DM McMahon Pty Ltd
6 Jones St (PO Box 6118)
Wagga Wagga NSW 2650
t (02) 6931 0510
www.dmmcmahon.com.au

25 September 2020

Attention:

BY EMAIL

Dear

Re: Visual inspection for bank stability of a large dam. Lot 6 DP841293 Reno Rd, Reno NSW 2722

I refer to the written instructions from yourself to undertake an inspection of a dam, for the purpose of assessing embankment stability at Lot 6 Reno Rd, Reno NSW (the site).

Introduction
McMahon have been engaged by Allspec and Partners Pty Ltd to undertake an inspection of a dam for the assessment of embankment stability on behalf of the developers of Lot 6 Reno Rd, Reno. The inspection was undertaken to identify any evidence of over-topping, through flow and undermining of the dam embankment. It is understood that the developers are in the process of developing a aqua culture farm and the dam will be used for recirculating water to a number of other ponds present on site. This assessment is limited to the large westernmost catchment dam within Lot 6 as seen completed in the 2011 (December) aerial image in Attachment B. McMahon undertook the site inspection on 7 July 2020. Photographs of the site condition at the time of the assessment can be found in Attachment A.

Site Description
The site is located to the south of Reno Rd, with the dam being set back approximately 500m south of the lot boundary. The dam is located in a first order (Strahler,1952) drainage catchment and is not visible from Reno Rd. Photographs of the typical site conditions encountered at the time of the assessment can be found in Attachment A.

Background Search
Allspec and Partners supplied a site survey conducted via aerial drone imagery and LiDAR surveying techniques. The supplied survey forms part of the description of the dam embankment features herewith.

A desktop review of historical aerial imagery of the site back to 1961 was undertaken to aid in the identification of any prior physical evidence of landslip that may have occurred on the site.

No prior evidence of landslip activity was evident in the vicinity of the site from a review of aerial photographs taken from 1961, 1971, 1980, 1986, 1991, 1998, 2006, 2010, 2011, 2013 and 2019.
From a review of the imagery, it is evident that the embankment was constructed in early 2010. From the available imagery, it is suggested that the dam was constructed by ripping existing soil and regolith and track rolling the in situ soils into a mass embankment by use of a bulldozer. Spillways were installed to the north and south end of the dam embankment. The original spillway appears to be constructed to the south, with an additional spillway installed to the north within two years of the dam construction. Details of the dam construction (methodology, plans, as constructed drawings, etc.)

have not been documented or were not supplied at the time of writing. Aerial photos depicting stages of dam construction can be found in attachment B.

Fieldwork

Visual Assessment

Fieldwork for the investigation was carried out on the 7 July 2020 and included a site walkover and inspection of the as constructed dam embankment as well as observations of spillways and downslope features. Subsurface investigation was not included as part of the scope of the assessment. No pits or boreholes were excavated, and the assessments of the soil materials are based on profile cuttings still evident from the time of construction.

The dam embankment wall spans approximately 95m and intersects a westerly flowing first order drainage channel from north to south. The embankment wall is approximately 10m high from the midpoint of the dam wall with a slope of approximately 0.5 (not measured) from the top of the embankment to the toe of the embankment. The dam appears to have been constructed from site-won cut to fill materials.

Dispersion testing was conducted on site with exposed soils on embankment walls and soil profiles cut for the construction of the embankment. Field dispersion testing was conducted with water obtained from the dam and did not show signs of dispersion or slaking after 5 mins. The soils were tested under natural soil moisture content and were generally moist to moderately moist.

Evidence of overtopping was not observed, however there was minor erosional evidence within spillways that suggest bank full conditions have been observed between 2010 and the time of inspection.

Tension cracking was observed at the top of the embankment. Tension cracks were evident in one section of the dam embankment and extended approximately 3m in length, with a surface crack distance of up to 20mm. The most likely mechanism for tension cracking as observed is drawdown of the dam water level from bank full storage.

Throughflow or seepage was evident at the northern toe of the dam embankment from the presence of sedge and tussock grasses generally indicating soils that are predominantly wet throughout the majority of the year. Sedge grasses and wet soils were particularly evident in the initial drainage channel prior to the reconstructed northern spillway sometime between 2011 and 2013.

