LUPIN MINE
NUNAVUT, CANADA

Water Licence No. 2AM-LUP1520

2018 Annual Report

to the Nunavut Water Board

Submitted by:
Lupin mines incorporated
[A Wholly owned independent Subsidiary of Mandalay Resources Corporation]
76 Richmond Street East, Suite 330
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MANDALAY RESOURCES

LUPIN MINE, NUNAVUT

WATER LICENCE NO. 2AM-LUP1520

2018 ANNUAL REPORT

EXECUTIVE SUMMARY

The Lupin Mine was in care and maintenance throughout 2018 resulting in minimal water use. Waste deposit took place from the Sewage Lakes disposal Facility and the Tailings Containment Facility during open water in accordance with the Licence requirements. The site was occupied from April 26, 2018 through December 31, 2018.

During this period, care and maintenance, and closure activities included the following:

- camp opening and closing, utilizing freshwater and deposit of sewage to the Sewage Lakes Disposal Facility, and incineration of general camp wastes;
- general site maintenance including airstrip, roads, minor repairs to Tailings Containment Area (TCA) internal dams;
- discharge of the Sewage Lakes Disposal Facility effluent (lower sewage lake). Approximately 282,506 m^3 of effluent was released to the environment, all within Licence discharge criteria;
- dewatering of the Tailings Dump Pond No.1 to the lower sewage lake;
- dewatering/transferring of water from the upper sewage lake to the lower sewage lake;
- removal of accumulated snow from the Bulk Fuel Storage (Main Tank Farm) prior to freshet resulted no discharge being required from the facilities;
- decommissioning of satellite tank farm, main tank farm and boneyard fuel tanks (22 in total) for final disposal. These varied in capacity from 1,880 L to 93,000 L. All were inspected and certified for future disposal. Main bulk fuel tanks and miscellaneous day tanks remain to be emptied, cleaned and certified;
- collection and pumping of TCA Dam 2 seepage back to the TCA Pond 2;
- discharge of water from the TCA, Pond 2. Approximately 1,947,851 m^3 of effluent was released from the TCA to the environment over a thirty-one (31) day period for an average daily rate of 62,834 m3/day. All water quality parameters were within Licence discharge criteria as well as meeting the discharge criteria of the Metal and Diamond Mining Effluent Regulations (Fisheries Act);

- general water quality monitoring;
- annual geotechnical inspection of engineered facilities; Tailings Containment Area, Sewage dam and fuel tank farm berm inspections;
- soil sampling to supplement database for the Final Closure and Reclamation Plan; installation of additional instrumentation for pore water quality and tailings cover saturation data collection;
- collection and removal of various hazardous materials and other waste (shipped to Yellowknife, NT)

KAVAMALIQINIRMUT NAINAAQHIMAYUT NAUNAITKUTAT
2018 UKIUM NUNNGUTAANUT NAUNAITKUTAT

Lupin Uyaraghiuqviat munaqtauhimayuq aulapkaqtitaupluni ukiumi 2018-mi talvuuna imaqtuqpallaanngittut. Annakkunik kuvihivaktut Annakuit Tahianit Kuvviqmit talvanilu Imaiyarvighaq Ilaliutighangit hikuitillugu malighugu Laisiutaanit pitquyauhimayut. Havakviit inuqaqhimayut Qitiqqautiyuq 26-mit Upluiqvia 31-mut, 2018-mi.

Talvuuna, munaqhiyut aulapkaiyullu, umiktiriyullu taimaa havaanguyut:

- hiniktarvingmik angmaqtiriyut umiktiririyullu, imariktuq atuqhugu kuviplugillu annakkuit talvunga Annakuit Tahia Kuvvianut, ikulattiplutiklu havakviup iqqakuinik;
- havakvingnik aulapkaivaktut milvingmiklu, apqutinik, ihuaqhaivaghugu Imaiyarvighaq Ilaliutighangit Iniat (TCA) ilauniittut haputiliuqhimayut;
- anialattiyut Anaqtarviup Tahianit Kuvviq (atpakitqiyamut kuvviqmut). Haniani 282,506 m^3-nik annakuit kuviyauhimayut avatinut, tamangnik Laisiutaanik kuvvikunut malighugit;
- imaiyaqhugu Imaiyarvighaq Kuvviq Tahia Nappa 1 atpakitqiyamut kuvviq tahianut;
- imaiyaqhugu/nuutittugu imaq qulvahitqiyamit kuvviqmit talvunga atpakitqiyamut kuvviq tahianut;
- aputaiyavaghutik apittaraangat Uqhuqyuat Qattaryuit Nayugaat (Uqhuqyuat Qattaryuit) immaktinnagu taimaa qurluralattiyaamik ihariaginngittut;
- atuqtittihuiqpalliayut satellite-mik uqhuqyuat qattaryuinik, uqhuqyuat qattaryuit nayugalluangit qattaryuillu (22-nguyut naallugit) iqqakuqtauyughat. Hapkua aallatqiiktumik aktikkutariiktut 1,880 L-mik taimaalu 93,000 L-mut. Tamangnik ihivriuqtauhimayut naammagiyauplutik iqqakuqtaghat. Angitqiyat uqhuqyuat qattaryuit kitullu atuqtauvaktut upluq tamaat imaiyaqtauyughat, halummaqtaulutik naammagiyaulutiklu;

- katitiriyut milukaqhutiklu TCA Haputiliuqhimayuq 2 qurluraqtuq talvunga TCA Tahiraq 2-mut;
- anialattiyut imarmik TCA-mit, Tahiraq 2. Haniani 1,947,851 m^3-nik kuvvikunik anialattivaktut TCA-mit taimaa 31-nik uplunik anialattivaghutik taimaa 62,834 m^3/uplumi. Tamangnik immat qanurininganiit maliguaqhimayaat Laisiutaat anialattinirmut maliguaqhugillu anialattiyunut taapkua Havingnik Hikuliaqpalungniklu Uyaraghiuqtit Kuvvirnut Maliktaghat (Iqalliqiyit Maligait);
- imarnik qanuriningganianik munaqhiyut;
- ukiuq tamaat nunaliqiyit ihivriuqhivaktut hannavingnik; Imaiyarvighat Nayugait, Annakuvingnut haputiliuqhimayuq uqhuqyuallu qattaryuit nayugait kingighihimayut ihivriuqhugit;
- nunanik qimilruqhivaktut ilauyaamik naunaitkutainut Kinguani Umikvighaanut Utiqtirvighaaniklu Nunanik Parnaiyautait; iliuraiyut ingilrutighanik immap qanuriningaanik imaiyarvingniklu qaanganit kinipaumanianik qauyihaiyaamik;
- katitiriyut ahivaqhiyullu aallatqiingnik amirnaqtut hunaqutit ahiillu iqqakuit (agyaqtauvaktut Yalunaimut, NT).

[illegible] – 2018 [illegible]

[illegible] 2018 [illegible]. [illegible] 26, 2018 [illegible] 31, 2018.

[illegible]:

- [illegible] 282,506 m^3 [illegible];
- [illegible] 1 [illegible];
- [illegible] 1,880 [illegible] 93,000 [illegible].

- [illegible] (TCA) [illegible] 2 [illegible] (TCA) [illegible] 2;
- [illegible] (TCA), [illegible] 2. [illegible] 1,947,851 m^3 [illegible] (TCA) [illegible] (31) [illegible] 62,834 m^3/[illegible]. [illegible] ([illegible]).
- [illegible];
- [illegible]; [illegible], [illegible];
- [illegible]; [illegible];
- [illegible] ([illegible], [illegible])

WATER LICENCE 2AM-LUP1520 - GENERAL CONDITIONS- SCHEDULE B

INTRODUCTION

The Lupin Mine is located approximately 285 km southeast of Kugluktuk in the Kitikmeot Region of Nunavut and is owned by Lupin Mines Incorporated (LMI), a wholly owned, indirect subsidiary of Mandalay Resources Corporation. The mine site is situated on the western shore of Contwoyto Lake, approximately 60 km south of the Arctic Circle. It is an underground gold mine that was in operation from 1982 to 2005 with temporary suspensions of activities between January 1998 and April 2000, and again between August 2003 and March 2004. The mine resumed production in March 2004 until February 2005. when the Site was placed into Care and Maintenance, and no active mining has taken place since.

On October 20 2017, Mandalay Resources Corporation, through its wholly owned, independent subsidiary Lupin Mines Incorporated (LMI), announced that the Lupin Mine will transition from care and maintenance to full closure and reclamation, beginning in 2018 through to 2020. An application for renewal and amendment of the current water licence (Application), as well as a Final Closure and Reclamation Plan (FCRP) was submitted to the Nunavut Water Board on July 27, 2018. The FCRP provides the necessary concepts, engineering background, and activities for the full closure and reclamation of the site, followed by a long-term monitoring program. The plan would supersede the most current Interim Closure and Reclamation Plan, approved by the NWB on July 20, 2018. The Application process has completed the Technical Review phase of the licensing process and is currently awaiting completion of commitments generated at the Technical Meeting and Pre-hearing Conference in preparation for the Public Hearing, which has been set for January 2020. Scheduling of final closure activities has been deferred one year due to winter road access requirements and delays in the security refund process, limiting financial commitments for the closure contract. Care and Maintenance of the Lupin Site will continue through 2019, with some preparation for closure activities, scheduled to commence in 2020.

Water Licence, No. 2AM-LUP1520 (Licence), a renewal of the previous licence, was issued to Lupin Mines Incorporated by the Nunavut Water Board (NWB or Board) and approved by the Minister of Aboriginal Affairs and Northern Development on October 5, 2015. Three amendments to Water Licence 2AM-LUP1520 have been issued since the Licence renewal, however these are limited in scope to the security requirements of the Licence, and do not affect the annual report. Under Part B, Item 2 of the Licence, an Annual Report is required to be submitted to the NWB prior to March 31 of the year following the calendar year being reported, and prepared in accordance with Schedule B of the Licence.

The following sections provide the information as required under Schedule B of Water Licence No. 2AM-LUP1520.

A. FRESH WATER INTAKE VOLUME (MONITORING STATION LUP-01)

The monthly and annual quantities in cubic metres of Water pumped from Contwoyto Lake at Station Number LUP-01.

The Lupin Mine camp opened on April 26, 2018. Pumping water from Contwoyto Lake began on April 28, 2018 utilizing a submersible pump, filling a 4,542 litre (1,200 usg) plastic tank within a water truck that is used to transport water to the camp's two (2) 4,542 litre storage tanks. The water is then run through a series of filters with disinfection provided by a flow-through Ultraviolet chamber prior to distribution in camp. The camp was open for 250 days in 2018, through December 31, 2018, using a total of 956.68 m^3 of freshwater, for an average water use of 3.827 m^3/day[1] for domestic purposes, well within the maximum authorized water use of 5,000 m^3/year. The following table summarizes the monthly and annual quantities in cubic metres of Water pumped from Contwoyto Lake at Monitoring Station LUP-01.

