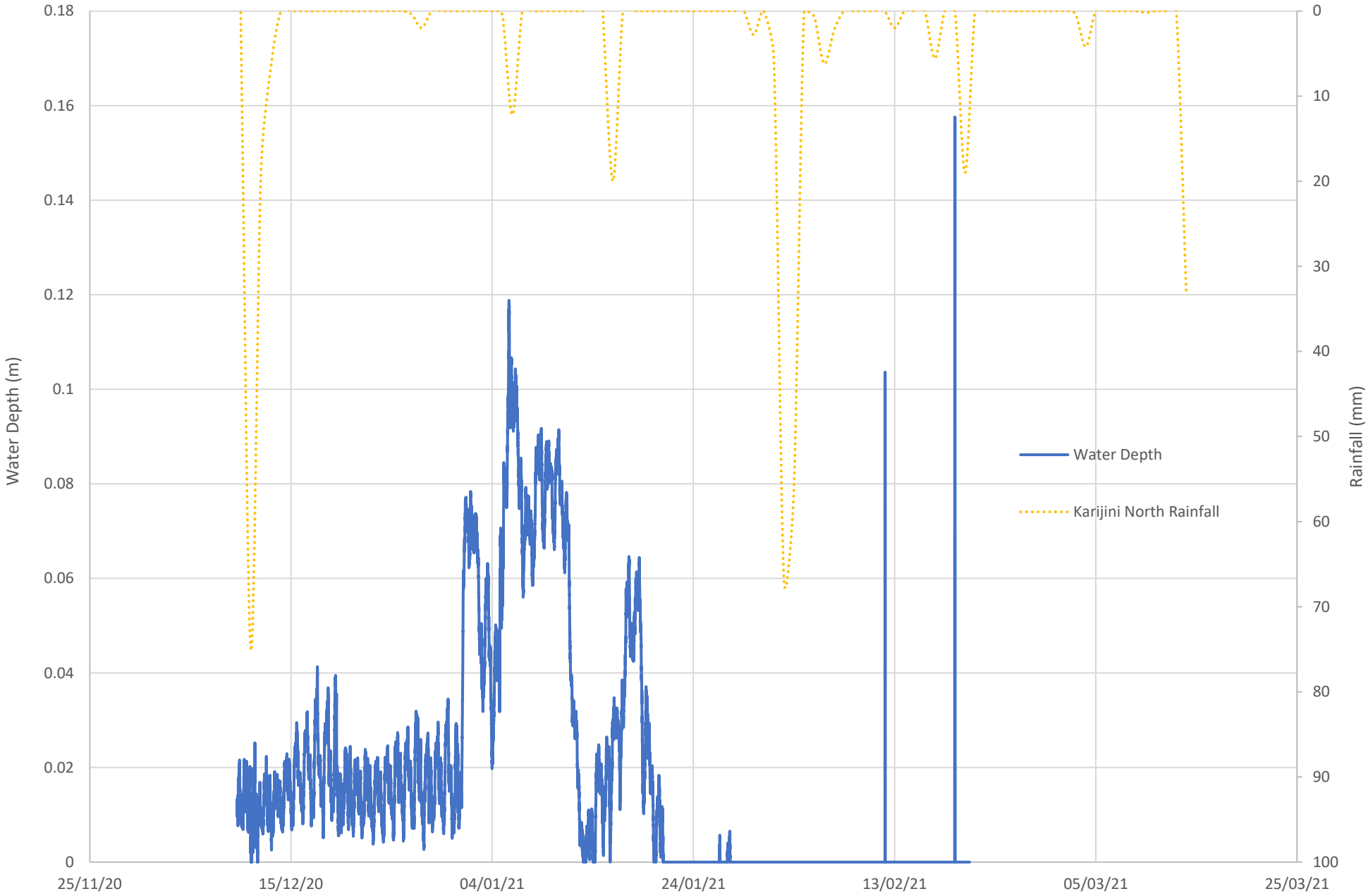
Water Depth vs. Rainfall - Lamb Creek North FIGURE 3