Geotechnical Laboratory Testing

Laboratory testing was outside of the scope of works and as such no laboratory testing of soil or rock materials was conducted as part of this assessment. Field testing as conducted on site is detailed above.

Water Sampling

McMahon obtained a water sample (7065/1) as directed by the developers on site. The sample was obtained to the north west of the existing site sheds, from the water line at the time of the site inspection. The water sample was obtained as a grab sample by use of a swing pole sampler. Sample bottles were triple rinsed with the dam water prior to sampling and stored in a chilled esky before being sent to a NATA accredited laboratory (ALS-Sydney) for analysis.

The sample was tested for pH, electrical conductivity, alkalinity, sulfate, chloride, calcium, magnesium, sodium, potassium, nitrite, nitrate and total anions and cations. The analytes as tested were selected for general water quality characteristics, specifications for a targeted testing suite were not supplied. The results of the analysis can be found in
attachment C.

Landslip Risk Assessment
A landslip risk assessment was outside the scope of works and as such was not conducted as part of this assessment.

If you have any queries about the contents of the letter format report, please contact the undersigned.

Yours sincerely,

Alexander Rudd
BSc
MAGS MEIANZ

David McMahon CEnvP SC
BAppSc SA
GradDip WRM
MEnvMgmt
MALGA MEIANZ MSSA

Assumptions
This assessment is based on the conditions of the embankment as specified herein, as assessed on 7 July 2020. Site conditions may change significantly over time and this assessment can only be relied upon for the time at which the visual inspection was made. If significant changes have occurred, or the site differs significantly from that which is described in this report, the site may need to be reassessed.

Attachments
A. Site photographs
B. Relevant historical aerial imagery
C. ALS results

Reference
Strahler, A. N. (1952). Hypsometric (area-altitude) analysis of erosional topology, Geological Society of America Bulletin, 63 (11): 1117-1142.

Disclaimer
The information contained in this report has been extracted from field sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that findings in this report are based solely upon the said site conditions at the time of inspection. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the substrate within the location may change due to variations in ground conditions outside the inspected area.

Notice of Copyright

McMahon
EARTH SCIENCE

DOCUMENT ATTACHMENTS

REPORT 7065

DM McMahon Pty Ltd
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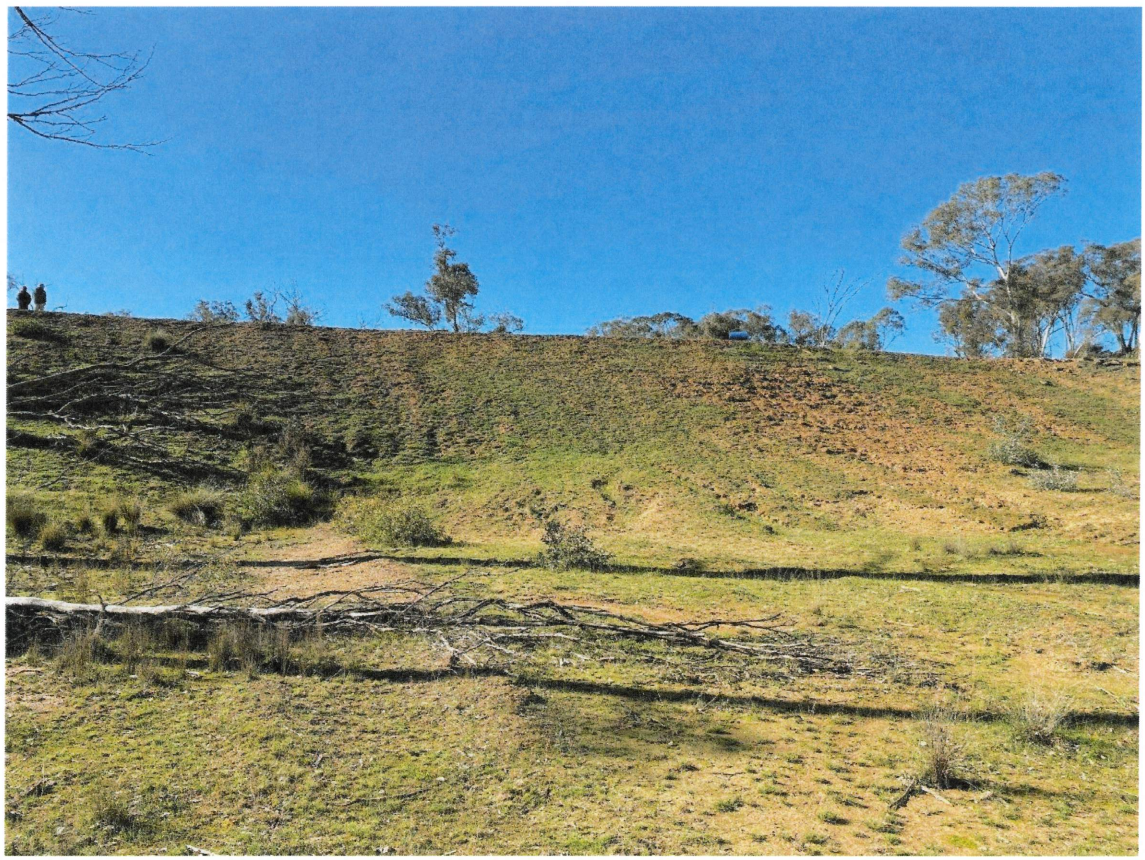
Attachment A : *Site photographs*