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Water Use (m^3/day)				0.18	69.67	108.25	155.52	159.52	108.70	115.53	115.23	124.08	956.68

B. TAILINGS EFFLUENT DISCHARGE (MONITORING STATION LUP-10)

The monthly and annual quantities in cubic metres of treated Tailings Effluent discharged at Station Number LUP-10.

Treatment of stored water in the Tailings Containment Area (TCA) and the discharge of Effluent at Monitoring Station LUP-10 took place between August 21, 2018 and September 19, 2018. Monthly and annual discharge volumes are summarized in the following table. Detailed Daily and Monthly Discharge volumes for monitoring Station LUP-10 are presented in Table No. 1 of Appendix A.

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total (m3)
TCA Effluent (m^3)								703,428	1,244,423				1,947,851

[1] *A Blue-White Industries Model F-1000-RT Totalizer flow meter is used to calculate the daily freshwater consumption.*

C. MINEWATER (MONITORING STATION LUP-11)

The monthly and annual quantities in cubic metres of Minewater discharged at Station Number LUP-11.

There was no mine water pumped from the underground workings at the Lupin Mine Site in 2018 while under care and maintenance.

D. SEWAGE EFFLUENT (MONITORING STATION LUP-14)

The monthly and annual quantities in cubic metres of treated Sewage Effluent discharged at Station Number LUP-14.

Two six-inch syphon lines were installed at the Lower Sewage Lake discharge point on July 11, 2018. Effluent release from the Sewage Lakes Disposal Facilities began on July 12, 2018 and continued until July 30, 2018. Total volume of effluent discharged at Monitoring Station LUP-14 was approximately 282,506m^3. The following table illustrates the monthly and annual discharge quantity of Sewage Effluent at monitoring Station LUP-14 in 2018. Initial problems with the metering on the discharge and resetting of the meter totalizer required estimating of the first few days' flow. A summary of the daily discharge from the Sewage Lakes Disposal Facility is included in Table No. 2 of Appendix A.

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Sewage Effluent (m^3/day)							282,506						282,506

Following the discharge of the Sewage Lakes Disposal Facilities, transfer of water from the upper sewage lake and the Tailings Line Dump Pond No.1 to the lower sewage lake took place in order to lower water levels and provide for storage of spring freshet in 2019.

E. HAZARDOUS WASTE AND CHEMICALS

Details on the types and quantities of Hazardous Waste and chemicals stored on site.

The following table summarizes the types and quantities of Hazardous Waste and chemicals remaining on site as of December 20, 2018, to be used or eventually transported off site.

Hazardous Waste and Chemicals Stored on Site	
Material	Amount
Waste Motor Oil	2000 litres (Powerhouse waste oil storage tanks 2(1,100L) oil cubes stored in the Powerhouse
Contaminated (old) Diesel Fuel	6,765 litres (33 drums in Third party Drum

	Storage - TPDS)
Contaminated (old) Jet Fuel	615 litres (3 drums in TPDS)
Oily Water	96,965 litres (473 drums in TPDS)
Acid Filled Batteries	36 count 12volt lead/acid Batteries (seacan)
Hydrated Lime	13,600 kg (680 - 20 kg bags, Cold Storage #2)
Portland Cement	3,000 kg (150 - 20 kg bags, Cold Storage #2)
Calcium Chloride	Approx. 20,000 kg (covered at laydown area #2)
Shotcrete Cement	30,000 kg (Cold Storage #4 near Winter Rd)

Since the Water Licence renewal in 2015, Hazardous Wastes and other waste materials have been characterized, consolidated and shipped off site. In 2018, a total of 39,288 kg (shipping weight) of Hazardous Wastes, chemicals and other materials were removed from the Lupin Mine site. The following table summarizes the types and quantities of Hazardous Waste, chemicals and materials that were packaged and shipped to Yellowknife, NT.

Waste , Hazardous Waste and Chemicals Shipped from Lupin in 2018	
Material	Amount
Used Oils	11 Drums; 4,734 lbs
Used Oil Filters/containers	1 mega bag; 181 lbs 1 Pallet old grease pails; 312 lbs 1 Drum used oil filters, 256 lbs
Contaminated Fuel	16 Drums from Satellite tank farm, 6,400 lbs 4 Drums, 1,600 lbs
Anti-Freeze (contaminated)	1 Drum; 424 lbs
Floordri (used)	1 Drum; 544 lbs 1 Drum; 530 lbs
Oxygen and Propane Cylinders	1 Crate and 2 tote bags, 400 lbs; 19 empty cylinders, 1,620 lbs
Used Lead Acid Batteries	6 crates, 2,296 lbs; 5 tote boxes, 498 lbs; 1 crate miners batteries, 292 lbs; 1 old tractor battery, 100 lbs.
Used Floordri (oil absorbent)	1 Drums; 530 lbs
Incinerator Ash	14 Drums; 3,991 lbs
Calcium Chloride (drilling salt)	16 Pallets, 31,733 lbs

	400 bags, 29,233 lbs
White Goods (1ea Fridge)	120 lbs
Recyclables	10 mega bags; 820 lbs
Total Materials Backhauled	86,614 lbs (39,288 kg)

Fuel and Petroleum Products Inventory:

As of December 20, 2018, there was approximately 1,225,625 litres of diesel fuel and 318,071 litres of jet fuel in storage in large fuel tanks within the Bulk Fuel Storage (Main Tank Farm). Within the Third-Party Drum Storage (TPDS) berm, stored in 205 Litre drums, there is approximately 2,460 Litres of gasoline in twelve (12) drums; 2,665 Litres of diesel fuel in thirteen (13) drums and approximately 6,253 litres in thirty-one (31) drums of jet-A and/or Av-gas.

Additionally, there are several empty 205 litre drums and three (3) empty 1,300 litre oil cubes on site available for spill contingency and/or temporary storage of hydrocarbons or hydrocarbon contaminated water.

F. MONITORING PROGRAM DATA

Tabular summaries of all data generated under the "Monitoring Program".

Water Quality Monitoring - Freshwater

Freshwater is obtained from Contwoyto Lake, pumphouse or causeway, as described in Section A above. A water sample is obtained from this location annually and submitted for physical and chemical analyses as per Licence monitoring requirements. The 2018 sample was obtained on May 24, 2018. The following table summarizes the Water quality analyses required under Schedule J, at the Freshwater Intake located at Contwoyto Lake, Monitoring Station LUP-01 (see Appendix B, Certificate of Analysis Lab WO#: L2092708, attached).

Station LUP-01		
Parameter	Result (mg/L) May 10, 2018	Laboratory Method Detection Limit (MDL)
pH	6.74	0.1
Conductivity		
Total Suspended Solids (TSS)	<3.0	3
Fecal Coliform (MPN/100mL)	<1 CFU/100mL	1
Total Metals (ICP Scan) mg/L		
Mercury (Hg)	<0.0000050	0.000005

Station LUP-01		
Parameter	Result (mg/L) May 10, 2018	Laboratory Method Detection Limit (MDL)
Aluminum (Al)	0.0163	0.003
Antimony (Sb)	<0.00010	0.0001
Arsenic (As)	0.00063	0.0001
Barium (Ba)	0.00347	0.0001
Beryllium (Be)	<0.00010	0.0001
Bismuth (Bi)	<0.000050	0.00005
Boron (B)	<0.010	0.01
Cadmium (Cd)	0.0000057	0.000005
Calcium (Ca)	1.24	0.05
Cesium (Cs)	0.000017	0.00001
Chromium (Cr)	0.00012	0.0001
Cobalt (Co)	0.00012	0.0001
Copper (Cu)	0.123	0.0005
Iron (Fe)	0.084	0.01
Lead (Pb)	0.000562	0.00005
Lithium (Li)	0.0011	0.001
Magnesium (Mg)	0.706	0.005
Manganese (Mn)	0.00403	0.0001
Molybdenum (Mo)	<0.000050	0.00005
Nickel (Ni)	0.00130	0.0005
Phosphorus (P)	<0.050	0.05
Potassium (K)	0.519	0.05
Rubidium (Rb)	0.00151	0.0002
Selenium (Se)	<0.000050	0.00005
Silicon (Si)	0.13	0.1
Silver (Ag)	<0.000010	0.00001
Sodium (Na)	0.747	0.05
Strontium (Sr)	0.00728	0.0002

Station LUP-01		
Parameter	Result (mg/L) May 10, 2018	Laboratory Method Detection Limit (MDL)
Sulfur (S)	1.19	0.5
Tellurium (Te)	<0.00020	0.0002
Thallium (Tl)	<0.000010	0.00001
Thorium (Th)	<0.00010	0.0001
Tin (Sn)	<0.00010	0.0001
Titanium (Ti)	<0.00060	0.0006
Tungsten (W)	<0.00010	0.0001
Uranium (U)	0.000020	0.00001
Vanadium (V)	<0.00050	0.0005
Zinc (Zn)	0.0054	0.003
Zirconium (Zr)	<0.000060	0.00006

Water Quality Monitoring - Effluent

Discharge of Effluent at the Lupin Mine took place from the Tailings Containment Area and the Sewage Lakes Disposal Facility. Discharge from the Bulk Fuel Storage Facility (including the Satellite Tank Farm and the Third-Party Drum Storage area) was not required in 2018 as accumulated snow was removed in May and June prior to spring melt, placed on the south facing downward slope of the mine site general area so that snow melt would be captured by the Upper Sewage Lake, and any contaminants would be remediated via the Sewage Lakes Disposal Facility prior to discharge. Effluent monitoring is summarized in the following sections.

Tailings Containment Area Discharge and Downstream Monitoring

Water quantity and quality monitoring was carried out during 2018 for discharge from the Tailings Containment Area as required by Schedule J of the Water Licence. Monthly and annual Water quantity discharged is summarized above in Section B of this report. Detailed discharge flow monitoring is included in Table 1 of Appendix A, providing daily and monthly volumes discharged at monitoring station LUP-10. Approximately 1,947,851 m^3 of effluent was discharged at Monitoring Station LUP-10 in 2018.

Initial water quality samples to comply with Part E, Item 9 were obtained on August 9, 2018 from Station LUP-10 (102), which is upstream of the discharge syphons at Dam1a, within the Tailings Pond 2. Water quality analyses as well as toxicity bioassay tests were carried out for compliance confirmation prior to initiating discharge. A request to discharge from the Tailings Containment Area (TCA) was sent to the Inspector on August 20, 2018, which included the pre-discharge water quality data and toxicity results.