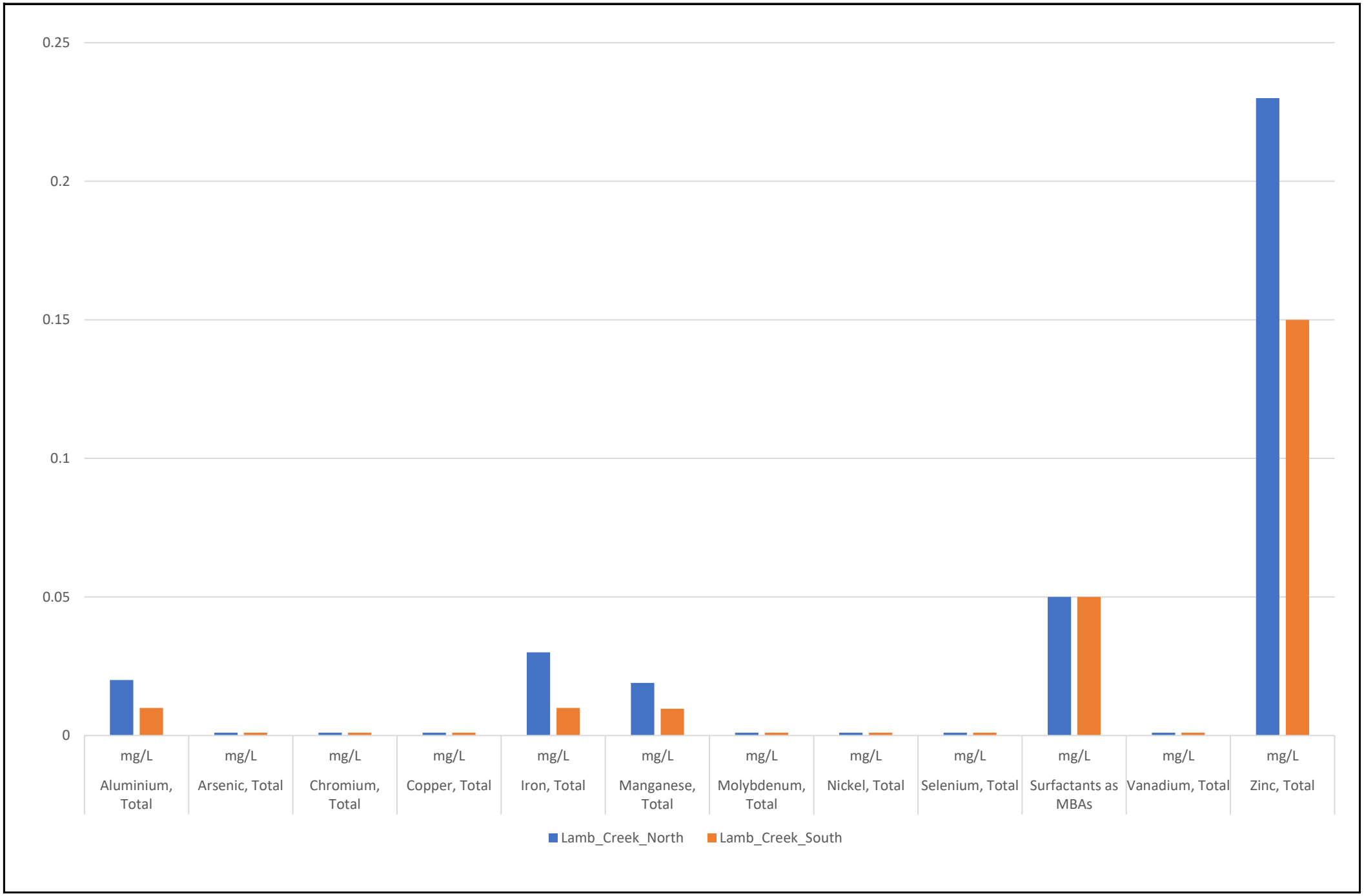
F:\326\3.C&R\Reports\SW Installation\[Figure 2 - Lamb Creek North.xlsx]Landscape Figure



AQ2

Water Depth vs. Rainfall - Lamb Creek South FIGURE 4

F:\326\3.C&R\Reports\SW Installation\[Figure 3 - Lamb Creek South.xlsx]Landscape Figure