Photograph 1: Dam Embankment from toe of embankment. Facing East.

Photograph 2: Northern end of dam embankment from toe of embankment. Facing North East.

Photograph 3: Southern end of dam embankment. Facing South East.

Photograph 4: Minor erosion evident from overland flow of southern spillway. Facing North.

Photograph 5: Dam embankment. Facing North. Minor erosion evident in foreground due to overland flow from southern spillway.

Photograph 6: Minor erosion due to overland flow from southern spillway. Facing West.

Photograph 7: Top of dam embankment. Facing North.

Photograph 8: Evidence of tension cracking along eastern side of top of dam embankment. Facing North.

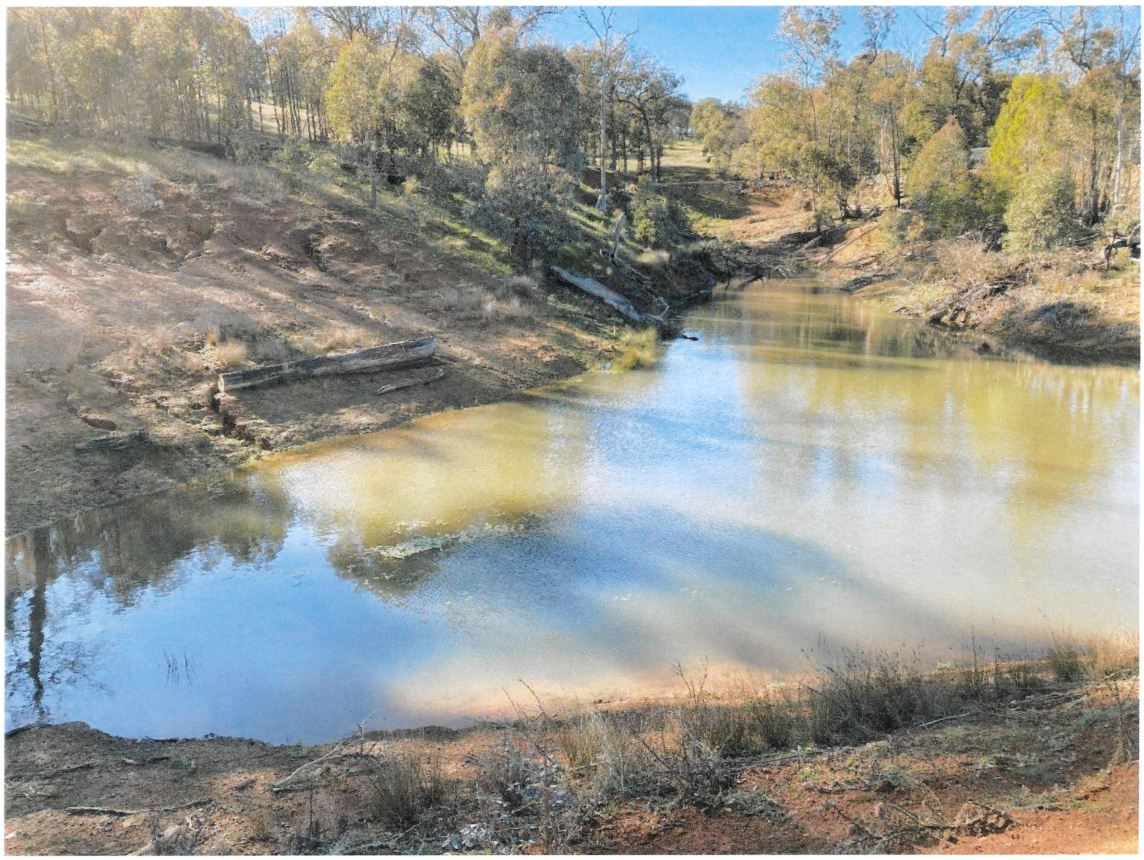
Photograph 9: Close up of tension cracking evident in Photograph 10.