Written approval for discharge was received from the Inspector on August 20, 2018 and discharge commenced on August 21, 2018, concluding on September 19, 2018.

A further sample for bioassay testwork was obtained on September 18, 2018, prior to the completion of discharge, from both Monitoring Stations LUP-10 (discharge) and LUP-10 (102), and submitted to the lab. Additional water quality monitoring at Station LUP-10 (102) was completed on September 27, 2018 for chemical analyses.

A summary of the chemical analysis results for the above are included within Tables 3-5 of Appendix A, indicating compliance with Water Licence Effluent quality limits. The full test result reports, certificate of analyses, of the bioassay tests are included in the Appendix B of this report. In summary, the bioassay testwork determined that at 100% effluent concentration, the water within the Tailings Pond 2 (prior to discharge and during discharge) was non-toxic (100% survival) in both the rainbow trout and daphnia LC_{50} test methods.

The following table summarizes the water quality of effluent discharged with respect to Effluent quality limits and compliance under Part E, Items 5 and 9 for Monitoring Station LUP-10.

	Monitoring Station	Field pH	pH (pH)	Total Suspended Solids (mg/L)	Cyanide, Total (mg/L)	Arsenic (As)-Total (mg/L)	Copper (Cu)-Total (mg/L)	Lead (Pb)-Total (mg/L)	Nickel (Ni)-Total (mg/L)	Zinc (Zn)-Total (mg/L)
Minimum	LUP-10	6.40	6.14	1.7	<0.0050	0.00299	0.00196	0.000029	0.0538	0.161
Maximum	LUP-10	7.86	6.76	15.0	<0.010	0.00826	0.00375	0.000073	0.0602	0.193
Average	LUP-10	6.82	6.41	n/a*	n/a	0.00525	0.00244	n/a	0.0565	0.177
Licence Criteria										
Max. Average Conc. (mg/L)		6.0-9.5		15	0.8	0.5	0.15	0.10	0.20	0.40
Max. Conc. of Any Grab Sample (mg/L)		6.0-9.5		30	1.6	1.0	0.30	0.20	0.40	0.80

*n/a = average not calculated as the majority of values were below detection

A full summary of data for the discharge at monitoring station LUP-10 in 2018, and the downstream monitoring stations prior to, during and post discharge is included in Appendix A. Table 3 summarizes the monitoring data for station LUP-10, whereas Tables 4 and 5 summarize the data for the downstream monitoring chronologically and by monitoring station respectively. Copies of the laboratory Certificates of Analysis for all monitoring related to the TCA discharge is included in Appendix B.

With the exception of the results from the TCA (monitoring station LUP-10 (102)) for post discharge, all effluent water quality during discharge was observed to be well within the Licence discharge criteria of Part E, Item 5. The final date of discharge, September 19, 2018, was not included in the calculations for minimum, maximum and average values as the results for most regulated parameters were erroneously high, likely due to the inclusion of suspended matter, as evidenced by the high total suspended solids value of 10.5 mg/L and the higher total metals concentrations, whereas the soluble parameters of ammonia, nitrate, nitrite and cyanide exhibited little difference from the previous days' discharge. Results from the post discharge sample (LUP-10, 102) mentioned above, were still within Licence

discharge criteria (with the exception of total zinc) although higher than during discharge, likely due to the transfer of water from Pond 1 to Pond 2.

As noted in Table 3, Appendix B, several dates were missing analysis results due to either the sample not being obtained or the sample shipment not arriving at the lab in Yellowknife, NT.

Sewage Lakes Disposal Facilities

A request to discharge from the Sewage Lakes Disposal Facilities was sent to the Inspector on July 9, 2018, which included pre-discharge water quality data. Written approval for discharge was received from the Inspector on July 9, 2018 and discharge commenced on July 13, 2018, continuing through to July 31, 2018. Approximately 282,506 M^3 of Effluent was discharged from the facilities. The following table summarizes the Water quality analyses as required under Part E, Items 9 and 11 of the Licence, for discharge to the environment of the Sewage Lakes Disposal Facilities at Monitoring Station LUP-14, sampled June 7, 2018. Additional analyses as required under Schedule J are included in Appendix B, in the attached Certificate of Analysis, Lab WO#: L2108799, Sample Label LSP (Lower Sewage Pond).

Station LUP-14		
Parameter	Result June 7, 2018	Maximum Concentration of Any Grab Sample (mg/L)
pH	6.53	6.0 - 9.5
Total Suspended Solids (TSS)	5.3	35
Biochemical Oxygen Demand (BOD_5)	6.0	30
Oil and Grease	<5.0	No Visible Sheen
Fecal Coliforms (MPN/100mL)	<1.0	1000cfu/100mL
Arsenic (As)	0.00664	0.05
Copper (Cu)	0.00109	0.20
Lead (Pb)	0.000566	0.05
Nickel (Ni)	0.00381	0.30
Zinc (Zn)	0.0061	0.50

Bulk Fuel Storage (Main Tank Farm)

As mentioned above, there was no discharge of effluent in 2018 from the fuel storage areas, that include the Main Tank Farm, Satellite Tank Farm and the Third-Party Storage Area. During May and early June, accumulated snow was collected from the tank farm areas, removed and disposed of along the south bank of the main laydown area north of the Upper Sewage Lake, where spring melt and runoff would report to the Sewage Disposal Facilities and be managed through the treatment and discharge of

the Lower Sewage Lake. Any remaining snow and future precipitation was minimal and managed through normal seasonal evaporation.

G. RESPONSE TO INSPECTION REPORTS AND COMPLIANCE REPORTS FILED BY AN INSPECTOR

A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector.

Include a summary of each inspection report, including date of inspection, inspector and date of response provided (Appendix D).

Crown Indigenous Relations and Northern Affairs Canada (CIRNAC) conducted an inspection at the Lupin Mine site on August 5, 2018 for the Water Licence and associated Land Leases. The site conditions were discussed on-site with representatives of LMI during the inspection and an inspection report for the Water Licence was filed on January 23, 2019 by the Inspector. One item was noted, for conditions of the Licence as being a "concern" regarding signage, with the remaining conditions being "acceptable". The items noted in the inspection report are as follows:

1. Items 2, 3 and 11 of Section 3 of the inspection report identified issues related to the signage for monitoring stations under the Licence. The sign for monitoring station LUP-14 was faded and requires replacement and a sign for the Raw Water intake was missing and needed to be placed to show the sample location. The signage at monitoring station LUP-10 had blown away and needed replacement. LMI replaced all the signs at site.

2. Other items/areas inspected during the August 5, 2018 inspection included:

    a. Satellite tank farm and main fuel tank farm;

    b. Landfarm; contaminated soils currently being treated, however all contaminated soils are to be placed underground during final closure;

    c. Water intake and water use records;

    d. Tailings Impoundment Area; lime mixing at Pond 2. Noted that Environment Canada was on site and obtained samples to provide approvals;

    e. Fingers Lake borrow pit area.

    No other issues were noted during the inspection of August 5, 2018.

H. A SUMMARY OF MODIFICATION AND/OR MAJOR MAINTENANCE WORK CARRIED OUT ON THE WATER SUPPLY AND THE WASTE DISPOSAL FACILITIES, INCLUDING ALL ASSOCIATED STRUCTURES

Areas identified in the 2017 Geotechnical Inspection requiring immediate repairs were addressed during the 2018 care and maintenance period (Appendix C).

The 2018 Lupin Mine Tailings Containment Area Geotechnical Inspection was conducted during the period of September 13-14, 2018 by Mr. Alvin Tong, PEng., Senior Geotechnical Engineer with Stantec. Detailed visual inspection was completed on all TCA components, along with readings of instrumentation. The Geotechnical Inspection report was finalized by Stantec, November 16, 2018 and submitted by LMI to the NWB on December 10, 2018, including a cover letter from LMI (see Appendix C). General observations indicated that the perimeter dams are in stable condition. Section 4.0 of the report provides the recommendations of the Engineer. The majority of the external dams require minor surface maintenance (grading and backfilling of minor erosion), although Dam1a was noted to have some deeper erosional gullies requiring repair. Internal dams were found to be in good condition, however several areas were in need of repair due to erosion, and Dam K was noted to have five large erosion gullies and a near vertical slope at the eroded toe requiring prioritized repair while Pond 2 water level is lowered for access. Section 4.2 provided a summary of repair priorities.

In addition to the geotechnical inspection, volumetric moisture sensors were installed in the covers of Cell 2 and Cell 3 during the inspection visit. These were installed to provide data on the degree of saturation throughout the year at the depth associated with the cover and tailings contact zone. Information being gathered includes volumetric water content, temperature and electric conductivity. The sensors are equipped with dataloggers and programmed to record readings every twelve (12) hours. Initial readings will be available in 2019 following spring thaw.

I. SUMMARY OF UNAUTHORIZED DISCHARGES

A list and description of all unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken.

There were no unauthorised discharges or spills reported in 2018.

J. WHERE APPLICABLE, REVISIONS AS ADDENDUMS, WITH AN INDICATION OF WHERE CHANGES HAVE BEEN MADE, FOR PLANS, REPORTS, AND MANUALS

Previous operational plans were re-submitted during the 2018 Licence renewal/amendment process. The following plans were last updated October 2017 as part of that process:

- Lupin Mine Site, Nunavut, Canada, Interim Abandonment and Restoration Plan; Lupin Mines Incorporated (A wholly owned indirect subsidiary of Mandalay Resources Corporation), October, 2017. Approved by the NWB on July 20, 2018.

- Closure Cost Update, Lupin Mine, Nunavut; Golder Associates, July 2018. A Progressive Reclamation Cost Update was later submitted to the NWB on September 24 2018, including an itemized spreadsheet as per NWB guidance, in support of the security reduction request by LMI.

K. UPDATED STATUS OF ANY PROGRESSIVE RECLAMATION AS IT RELATES TO TAILINGS COVER REMEDIATION AND JUSTIFICATION FOR NOT PROCEEDING TO FULL RECLAMATION UNDER PART I, ITEM 7;

Progressive Reclamation

Tailings Containment Area

Progressive reclamation included the covering of Cell 5 as well as repairs to various other cover areas in the TCA, undertaken during the period of July 6, 2018 through October 18, 2018. Reclamation activity at the TCA was shut down on October 18, 2018 due to snow and freezing conditions. Approximately 19,136 m^3 of esker material was placed in Cell 5 during 2018 to cover exposed tailings.. An area of approximately 104,500 m^2 remains to be covered In Cell 5 and approximately 86,000 m^2 remains to be covered in Cell 3, for a total area of approximately 190,500 m^2 remaining to be covered within the Tailings Containment Area.