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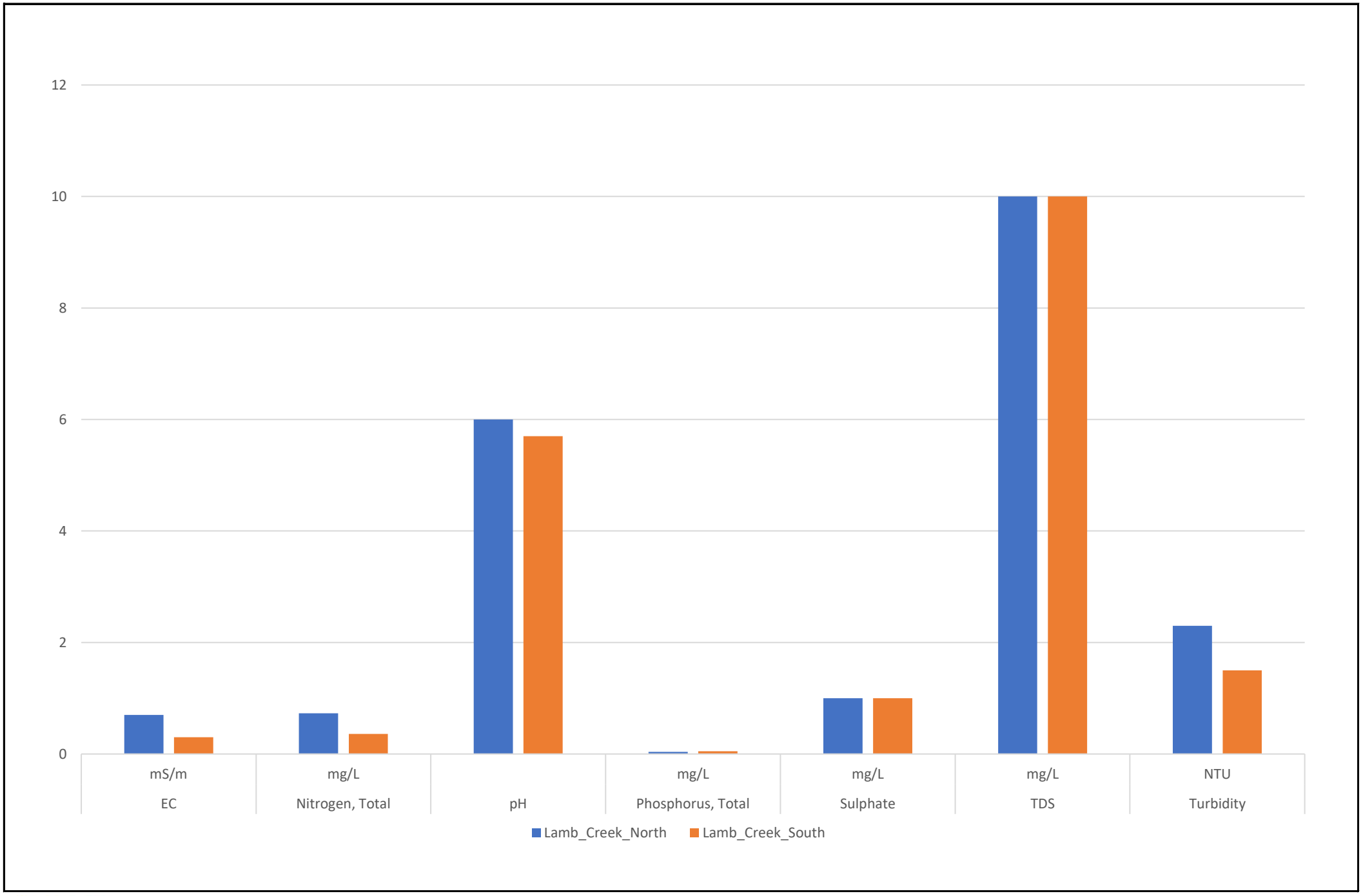
Water Quality Results - 1 FIGURE 5

F:\326\3.C&R\Reports\SW Installation\[Figure 4 - Water Quality Results 2.xlsx]1



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F:\326\3.C&R\Reports\SW Installation\[Figure 4 - Water Quality Results 2.xlsx]2

Water Quality Results - 2 FIGURE 6

APPENDIX A

ChemCentre
Scientific Services Division
Report of Examination

Accredited for compliance with ISO/IEC 17025 - Testing, Accreditation No. 8

Resources and Chemistry Precinct
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www.chemcentre.wa.gov.au
ABN 40 991 885 705

Purchase Order: None
ChemCentre Reference: 20S3719 R0

AQ2 (Pty) Ltd
Level 4, 56 William Street
PERTH WA 6000

Attention: Brieland Jones

Report on: 2 samples received on 04/03/2021

LAB ID	Material	Client ID and Description
20S3719 / 001	water	LCSW-1 Northern location
20S3719 / 002	water	LCSW-2 Southern location