Photograph 10: Tension cracking of eastern side of top of embankment. Facing North.

Photograph 11: Dam embankment. Facing South.

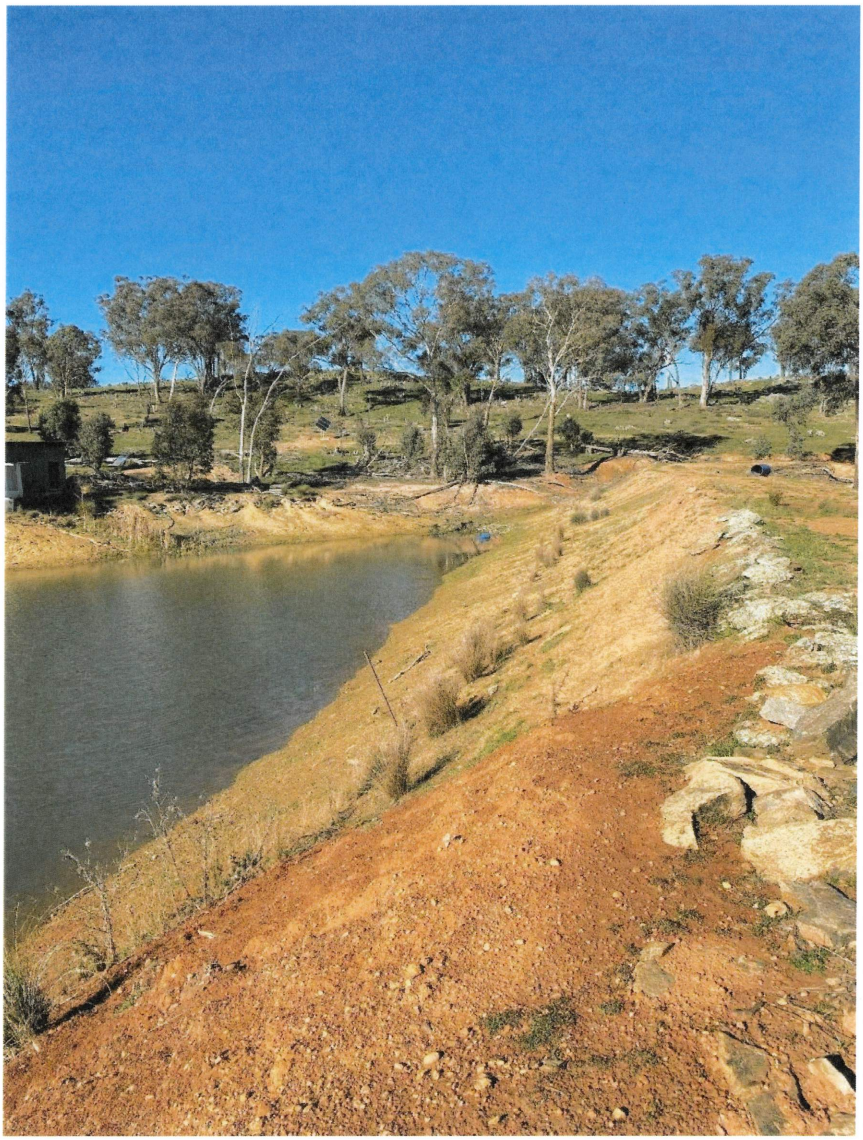
Photograph 12: Downslope of dam embankment. Facing south west.