Mine Site – Fuel Tanks

LIM contracted ChemKleen Environmental Solutions to provide all necessary manpower, equipment and tools for cleaning diesel and gasoline storage tanks at the Lupin Mine. The work at the Lupin Main Tank Farm, satellite tank farm and the Boneyard took place from August 14th through to August 30, 2018. In total twenty-two (22) fuel tanks were cleaned/taken out of service including, four (4) yellow coloured vertical diesel tanks (63,500L each) at the Main Tank Farm, ten (10) horizontal diesel tanks (93,000L each) and two (2) gasoline tanks (24,000L each) from the Satellite tank farm, three (3) horizontal tanks (500 gallon, 50,000L and 93,000L) and three (3) vertical tanks (65,000L each) from the Boneyard were cleaned and certified for tank withdrawal and marked 'Out of Service'.

The final report from ChemKleen, dated December 7, 2018 was submitted to the NWB and is available on the NWB ftp site (public register) at the following link:

ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-LUP1520%20LMI/3%20TECH/2%20SECURITY%20%28C%29/2018/180802%20Security%20Reduction%20Request/181208%202AM-LUP1520%20Appendix%20C%20Lupin%20Tank%20Cleaning%20Engineered%20Report-IMLE.pdf

Soil Sampling - TCA (Pond 2 Substrate) and Landfarm

Soil sampling from the Tailings Containment Area and the Landfarm at the Mine site took place in September 2018 to obtain additional information for closure planning. The Pond 2 substrate will be tested for overall characterization and chemical stability. The Landfarm was sampled to assess the treatment of hydrocarbon contaminated soils that were placed in the facility in 2017. The overall plan however for these soils, regardless of treatment efficiencies, is for final disposal underground via the crown pillar opening, at closure.

OTHER

Hazardous Materials

In 2018, approximately 39,288 kg of various material was removed from the Lupin site for disposal. A summary of materials removed from site and the volumes of materials remaining on site for either removal or consumption are included under section E above.

Full Reclamation

As noted above, Lupin Mines Incorporated, a wholly-owned, independent subsidiary of Mandalay Resources Corporation, plans to transition from care and maintenance to final closure and reclamation. Initial plans were started in 2018, and then in 2019 by carrying out measures approved under the approved Interim Closure and Reclamation Plan, with further transitioning to completion under the Final Closure and Reclamation Plan, once approved during the current amendment and renewal process for Licence No. 2AM-LUP1520.

L. A SUMMARY OF PUBLIC CONSULTATION AND PARTICIPATION WITH LOCAL ORGANIZATIONS AND THE RESIDENTS OF THE NEARBY COMMUNITIES, INCLUDING A SCHEDULE OF UPCOMING COMMUNITY EVENTS AND INFORMATION SESSIONS.

January 22, 2018, LMI had a meeting with Geoff Clark, KIA, in Vancouver to discuss the Ulu progressive reclamation plan and provided an update on the Lupin mine site closure plan.

M. A SUMMARY OF ANY ABANDONMENT AND RECLAMATION WORK COMPLETED DURING THE YEAR AND AN OUTLINE OF ANY WORK ANTICIPATED FOR THE NEXT YEAR;

Progressive reclamation activities included the removal from site, of hazardous materials as summarized in section E. In addition, work began on the removal of engine oils and glycol from the main powerhouse generators as well as general removal of building contents including office furniture, electronics, paints and aerosols, cleaners/chemicals, placed in storage for future disposal.

LMI completed several studies in relation to proposed reclamation activities in support of its interim closure and reclamation plan, water licence requirements, and requirements of the Fisheries Act, Metal Mines Effluent Regulations. These were as follows:

- Completed Environmental Effects Monitoring program for the 2018 TCA discharge under the Metal and Diamond Mines Effluent Regulations (Fisheries Act.), with the quarterly report submitted to Environment and Climate Change Canada in November, 2018.

In addition, the following studies and activities are planned for 2019:

- Carry out a planned Phase 6 (final phase) EEM studies under the Metal and Diamond Mining Effluent Regulations, scheduled for August 2019;
- Carry out a Human Health and Ecological Risk Assessment for the Lupin site as a requirement of the licence amendment and renewal process and final closure planning;
- Continued progressive reclamation of the Tailings Containment Area (TCA), covering of exposed tailings in Cell 5;
- Progressive reclamation where applicable under the approved Interim Closure and Reclamation Plan;
- Further consolidation of hazardous materials, chemicals, electronics etc. for packaging and shipment off site;
- Treatment and discharge of water in TCA Pond 2 (approximately 2 million cubic metres);
- General maintenance and or repairs as identified in the 2018 Annual Geotechnical Inspection;
- Site visit for regulators and consultants for verification of completed progressive closure activities in support of reclamation security amount adjustments as well as providing supporting documentation of completed and planned site work during formal review of the application for amendment and review of the current water Licence.

N. ANY OTHER DETAILS ON WATER USE OR WASTE DISPOSAL REQUESTED BY THE BOARD BY THE BOARD BY NOVEMBER 1 OF THE YEAR BEING REPORTED.

Lupin Mines Incorporated did not receive additional requests for information from the Nunavut Water Board prior to November 1, 2018 for the 2018 annual reporting period.

APPENDIX A –TABLES 1-5

TABLE NO. 1

Tailings Containment Area

Monitoring Station LUP-10; 2018 Effluent Discharge Volume Monitoring

August	Syphon 1		Syphon 2		TOTAL	
Date	YTD Meter Total (m3)	Daily Meter Output (m3)	YTD Meter Total (m3)	Daily Meter Output (m3)	Daily Meter Output (m3)	YTD Meter Total (m3)
21	0	0	0	0	0	0
22	14831	14831	12282	12282	27113	27,113
22	46544	46544	43166	43166	89710	89,710
23	67537	20993	63427	20261	41254	130,964
24	113496	45959	108054	44627	90586	221,550
24	0	0	125074	17020	17020	238,570
25	161180	47684	147372	22298	69981	308,551
26	206793	45613	169814	22442	68055	376,606
27	254539	47746	192133	22320	70066	446,672
28	300294	45755	214578	22444	68200	514,872
29	346228	45934	236141	21563	67497	582,369
30	391854	45627	259562	23422	69048	651,417
31	437458	45603	265970	6408	52011	703,428
					Total August	**703,428**

September	Syphon 1		Syphon 2		TOTAL	
Date	YTD Meter Total (m3)	Daily Meter Output (m3)	YTD Meter Total (m3)	Daily Meter Output (m3)	Daily Meter Output (m3)	YTD Meter Total (m3)
1	481052	43595	292362	26391	69986	773,414
2	525865	44812	318134	25773	70585	843,999
3	570263	44398	346481	28346	72744	916,744
4	614407	44144	370962	24482	68626	985,369
5	658460	44053	395629	24667	68720	1,054,089
6	700586	42126	420016	24387	66514	1,120,603
7	746425	45839	444635	24617	70456	1,191,059
8	788469	41682	469187	24552	66596	1,257,655
9	831373	42904	494937	25751	68655	1,326,310
10	873389	42378	521051	26114	68492	1,394,802
11	916593	43204	547487	26436	69640	1,464,442
12	957982	40989	573384	27808	68797	1,533,239
13	998139	40577	601115	27731	69329	1,602,568
14	1038952	40812	629531	28416	69228	1,671,796
15	1078813	39861	658863	29332	69193	1,711,657
16	1118500	39737	688376	29513	69268	1,780,925
17	1157897	39347	718217	29841	69188	1,850,113
18	1196890	38993	747176	28959	67952	1,918,065
19		22054	0	7732	29786	1,947,851
20					**Total September**	**1,244,423**
					Total 2018	**1,947,851**

TABLE NO. 2

Lower Sewage Pond Syphons

Monitoring Station LUP-14; 2018 Effluent Discharge Volume Monitoring

July	Syphon 1		Syphon 2		TOTAL	
Date	YTD Meter Total (usg)	Daily Meter Output (m3)	YTD Meter Total (m3)	Daily Meter Output (m3)	Daily Meter Output (m3)	YTD Meter Total (m3)
12-Jul-18	0	0	0	0	0	0
13-Jul-18		Est.		Est.	17,000	17,000
14-Jul-18		Est.		Est.	17,000	34,000
15-Jul-18		Est.		Est.	17,000	51,000
16-Jul-18	2317451.6	Est.		Est.	35,090	86,090
17-Jul-18	6454167.4	15659		15659	31,318	117,408
18-Jul-18	7631655.4	4457		4457	8,914	126,322
19-Jul-18	10561178.4	11089		11089	22,179	148,501
20-Jul-18	12511789.7	7384		7384	14,768	163,269
21-Jul-18	14386559.3	7097		7097	14,194	177,463
22-Jul-18	16198583.8	6859		6859	13,719	191,182
23-Jul-18	17967451.2	6696		6696	13,392	204,574
24-Jul-18	19625442.6	6276		6276	12,552	217,126
25-Jul-18	21252254.7	6158		6158	12,316	229,442
26-Jul-18	22786088.0	5806		5806	11,612	241,054
27-Jul-18	24222994.3	5439		5439	10,878	251,932
28-Jul-18	25620930.1	5292		5292	10,584	262,516
29-Jul-18	26880765.8	4769		4769	9,538	272,054
30-Jul-18	28261298.1	5226		5226	10,452	282,506
					Total July	**282,506**

Note: Meter malfunctioning July 13, 14 and 15th 2018.
Syphon 2 Flow based on Syphon 1 Flowrate

TABLE NO. 3

2018 Tailings Containment Area Discharge Water Quality Monitoring - Effluent Quality Results Summary
Monitoring Station LUP-10