LAB ID			001	002
Client ID			LCSW-1	LCSW-2
Sampled			23/02/2021	23/02/2021
Analyte	**Method**	**Unit**		
Aluminium	iMET1WCICP	mg/L	0.019	0.006
Aluminium, total	iMET1WTICP	mg/L	0.02	<0.01
Arsenic	iMET1WCMS	mg/L	<0.001	<0.001
Arsenic, total	iMET1WTMS	mg/L	<0.001	<0.001
Cadmium	iMET1WCMS	mg/L	<0.0001	<0.0001
Cadmium, total	iMET1WTMS	mg/L	<0.0001	<0.0001
Chromium	iMET1WCMS	mg/L	<0.0005	<0.0005
Chromium, total	iMET1WTMS	mg/L	<0.001	<0.001
Copper	iMET1WCMS	mg/L	0.0004	0.0003
Copper, total	iMET1WTMS	mg/L	0.001	<0.001
Electrical Conductivity	iEC1WZSE	mS/m	0.7	0.3
Iron	iMET1WCICP	mg/L	0.020	<0.005
Iron, total	iMET1WTICP	mg/L	0.03	<0.01
Lead	iMET1WCMS	mg/L	0.0001	<0.0001
Lead, total	iMET1WTMS	mg/L	<0.0005	<0.0005
Manganese	iMET1WCMS	mg/L	0.019	0.0097
Manganese, total	iMET1WTMS	mg/L	0.019	0.0097
Mercury	iMET1WCMS	mg/L	0.0001	0.0001
Mercury, total	iMET1WTMS	mg/L	<0.0001	<0.0001
Molybdenum	iMET1WCMS	mg/L	<0.001	<0.001
Molybdenum, total	iMET1WTMS	mg/L	<0.001	<0.001
Nickel	iMET1WCMS	mg/L	<0.001	<0.001
Nickel, total	iMET1WTMS	mg/L	<0.001	<0.001
Nitrogen, total	iNP1WTFIA	mg/L	0.73	0.36
pH	iPH1WASE		6.0	5.7
Phosphorus, total	iPP1WTFIA	mg/L	0.038	0.048
Selenium	iMET1WCMS	mg/L	<0.001	<0.001
Selenium, total	iMET1WTMS	mg/L	<0.001	<0.001
Sulphate	iCO1WCDA	mg/L	<1	<1

LAB ID			001	002
Client ID			LCSW-1	LCSW-2
Sampled			23/02/2021	23/02/2021
Analyte	**Method**	**Unit**		
Surfactants as MBAS*	iSUPPTOAGAL	mg/L	<0.05	<0.05
Total dissolved solids(grav)	iSOL1WDGR	mg/L	<10	<10
Turbidity	iTURB1WCZZ	NTU	2.3	1.5
Vanadium	iMET1WCMS	mg/L	<0.0001	<0.0001
Vanadium, total	iMET1WTMS	mg/L	<0.001	<0.001
Zinc	iMET1WCICP	mg/L	0.23	0.15
Zinc, total	iMET1WTICP	mg/L	0.23	0.15
Date Analysed	iCO1WCDA		8/3/2021	8/3/2021
	iEC1WZSE		10/3/2021	10/3/2021
	iMET1WCICP		11/3/2021	11/3/2021
	iMET1WCMS		18/3/2021	18/3/2021
	iMET1WTICP		18/3/2021	11/3/2021
	iMET1WTMS		18/3/2021	18/3/2021
	iNP1WTFIA		11/3/2021	11/3/2021
	iPH1WASE		10/3/2021	10/3/2021
	iPP1WTFIA		11/3/2021	11/3/2021
	iSOL1WDGR		9/3/2021	9/3/2021
	iSUPPTOAGAL		16/3/2021	16/3/2021
	iTURB1WCZZ		9/3/2021	9/3/2021
Sample Condition			Cold	Cold

Method	**Method Description**
iCO1WCDA	Colourimetric analysis by DA (Discrete Autoanalyser).
iEC1WZSE	Electrical conductivity in water compensated to 25C.
iMET1WCICP	Total dissolved metals by ICPAES.
iMET1WCMS	Total dissolved metals by ICPMS.
iMET1WTICP	Total metals by microwave digestion and ICPAES.
iMET1WTMS	Total metals by microwave digestion and ICPMS.
iNP1WTFIA	Total Nitrogen by persulphate digestion and analysis by FIA.
iPH1WASE	pH in water by pH meter.
iPP1WTFIA	Total Phosphorus by persulphate digestion and FIA.
iSOL1WDGR	Total dissolved solids (TDS) by gravimetry, dried at 178 - 182 C.
iSUPPTOAGAL	Analysis outsourced to NMI.
iTURB1WCZZ	Turbidity of water by Nephelometer.

Methylene Blue Active Substances were subcontracted to NMI, 105 Delhi Road, North Ryde, NSW, 2133. NATA accreditation 198. A copy of their report is attached.

Analysis of the pH was outside the holding time of six hours. The results should be used as reference only.

These results apply only to the sample(s) as received. Unless arrangements are made to the contrary, these samples will be disposed of after 30 days of the issue of this report.
This report may only be reproduced in full.

*Analysis not covered by scope of ChemCentre's NATA accreditation.

Alex Martin
Chemist
SSD Inorganic Chemistry
18-Mar-2021