Photograph 13: Downslope of dam embankment. Facing west. Sedge grass evident in foreground, likely through seepage underneath dam embankment.



Photograph 14: Northern side of dam. Facing East.

Photograph 15: Southern side of dam. Facing South east.



Photograph 16: Western end of dam, eastern side of dam embankment. Facing South.

Photograph 17: Northern spillway. Facing north west.

Photograph 18: Site cutting from dam construction. Facing north east.

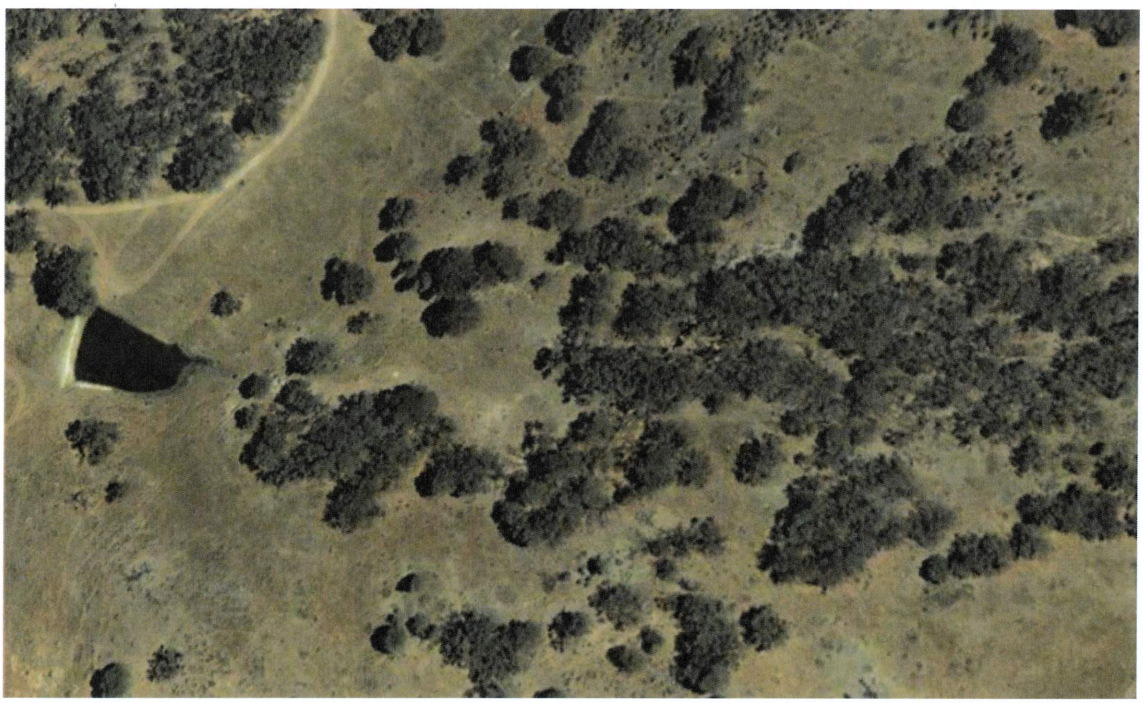
Photograph 19: Spillway with concrete surrounding outflow pipe. Concrete height approximately level with midsection of outflow pipe.

Photograph 20: Outlet end of northern spillway outflow pipe. Facing South.