Lab Sample ID	Licence Parameters Monitored	Date	Monitoring Station	Field pH	pH (pH)	Total Suspended Solids (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity, Total (as CaCO3) (mg/L)	Ammonia, Total (as N) (mg/L)	Nitrate (as N) (mg/L)	Nitrite (as N) (mg/L)	Cyanide, Total (mg/L)	Arsenic (As)-Total (mg/L)	Copper (Cu)-Total (mg/L)	Lead (Pb)-Total (mg/L)	Nickel (Ni)-Total (mg/L)	Zinc (Zn)-Total (mg/L)
L2144620-1	Pre-decant	09-Aug-18	LUP-10(102)		6.31	<3.0	148	1.1	0.0726	0.576	0.0171	<0.0050	0.00229	0.00559	0.000157	0.0594	0.183
See note 1	Daily	21-Aug-18	LUP-10														
See note 2	Daily	22-Aug-18	LUP-10	7.86													
	Daily	23-Aug-18	LUP-10	6.85													
	Daily	24-Aug-18	LUP-10	6.96													
L2154947-1	Daily	25-Aug-18	LUP-10	n/a	6.42	<3.0	155	1.8	n/a	0.649	0.0068	<0.0050	0.00299	0.00247	<0.000050	0.0555	0.165
L2154947-2	Daily	26-Aug-18	LUP-10	6.49	6.76	<3.0	149	3.3	n/a	0.592	0.0083	<0.0050	0.00307	0.00233	<0.000050	0.0555	0.161
L2154947-3	Daily	27-Aug-18	LUP-10	6.63	6.49	<3.0	150	2.3	n/a	0.591	0.0069	<0.0050	0.00312	0.00235	<0.000050	0.0558	0.162
L2154947-4	Daily	28-Aug-18	LUP-10	6.77	6.70	<3.0	151	2.9	n/a	0.587	0.0069	<0.0050	0.00322	0.00234	<0.000050	0.0568	0.164
L2156607-1	Weekly	29-Aug-18	LUP-10	7.67	6.64	<1.0	143	1.9	0.0637	0.561	0.0069	<0.0050	0.00332	0.00237	<0.000050	0.0551	0.165
L2159828-1	Weekly	30-Aug-18	LUP-10	7.32	6.29	<3.0	146	1.6	0.0668	0.582	0.0071	<0.0050	0.00336	0.00248	<0.000050	0.0551	0.181
L2159828-2	Weekly	31-Aug-18	LUP-10	7.25	6.29	<3.0	154	1.8	0.0657	0.581	0.0072	<0.0050	0.00342	0.00240	<0.000050	0.0580	0.188
L2159828-3	Weekly	01-Sep-18	LUP-10	7.08	6.24	<3.0	153	1.4	0.0652	0.580	0.0070	<0.0050	0.00364	0.00243	<0.000050	0.0585	0.192
L2159828-4	Weekly	02-Sep-18	LUP-10	6.88	6.22	10.0	146	1.5	0.0637	0.582	0.0072	<0.0050	0.00339	0.00281	<0.000050	0.0566	0.183
L2159828-5	Weekly	03-Sep-18	LUP-10	6.66	6.21	3.0	140	1.6	0.0616	0.583	0.0071	<0.0050	0.00754	0.00375	<0.000050	0.0585	0.193
L2159828-6	Weekly	04-Sep-18	LUP-10	6.46	6.19	1.7	142	1.3	0.0635	0.580	0.0070	<0.010	0.00483	0.00298	<0.000050	0.0561	0.179
L2159828-7	Weekly	05-Sep-18	LUP-10	6.48	6.17	<3.0	143	1.4	0.0667	0.574	0.0068	<0.010	0.00507	0.00265	<0.000050	0.0569	0.183
L2159828-8	Weekly	06-Sep-18	LUP-10	6.42	6.14	<3.0	140	1.3	0.0654	0.578	0.0072	<0.0050	0.00513	0.00233	<0.000050	0.0539	0.171
L2161073-1	Daily	07-Sep-18	LUP-10	6.63	6.29	15.0	148	1.2	0.0606	0.578	0.0059	<0.0050	0.00549	0.00256	<0.000050	0.0567	0.177
See note 2		08-Sep-18	LUP-10	6.45													
		09-Sep-18	LUP-10	6.40													
		10-Sep-18	LUP-10	6.58													
L2163999-1	Weekly	11-Sep-18	LUP-10	6.54	6.51	<3.0	148	2.5	0.0681	0.563	0.0073	<0.0050	0.00680	0.00260	0.000073	0.0602	0.189
L2163999-2	Weekly	12-Sep-18	LUP-10	6.49	6.36	<3.0	147	2.0	0.0641	0.562	0.0072	<0.0050	0.00826	0.00251	0.000065	0.0592	0.187
L2163999-3	Weekly	13-Sep-18	LUP-10	6.97	6.76	<3.0	150	3.6	0.0638	0.565	0.0071	<0.0050	0.00788	0.00233	0.000055	0.0590	0.187
L2166720-1	Weekly	14-Sep-18	LUP-10	7.12	6.76	<3.0	150	3.9	0.0732	0.560	0.0065	<0.0050	0.00639	0.00204	0.000060	0.0538	0.169
L2166720-2	Weekly	15-Sep-18	LUP-10	6.88	6.41	<3.0	150	2.0	0.0637	0.559	0.0064	<0.0050	0.00685	0.00209	<0.000050	0.0551	0.174
L2166720-3	Weekly	16-Sep-18	LUP-10	6.49	6.39	<3.0	151	2.1	0.0674	0.560	0.0064	<0.0050	0.00723	0.00200	0.000029	0.0553	0.174
L2166720-4	Weekly	17-Sep-18	LUP-10	6.76	6.43	<3.0	146	2.1	0.0730	0.560	0.0065	<0.0050	0.00717	0.00196	0.000054	0.0556	0.174
L2166720-5	Weekly	18-Sep-18	LUP-10	6.97	6.36	<1.0	149	2.0	0.0690	0.560	0.0066	<0.0050	0.00739	0.00196	0.000070	0.0547	0.171
L2169165-5	Weekly	19-Sep-18	LUP-10		5.88	10.5	160	<1.0	0.0686	0.635	0.0064	<0.0050	0.04230	0.01570	0.000614	0.0932	0.550
		20-Sep-18	LUP-10	6.88													
L2172220-1	Post Decant	27-Sep-18	LUP-10	n/a	6.27	7.3	167	6.2	n/a	0.501	0.0039	<0.0050	0.02050	0.00778	0.000217	0.0804	0.283
		Minimum	LUP-10	6.40	6.14	1.70	140	1.1	0.0606	0.559	0.0059	<0.0050	0.00229	0.00196	0.000029	0.0538	0.161
		Maximum	LUP-10	7.86	6.76	15.00	155	3.9	0.0732	0.649	0.0171	<0.010	0.00826	0.00559	0.000157	0.0602	0.193
		Average	LUP-10	6.82	6.41	n/a	148	2.0	0.0662	0.577	0.0074	n/a	0.00512	0.00258	n/a	0.0566	0.177
Licence Criteria																	
Max. Average Concenration (mg/L)				6.0-9.5		15						0.8	0.5	0.15	0.10	0.20	0.40
Max. Conc. of Any Grab Sample (mg/L)				6.0-9.5		30						1.6	1.0	0.30	0.20	0.40	0.80

Note 1	No Sample Obtained
Note 2	Samples Not Received by Lab

TABLE NO. 4

2018 Tailings Containment Area Discharge Water Quality Monitoring - Downstream Water Quality Results Summary
Monitoring Stations LUP-20, LUP-21, LUP-22, LUP-24 and LUP-25

Chronological

Lab Sample ID	Licence Monitored Parameters	Date	Monitoring Station	Field pH	pH (pH)	Total Suspended Solids (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity, Total (as CaCO3) (mg/L)	Ammonia, Total (as N) (mg/L)	Nitrate (as N) (mg/L)	Nitrite (as N) (mg/L)	Cyanide, Total (mg/L)	Arsenic (As)-Total (mg/L)	Copper (Cu)-Total (mg/L)	Lead (Pb)-Total (mg/L)	Nickel (Ni)-Total (mg/L)	Zinc (Zn)-Total (mg/L)
L2148649-1		14-Aug-18	LUP-22		6.44	<3.0	6.41	3.1	<0.0050			<0.0050	0.00047	0.00113	<0.000050	0.00172	<0.0030
			LUP-24		-	-	-	-	-	-		-	-	-	-	-	-
L2148663-1		14-Aug-18	LUP-25		6.37	<3.0	9.65	2.6	<0.0050			<0.0050	0.00175	0.00193	0.000317	0.00451	0.0062
L2156645-1	Weekly	29-Aug-18	LUP-20		5.86	<3.0	119	1.1	0.0079			<0.0050	0.00134	0.00166	<0.000050	0.06160	0.1110
L2156633-1		29-Aug-18	LUP-21		6.55	<3.0	6.21	3.2	<0.0050	-		<0.0050	0.00036	0.00094	<0.000050	0.00130	<0.0030
L2156633-2		29-Aug-18	LUP-22		6.39	<3.0	29.3	2.7	0.0057			<0.0050	0.00057	0.00106	<0.000050	0.01380	0.0222
L2156633-3		29-Aug-18	LUP-24		6.56	<3.0	6.38	3.1	<0.0050	-		<0.0050	0.00034	0.00081	<0.000050	0.00203	<0.0030
L2156633-4		29-Aug-18	LUP-25		6.46	<3.0	19.4	2.8	0.0070			<0.0050	0.00054	0.00100	<0.000050	0.00865	0.0132
L2161094-1		06-Sep-18	LUP-20		5.57	<3.0	98.4	<1.0	0.0118			<0.0050	0.00141	0.00189	<0.000050	0.04970	0.1080
L2161099-1		06-Sep-18	LUP-21		6.62	<3.0	7.04	3.0	<0.0050	-		<0.0050	0.00042	0.00104	<0.000050	0.00163	<0.0030
L2161099-2		06-Sep-18	LUP-22		6.43	<3.0	33.6	2.0	<0.0050			<0.0050	0.00065	0.00106	<0.000050	0.01450	0.0300
L2161099-3		06-Sep-18	LUP-24		6.71	<3.0	8.54	2.9	0.0055	-		<0.0050	0.00028	0.00064	<0.000050	0.00278	0.0043
L2161099-4		06-Sep-18	LUP-25		6.72	<3.0	6.16	3.0	<0.0050			<0.0050	0.00029	0.00070	<0.000050	0.00151	<0.0030
L2164022-1		12-Sep-18	LUP-20		5.64	<3.0	126	<1.0	0.0149			<0.0050	0.00107	0.00107	<0.000050	0.06320	0.1410
L2164019-1		12-Sep-18	LUP-21		6.61	<3.0	6.49	2.3	0.0082	-		<0.0050	0.00083	0.00122	0.000228	0.00156	<0.0030
L2164019-2		12-Sep-18	LUP-22		6.48	<3.0	30.3	2.1	0.0141			<0.0050	0.00078	0.00130	0.000175	0.01310	0.0252
L2164019-3		12-Sep-18	LUP-24		6.66	<3.0	9.95	2.9	0.0068	-		<0.0050	0.00033	0.00095	<0.000050	0.00344	0.0059
L2164019-4		12-Sep-18	LUP-25		6.68	4.2	9.86	2.8	<0.0050			<0.0050	0.00102	0.00104	0.000157	0.00371	0.0065
L2169169-1		19-Sep-18	LUP-20		5.79	<3.0	149	<1.0	0.0178			<0.0050	0.00104	0.00126	<0.000050	0.06820	0.1600
L2169165-1		19-Sep-18	LUP-21		6.49	<3.0	22.8	8.6	<0.0050	-		<0.0050	0.00057	0.00112	<0.000050	0.00838	0.0223
L2169165-2		19-Sep-18	LUP-22		6.45	<3.0	37.5	4.5	<0.0050			<0.0050	0.00056	0.00106	<0.000050	0.01520	0.0363
L2169165-3		19-Sep-18	LUP-24		6.49	5.9	9.36	2.8	<0.0050	-		<0.0050	0.00032	0.00081	<0.000050	0.00312	0.0079
L2169165-4		19-Sep-18	LUP-25		6.61	<3.0	9.62	5.0	<0.0050			<0.0050	0.00033	0.00077	<0.000050	0.00316	0.0076
L2172163-1		26-Sep-18	LUP-20		5.96	<3.0	107	1.6	0.0230			<0.0050	0.00150	0.00273	0.000823	0.06400	0.1550
L2172142-1		26-Sep-18	LUP-21		6.61	<3.0	6.59	2.9	0.0072	-		<0.0050	0.00040	0.00092	<0.000050	0.00132	<0.0030
L2172142-2		26-Sep-18	LUP-22		6.66	6.5	41.3	3.5	0.0244			<0.0050	0.00086	0.00143	0.000144	0.01350	0.0270
L2172142-3		26-Sep-18	LUP-24		6.67	<3.0	13.0	3.1	0.0180	-		<0.0050	0.00051	0.00117	0.000156	0.00445	0.0109
			LUP-25		-	-	-	-	-			-	-	-	-	-	-

TABLE NO. 5

2018 Tailings Containment Area Discharge Water Quality Monitoring - Downstream Water Quality Results Summary

Monitoring Stations LUP-20, LUP-21, LUP-22, LUP-24 and LUP-25

Monitoring Stations

Lab Sample ID	Licence Monitored Parameters	Date	Monitoring Station	Field pH	pH (pH)	Total Suspended Solids (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity, Total (as CaCO3) (mg/L)	Ammonia, Total (as N) (mg/L)	Nitrate (as N) (mg/L)	Nitrite (as N) (mg/L)	Cyanide, Total (mg/L)	Arsenic (As)-Total (mg/L)	Copper (Cu)-Total (mg/L)	Lead (Pb)-Total (mg/L)	Nickel (Ni)-Total (mg/L)	Zinc (Zn)-Total (mg/L)
L2156645-1	Weekly	29-Aug-18	LUP-20		5.86	<3.0	119	1.1	0.0079			<0.0050	0.00134	0.00166	<0.000050	0.06160	0.1110
L2161094-1		06-Sep-18	LUP-20		5.57	<3.0	98.4	<1.0	0.0118			<0.0050	0.00141	0.00189	<0.000050	0.04970	0.1080
L2164022-1		12-Sep-18	LUP-20		5.64	<3.0	126	<1.0	0.0149			<0.0050	0.00107	0.00107	<0.000050	0.06320	0.1410
L2169169-1		19-Sep-18	LUP-20		5.79	<3.0	149	<1.0	0.0178			<0.0050	0.00104	0.00126	<0.000050	0.06820	0.1600
L2172163-1		26-Sep-18	LUP-20		5.96	<3.0	107	1.6	0.0230			<0.0050	0.00150	0.00273	0.000823	0.06400	0.1550
L2156633-1		29-Aug-18	LUP-21		6.55	<3.0	6.21	3.2	<0.0050	-		<0.0050	0.00036	0.00094	<0.000050	0.0013	<0.0030
L2161099-1		06-Sep-18	LUP-21		6.62	<3.0	7.04	3.0	<0.0050	-		<0.0050	0.00042	0.00104	<0.000050	0.00163	<0.0030
L2164019-1		12-Sep-18	LUP-21		6.61	<3.0	6.49	2.3	0.0082	-		<0.0050	0.00083	0.00122	0.000228	0.00156	<0.0030
L2169165-1		19-Sep-18	LUP-21		6.49	<3.0	22.8	8.6	<0.0050	-		<0.0050	0.00057	0.00112	<0.000050	0.00838	0.0223
L2172142-1		26-Sep-18	LUP-21		6.61	<3.0	6.59	2.9	0.0072	-		<0.0050	0.00040	0.00092	<0.000050	0.00132	<0.0030
L2148649-1		14-Aug-18	LUP-22		6.44	<3.0	6.41	3.1	<0.0050			<0.0050	0.00047	0.00113	<0.000050	0.00172	<0.0030
L2156633-2		29-Aug-18	LUP-22		6.39	<3.0	29.3	2.7	0.0057			<0.0050	0.00057	0.00106	<0.000050	0.0138	0.0222
L2161099-2		06-Sep-18	LUP-22		6.43	<3.0	33.6	2.0	<0.0050			<0.0050	0.00065	0.00106	<0.000050	0.0145	0.0300
L2164019-2		12-Sep-18	LUP-22		6.48	<3.0	30.3	2.1	0.0141			<0.0050	0.00078	0.00130	0.000175	0.0131	0.0252
L2169165-2		19-Sep-18	LUP-22		6.45	<3.0	37.5	4.5	<0.0050			<0.0050	0.00056	0.00106	<0.000050	0.0152	0.0363
L2172142-2		26-Sep-18	LUP-22		6.66	6.5	41.3	3.5	0.0244			<0.0050	0.00086	0.00143	0.000144	0.0135	0.0270
L2156633-3		29-Aug-18	LUP-24		6.56	<3.0	6.38	3.1	<0.0050	-		<0.0050	0.00034	0.00081	<0.000050	0.00203	<0.0030
L2161099-3		06-Sep-18	LUP-24		6.71	<3.0	8.54	2.9	0.0055	-		<0.0050	0.00028	0.00064	<0.000050	0.00278	0.0043
L2164019-3		12-Sep-18	LUP-24		6.66	<3.0	9.95	2.9	0.0068	-		<0.0050	0.00033	0.00095	<0.000050	0.00344	0.0059
L2169165-3		19-Sep-18	LUP-24		6.49	5.9	9.36	2.8	<0.0050	-		<0.0050	0.00032	0.00081	<0.000050	0.00312	0.0079
L2172142-3		26-Sep-18	LUP-24		6.67	<3.0	13.0	3.1	0.0180	-		<0.0050	0.00051	0.00117	0.000156	0.00445	0.0109
L2148663-1		14-Aug-18	LUP-25		6.37	<3.0	9.65	2.6	<0.0050			<0.0050	0.00175	0.00193	0.000317	0.00451	0.0062
L2156633-4		29-Aug-18	LUP-25		6.46	<3.0	19.4	2.8	0.0070			<0.0050	0.00054	0.00100	<0.000050	0.00865	0.0132
L2161099-4		06-Sep-18	LUP-25		6.72	<3.0	6.16	3.0	<0.0050			<0.0050	0.00029	0.00070	<0.000050	0.00151	<0.0030
L2164019-4		12-Sep-18	LUP-25		6.68	4.2	9.86	2.8	<0.0050			<0.0050	0.00102	0.00104	0.000157	0.00371	0.0065
L2169165-4		19-Sep-18	LUP-25		6.61	<3.0	9.62	5.0	<0.0050			<0.0050	0.00033	0.00077	<0.000050	0.00316	0.0076
			LUP-25		-	-	-	-	-			-	-	-	-	-	-

APPENDIX B - COA

Acute Toxicity Test Results

Sample L2144620-1 LUP 10 (LUP102),
collected August 9, 2018

Final Report

August 28, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temperature
	Collected	Received	*Daphnia magna* test initiation	
L2144620-1 LUP 10 (LUP102)	09-Aug-18 at N/A	13-Aug-18 at 0940h	14-Aug-18 at 1610h	7.0°C

N/A = Not available

TEST

- *Daphnia magna* 48-h LC50 test

RESULTS

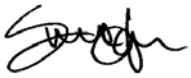
Toxicity test results

Sample ID	LC50 (%v/v)
L2144620-1 LUP 10 (LUP102)	>100

QA/QC

QA/QC summary	*Daphnia magna*
Reference toxicant LC50 (95% CI)	5.2 (4.2 – 6.4) g/L NaCl[1]
Reference toxicant historical mean (2 SD range)	5.7 (3.9 – 8.4) g/L NaCl
Reference toxicant CV	20%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1] Test date: August 7, 2018, LC = Lethal Concentration, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist

Reviewed By:
Edmund Canaria, R.P.Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Daphnia magna Summary Sheet

Client: ALS Environmental
Work Order No.: 181326

Start Date/Time: 14 August 18; 1610h
Test Species: *Daphnia magna*
Set up by: CW

Sample Information:

Sample ID: L21AA620-1 LUP 10 (LUP102)
Sample Date: 09 August 18
Date Received: 13 August 18
Sample Volume: 2×500 ml

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 073118B
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 23
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC16
Stock Solution ID: 18Na03
Date Initiated: Aug. 7/2018
48-h LC50 (95% CL): 5.2 (4.2 - 6.4) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.7 (3.9 - 8.4) g/L NaCL
Reference Toxicant CV (%): 20%

Test Results: The 48 hour LC50 is estimated to be >100% (v/v)

Reviewed by: [signature]

Date reviewed: Aug 27, 2018

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS
Sample ID: L2144620-1 LUP 10 (LUP102)
Work Order No.: 181326

Start Date/Time: Aug. 14/2018@1610h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: CW

Thermometer: CER#5 pH meter/probe: 3/3 DO meter/probe: 3/3 Cond./Salinity meter/probe: 3/3

Concentration (%v/v)	Rep	Number of Live Organisms 24	48	No. Immobilized 48	Temperature (°C) 0	24	48	Dissolved oxygen (mg/L) 0	24	48	pH 0	24	48	Conductivity (µS/cm) 0	48
Control	A	10	10	0	19.5	20.0	19.5	8.4	8.8	7.5	7.7	7.7	7.7	338	339
	B														
	C														
	D														
6.25	A	10	10	0	19.5	20.0	19.5	8.3	7.8	7.8	7.7	7.7	7.7	350	350
	B														
	C														
	D														
12.5	A	10	10	0	19.5	20.0	19.5	8.4	8.1	7.9	7.7	7.7	7.7	361	363
	B														
	C														
	D													CW	
25	A	10	10	0	20.0	20.0	20.0	8.4	8.1	7.9	7.6	7.7	7.7	378	379
	B														
	C														
	D														
50	A	10	10	0	20.0	20.0	20.0	8.5	8.1	7.9	7.5	7.5	7.5	417	418
	B														
	C														
	D														
100	A	10	10	0	20.0	20.0	20.0	8.9	8.2	8.1	6.4	6.9	6.9	497	494
	B														
	C														
	D														
Technician Initials		CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW

	Hardness*	Alkalinity*
Concentration	*(mg/L as CaCo3)	
Control (MHW)	100	70
Highest conc.	146	1
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		
DO (mg/L)	8.9		
pH	6.4		
Cond (µS/cm)	497		
Salinity (ppt)	0.2		

Comments: _____ Mortality: Heartbeat checked under microscope No

Sample Description: clear colourless liquid. No particulate, No odour.