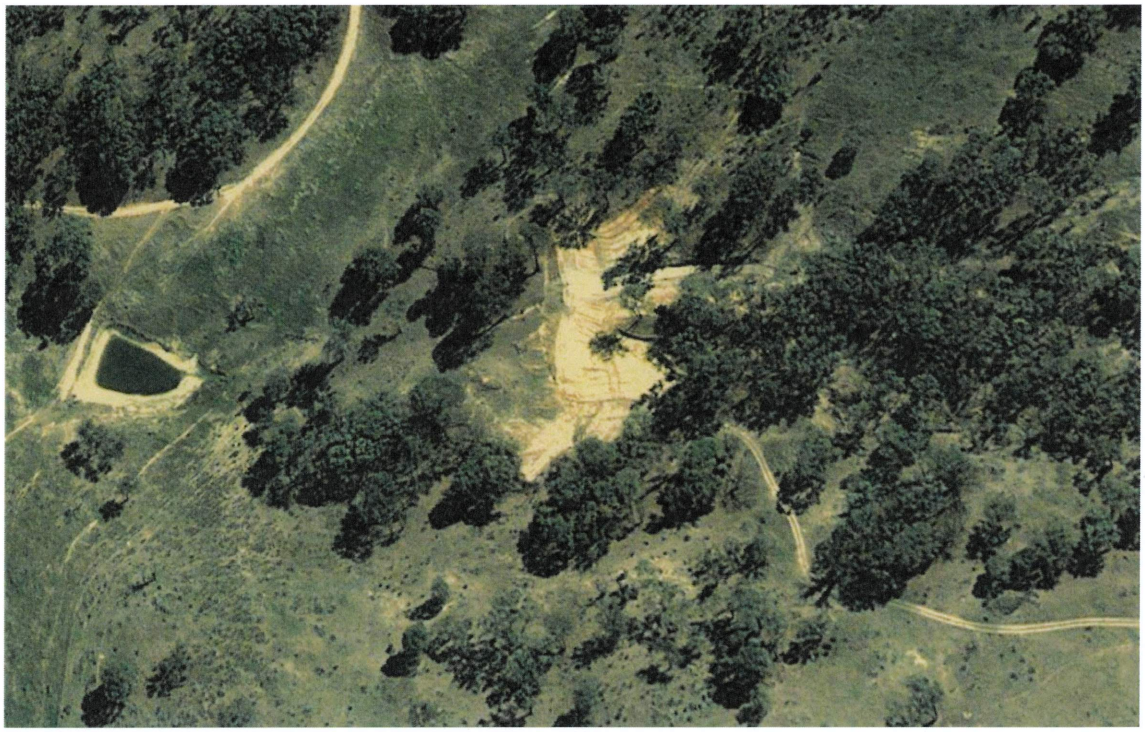
Photograph 21: Northern spillway channel directing overflow from outflow pipe downslope to the west. Facing west.

Attachment B : *Relevant historical aerial imagery*

1998 – No evidence of dam construction.



2006 (January) – No evidence of dam construction.



2010 (March) – Evidence of dam during construction.

2011 (December) – Dam construction complete.

2013 (November) – Dam at near bank full condition.

Attachment C : *ALS results*

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2023800**	Page	: 1 of 3
Client	: **DM MCMAHON PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR DAVID MCMAHON	Contact	: Customer Services ES
Address	: 6 JONES ST Wagga Wagga NSW, AUSTRALIA 2650	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 02 6931 0510	Telephone	: +61-2-8784 8555
Project	: Reno Road, Reno NSW	Date Samples Received	: 10-Jul-2020 12:45
Order number	: 7065	Date Analysis Commenced	: 10-Jul-2020
C-O-C number	: ----	Issue Date	: 15-Jul-2020 15:14
Sampler	: Alexander Rudd		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	7065/1	----	----	----	----
			Client sampling date / time	07-Jul-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2023800-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.54	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	269	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	175	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	51	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	51	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	51	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	----	----	----	----
Magnesium	7439-95-4	1	mg/L	11	----	----	----	----
Sodium	7440-23-5	1	mg/L	31	----	----	----	----
Potassium	7440-09-7	1	mg/L	3	----	----	----	----
ED093F: SAR and Hardness Calculations								
^ Sodium Adsorption Ratio	----	0.01	-	1.86	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.13	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.13	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	2.46	----	----	----	----
ø Total Cations	----	0.01	meq/L	2.48	----	----	----	----