Batch#: 073118B 7-d previous # young/brood: 23 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: _____ Date reviewed: Aug. 27, 2018

APPENDIX C – Chain-of-custody form

L2144620

YELLOWKNIFE

ALS Environmental

Subcontract Request Form

Special Request - NL
is for Daphnia magna
LC50 Static ~~Pass/Fail~~

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY BC V5A 4N7

WO# 181326

NOTES: Please reference on final report and invoice: PO# L2144620
ALS requires QC data to be provided with your final results.

- confirmed w/ client. -YKC Aug. 13/18

Please see enclosed 1 sample(s) in 2 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2144620-1 LUP 10 (LUP102)	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	8/9/2018 8/15/2018	P

Subcontract Info Contact: Rick Zolkiewski (867) 873-5593

Analysis and reporting info contact: Rick Zolkiewski
314 OLD AIRPORT ROAD
Unit 116
YELLOWKNIFE,NT X1A 3T3
Phone: (867) 873-5593 Email: Rick.Zolkiewski@alsglobal.com

Please email confirmation of receipt to: Rick.Zolkiewski@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: Tyson Hamilton Date Received: Aug. 13/18 @ 09:40

Verified By: TH Date Verified: _____

Temperature: 7.0°C

Sample Integrity Issues: 2x500ml

Description: clear colourless fluid, no particulate, no odour

Friday, August 10, 2018 11:59 AM

(Lupin Mines)

END OF REPORT

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 29-AUG-18
Report Date: 29-OCT-18 10:57 (MT)
Version: FINAL REV. 2

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2154947

Project P.O. #:	NOT SUBMITTED
Job Reference:	LUPIN MINE
C of C Numbers:	10-366269
Legal Site Desc:	

Comments:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2154947-1	L2154947-2	L2154947-3	L2154947-4	
Description	WATER	WATER	WATER	WATER	
Sampled Date	25-AUG-18	26-AUG-18	27-AUG-18	28-AUG-18	
Sampled Time	11:00	11:00	11:00	11:00	
Client ID	LUP-10	LUP-10	LUP-10	LUP-10	
Grouping	**Analyte**				
WATER					
Physical Tests	Hardness (as CaCO3) (mg/L)	155	149	150	151
	pH (pH)	6.42	6.76	6.49	6.70
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.8	3.3	2.3	2.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	1.8	3.3	2.3	2.9
	Nitrate (as N) (mg/L)	0.649	0.592	0.591	0.587
	Nitrite (as N) (mg/L)	0.0068	0.0083	0.0069	0.0069
Cyanides	Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
Total Metals	Aluminum (Al)-Total (mg/L)	0.0366	0.0351	0.0373	0.0360
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00299	0.00307	0.00312	0.00322
	Barium (Ba)-Total (mg/L)	0.0138	0.0138	0.0133	0.0142
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.045	0.044	0.045	0.045
	Cadmium (Cd)-Total (mg/L)	0.000154	0.000154	0.000142	0.000162
	Calcium (Ca)-Total (mg/L)	44.7	44.1	44.5	45.2
	Cesium (Cs)-Total (mg/L)	0.000072	0.000070	0.000070	0.000074
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00013	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.0260	0.0255	0.0259	0.0267
	Copper (Cu)-Total (mg/L)	0.00247	0.00233	0.00235	0.00234
	Iron (Fe)-Total (mg/L)	0.065	0.064	0.067	0.069
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0187	0.0188	0.0186	0.0190
	Magnesium (Mg)-Total (mg/L)	7.07	6.95	6.93	7.10
	Manganese (Mn)-Total (mg/L)	0.688	0.697	0.708	0.716
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.0555	0.0555	0.0558	0.0568
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.82	3.84	3.75	3.79
	Rubidium (Rb)-Total (mg/L)	0.00186	0.00184	0.00175	0.00178
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	0.000061	<0.000050
	Silicon (Si)-Total (mg/L)	1.42	1.39	1.35	1.39

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2154947-1	L2154947-2	L2154947-3	L2154947-4	
	Description	WATER	WATER	WATER	WATER	
	Sampled Date	25-AUG-18	26-AUG-18	27-AUG-18	28-AUG-18	
	Sampled Time	11:00	11:00	11:00	11:00	
	Client ID	LUP-10	LUP-10	LUP-10	LUP-10	
Grouping	**Analyte**					
WATER						
Total Metals	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	30.4	29.8	30.0	30.8	
	Strontium (Sr)-Total (mg/L)	0.204	0.205	0.203	0.206	
	Sulfur (S)-Total (mg/L)	61.9	61.0	58.9	60.8	
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00032	
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)	0.000024	0.000025	0.000028	0.000026	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	0.165	0.161	0.162	0.164	
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	
	Calcium (Ca)-Dissolved (mg/L)	49.6	47.6	48.2	48.5	
	Magnesium (Mg)-Dissolved (mg/L)	7.57	7.36	7.30	7.32	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Potassium (K)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2154947-1, -2, -3, -4
Matrix Spike	Uranium (U)-Total	MS-B	L2154947-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-366269

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 10-366269

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis	☑ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330	Email 1: klewis@elginmining.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1	Email 2: lupinlogistics@discoverymining.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340 Fax:	Email 3:	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Lupin Mine	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	payables@mandalayresources.com	PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q68017	
Lab Work Order # (lab use only)	L2154947	ALS Contact: Rick Zolieski	Sampler: D. Vokey

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)		Nitrite	Nitrate						Number of Containers
	LUP-10	25-Aug-18	11:00	Water	X	X	X	X		X	X						4
	LUP-10	26-Aug-18	11:00	Water	X	X	X	X		X	X						4
	LUP-10	27-Aug-18	11:00	Water	X	X	X	X		X	X						4
		28-Aug-18	11:00	Water	X	X	X	X		X	X						4

L2154947-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
D. Vokey	29-08-18	18:00	OS	29 Aug	10.30	7.6 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 31-AUG-18
Report Date: 11-OCT-18 14:58 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2156607

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers: 09-002564
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2156607-1				
	Description	WATER				
	Sampled Date	29-AUG-18				
	Sampled Time	11:00				
	Client ID	LUP-10				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	484				
	Hardness (as CaCO3) (mg/L)	143 HTC				
	pH (pH)	6.64				
	Total Suspended Solids (mg/L)	<1.0				
		<3.0				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.9				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	1.9				
	Ammonia, Total (as N) (mg/L)	0.0637				
	Nitrate (as N) (mg/L)	0.561				
	Nitrite (as N) (mg/L)	0.0069				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0343				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00332				
	Barium (Ba)-Total (mg/L)	0.0131				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.043				
	Cadmium (Cd)-Total (mg/L)	0.000155				
	Calcium (Ca)-Total (mg/L)	46.3				
	Cesium (Cs)-Total (mg/L)	0.000074				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	0.0260				
	Copper (Cu)-Total (mg/L)	0.00237				
	Iron (Fe)-Total (mg/L)	0.069				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0200				
	Magnesium (Mg)-Total (mg/L)	6.58				
	Manganese (Mn)-Total (mg/L)	0.665				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	0.0551				
	Phosphorus (P)-Total (mg/L)	<0.050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2156607-1				
	Description	WATER				
	Sampled Date	29-AUG-18				
	Sampled Time	11:00				
	Client ID	LUP-10				
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)	3.50				
	Rubidium (Rb)-Total (mg/L)	0.00190				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	1.40				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	29.3				
	Strontium (Sr)-Total (mg/L)	0.206				
	Sulfur (S)-Total (mg/L)	59.7				
	Tellurium (Te)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Thorium (Th)-Total (mg/L)	<0.00010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00034				
	Tungsten (W)-Total (mg/L)	<0.00010				
	Uranium (U)-Total (mg/L)	0.000026				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	0.165				
	Zirconium (Zr)-Total (mg/L)	<0.000060				
Radiological Parameters	Ra-226 (Bq/L)	<0.013 DLRC				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Manganese (Mn)-Total	MB-LOR	L2156607-1
Matrix Spike	Arsenic (As)-Total	MS-B	L2156607-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2156607-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2156607-1
Matrix Spike	Iron (Fe)-Total	MS-B	L2156607-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2156607-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L2156607-1
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2156607-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2156607-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2156607-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLRC	Detection Limit Raised for RadioChemistry test due to sample matrix (e.g. high TDS) or instrument detector conditions.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002
This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

09-002564

GLOSSARY OF REPORT TERMS
Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 09-002564

Report To				Report Format / Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources			☑ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis			☑ PDF	☐ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330			Email 1:	klewis@elginmining.com			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1			Email 2:	lupinlogistics@discoverymining.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340	Fax:		Email 3:				Analysis Request
Invoice To	Same as Report ?	☑ Yes	☐ No	Client / Project Information				Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?		☑ Yes	☐ No	Job #:	Lupin Mine			
Company:	payables@mandalayresources.com			PO / AFE:				
Contact:				LSD:				
Address:								
Phone:		Fax:		Quote #:	Q68017			
Lab Work Order # (lab use only)	L2156607			ALS Contact:	Rick Zolieski	Sampler:	D. Vokey	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	Radium 226	Nitrite	Nitrate	Ammonia (NH4)	Number of Containers
	LUP-10	29-Aug-18	11:00	Water	X	X	X	X	X	X	X	X	5

L2156607-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
D. Vokey	30-08-18	11:00		August 30/18	13:45	8.0 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 06-SEP-18
Report Date: 11-OCT-18 16:29 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2159828

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers: 15-584712
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2159828-1 WATER 30-AUG-18 11:00 LUP-10	L2159828-2 WATER 31-AUG-18 11:00 LUP-10	L2159828-3 WATER 01-SEP-18 12:00 LUP-10	L2159828-4 WATER 02-SEP-18 11:00 LUP-10	L2159828-5 WATER 03-SEP-18 11:00 LUP-10
WATER						
Physical Tests	Conductivity (uS/cm)	486				
	Hardness (as CaCO3) (mg/L)	146 HTC	154 HTC	153 HTC	146 HTC	140 HTC
	pH (pH)	6.29	6.29	6.24	6.22	6.21
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	10.0	3.0
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.3				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	1.6	1.8	1.4	1.5	1.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Ammonia, Total (as N) (mg/L)	1.6	1.8	1.4	1.5	1.6
	Nitrate (as N) (mg/L)	0.0668	0.0657	0.0652	0.0637	0.0616
	Nitrite (as N) (mg/L)	0.582	0.581	0.580	0.582	0.583
Cyanides	Cyanide, Total (mg/L)	0.0071	0.0072	0.0070	0.0072	0.0071
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Antimony (Sb)-Total (mg/L)	0.0352	0.0349	0.0360	0.0310	0.194
	Arsenic (As)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)-Total (mg/L)	0.00336	0.00342	0.00364	0.00339	0.00754
	Beryllium (Be)-Total (mg/L)	0.0162	0.0174	0.0168	0.0156	0.0144
	Bismuth (Bi)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Boron (B)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Cadmium (Cd)-Total (mg/L)	0.044	0.046	0.048	0.046	0.044
	Calcium (Ca)-Total (mg/L)	0.000158	0.000182	0.000157	0.000161	0.000169
	Cesium (Cs)-Total (mg/L)	46.5	49.3	49.5	47.1	44.9
	Chromium (Cr)-Total (mg/L)	0.000060	0.000070	0.000070	0.000066	0.000115
	Cobalt (Co)-Total (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	0.00103
	Copper (Cu)-Total (mg/L)	0.0266	0.0279	0.0279	0.0271	0.0274
	Iron (Fe)-Total (mg/L)	0.00248	0.00240	0.00243	0.00231	0.00375
	Lead (Pb)-Total (mg/L)	0.068	0.072	0.077	0.069	0.320
	Lithium (Li)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000142
	Magnesium (Mg)-Total (mg/L)	0.0202	0.0213	0.0216	0.0208	0.0196
	Manganese (Mn)-Total (mg/L)	7.26	7.44	7.15	6.99	6.88
	Molybdenum (Mo)-Total (mg/L)	0.703	0.727	0.731	0.719	0.696
	Nickel (Ni)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phosphorus (P)-Total (mg/L)	0.0551	0.0580	0.0585	0.0566	0.0585
	Potassium (K)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
		3.67	3.81	3.80	3.67	3.57

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2159828-6	L2159828-7	L2159828-8		
	Description	WATER	WATER	WATER		
	Sampled Date	04-SEP-18	05-SEP-18	06-SEP-18		
	Sampled Time	11:00	11:00	07:00		
	Client ID	LUP-10	LUP-10	LUP-10		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	490				
	Hardness (as CaCO3) (mg/L)	142 HTC	143 HTC	140 HTC		
	pH (pH)	6.19	6.17	6.14		
	Total Suspended Solids (mg/L)	1.7	<3.0	<3.0		
		<3.0				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.3	1.4	1.3		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	1.3	1.4	1.3		
	Ammonia, Total (as N) (mg/L)	0.0635	0.0667	0.0654		
	Nitrate (as N) (mg/L)	0.580	0.574	0.578		
	Nitrite (as N) (mg/L)	0.0070	0.0068	0.0072		
Cyanides	Cyanide, Total (mg/L)	<0.010	<0.010	<0.0050		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0534	0.0528	0.0430		
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)	0.00483	0.00507	0.00513		
	Barium (Ba)-Total (mg/L)	0.0133	0.0135	0.0134		
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.044	0.044	0.043		
	Cadmium (Cd)-Total (mg/L)	0.000150	0.000152	0.000158		
	Calcium (Ca)-Total (mg/L)	45.5	46.1	45.1		
	Cesium (Cs)-Total (mg/L)	0.000066	0.000063	0.000063		
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Total (mg/L)	0.0267	0.0270	0.0257		
	Copper (Cu)-Total (mg/L)	0.00298	0.00265	0.00233		
	Iron (Fe)-Total (mg/L)	0.133	0.140	0.133		
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Total (mg/L)	0.0194	0.0194	0.0189		
	Magnesium (Mg)-Total (mg/L)	6.83	6.89	6.56		
	Manganese (Mn)-Total (mg/L)	0.707	0.712	0.669		
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Nickel (Ni)-Total (mg/L)	0.0561	0.0569	0.0539		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	3.55	3.55	3.44		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2159828-1 WATER 30-AUG-18 11:00 LUP-10	L2159828-2 WATER 31-AUG-18 11:00 LUP-10	L2159828-3 WATER 01-SEP-18 12:00 LUP-10	L2159828-4 WATER 02-SEP-18 11:00 LUP-10	L2159828-5 WATER 03-SEP-18 11:00 LUP-10
WATER						
Total Metals	Rubidium (Rb)-Total (mg/L)	0.00194	0.00202	0.00189	0.00194	0.00203
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	1.39	1.48	1.48	1.43	1.57
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	30.3	32.4	31.5	30.4	29.6
	Strontium (Sr)-Total (mg/L)	0.218	0.227	0.240	0.221	0.212
	Sulfur (S)-Total (mg/L)	59.7	63.7	63.1	60.8	59.8
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	0.00758
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000025	0.000023	0.000025	0.000022	0.000044
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.181	0.188	0.192	0.183	0.193
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060
Aggregate Organics	Oil and Grease (mg/L)					
Radiological Parameters	Ra-226 (Bq/L)	0.0060	0.0081	0.013	<0.011 DLRC	0.0081

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2159828-6	L2159828-7	L2159828-8		
	Description	WATER	WATER	WATER		
	Sampled Date	04-SEP-18	05-SEP-18	06-SEP-18		
	Sampled Time	11:00	11:00	07:00		
	Client ID	LUP-10	LUP-10	LUP-10		
Grouping	**Analyte**					
WATER						
Total Metals	Rubidium (Rb)-Total (mg/L)	0.00189	0.00186	0.00192		
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Silicon (Si)-Total (mg/L)	1.39	1.44	1.35		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	29.9	29.7	28.6		
	Strontium (Sr)-Total (mg/L)	0.213	0.215	0.209		
	Sulfur (S)-Total (mg/L)	60.2	60.2	57.2		
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Total (mg/L)	0.000026	0.000027	0.000022		
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	0.179	0.183	0.171		
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060		
Aggregate Organics	Oil and Grease (mg/L)		<5.0			
Radiological Parameters	Ra-226 (Bq/L)	0.015	0.0078	0.0097		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Copper (Cu)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Total	MS-B	L2159828-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLRC	Detection Limit Raised for RadioChemistry test due to sample matrix (e.g. high TDS) or instrument detector conditions.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

OGG-SF-VA	Water	Oil & Grease by Gravimetric	BCMOE (2010), EPA1664A

The procedure involves an extraction of the entire water sample with hexane. This extract is then evaporated to dryness, and the residue weighed to determine Oil and Grease.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Reference Information

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1
TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-584712

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 15-584712

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis	☑ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330	Email 1: klewis@elginmining.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1	Email 2: lupinlogistics@discoverymining.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340 Fax:	Email 3: colleen_prather@golder.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Lupin Mine	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	payables@mandalayresources.com	PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q68017	
Lab Work Order # (lab use only)	L2159828	ALS Contact: Rick Zolieski	Sampler: D. Vokey

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	Radium 226	Nitrite	Nitrate	Ammonia (NH4)	Oil and Grease (Visible Sheen)				Number of Containers
1	LUP-10	30-Aug-18	11:00	Water	X	X	X	X	X	X	X	X					5
2	LUP-10	31-Aug-18	11:00	Water	X	X	X	X	X	X	X	X					5
3	LUP-10	01-Sep-18	12:00	Water	X	X	X	X	X	X	X	X					5
4	LUP-10	02-Sep-18	11:00	Water	X	X	X	X	X	X	X	X					5
5	LUP-10	03-Sep-18	11:00	Water	X	X	X	X	X	X	X	X					5
6	LUP-10	04-Sep-18	11:00	Water	X	X	X	X	X	X	X	X					5
7	LUP-10	05-Sep-18	11:00	Water	X	X	X	X	X	X	X	X	X				6
8	LUP-10	06-Sep-18	7:00	Water	X	X	X	X	X	X	X	X					5

L2159828-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
D. Vokey	6-Sep-18	11:00		6/9	14:15	1.2 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 07-SEP-18
Report Date: 19-SEP-18 14:02 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2161073

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers: 15-584492
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161073-1				
	Description	WATER				
	Sampled Date	07-SEP-18				
	Sampled Time	11:00				
	Client ID	LUP-10				
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	148				
	pH (pH)	6.29				
	Total Suspended Solids (mg/L)	15.0				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.2				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	1.2				
	Ammonia, Total (as N) (mg/L)	0.0606				
	Nitrate (as N) (mg/L)	0.578				
	Nitrite (as N) (mg/L)	0.0059				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0410				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00549				
	Barium (Ba)-Total (mg/L)	0.0150				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.045				
	Cadmium (Cd)-Total (mg/L)	0.000179				
	Calcium (Ca)-Total (mg/L)	49.8				
	Cesium (Cs)-Total (mg/L)	0.000061				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	0.0274				
	Copper (Cu)-Total (mg/L)	0.00256				
	Iron (Fe)-Total (mg/L)	0.136				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0182				
	Magnesium (Mg)-Total (mg/L)	6.88				
	Manganese (Mn)-Total (mg/L)	0.758				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	0.0567				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	4.00				
	Rubidium (Rb)-Total (mg/L)	0.00195				
	Selenium (Se)-Total (mg/L)	<0.000050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161073-1
	Description	WATER
	Sampled Date	07-SEP-18
	Sampled Time	11:00
	Client ID	LUP-10
Grouping	**Analyte**	
WATER		
Total Metals	Silicon (Si)-Total (mg/L)	1.46
	Silver (Ag)-Total (mg/L)	<0.000010
	Sodium (Na)-Total (mg/L)	29.2
	Strontium (Sr)-Total (mg/L)	0.226
	Sulfur (S)-Total (mg/L)	59.8
	Tellurium (Te)-Total (mg/L)	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030
	Tungsten (W)-Total (mg/L)	<0.00010
	Uranium (U)-Total (mg/L)	0.000026
	Vanadium (V)-Total (mg/L)	<0.00050
	Zinc (Zn)-Total (mg/L)	0.177
	Zirconium (Zr)-Total (mg/L)	<0.000060
Dissolved Metals	Dissolved Metals Filtration Location	LAB
	Calcium (Ca)-Dissolved (mg/L)	47.6
	Magnesium (Mg)-Dissolved (mg/L)	7.00

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2161073-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2161073-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2161073-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2161073-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2161073-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L2161073-1
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2161073-1
Matrix Spike	Potassium (K)-Total	MS-B	L2161073-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2161073-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2161073-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2161073-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Reference Information

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-584492

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

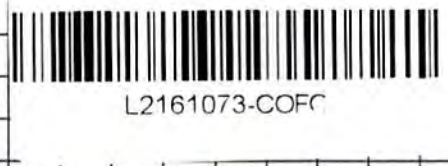
www.alsglobal.com

COC # 15-584492

Page 1 of 1

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis	☑ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330	Email 1: klewis@elginmining.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1	Email 2: lupinlogistics@discoverymining.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340 Fax:	Email 3: colleen_prather@golder.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Lupin Mine	
Company:	payables@mandalayresources.com	PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q68017	
Lab Work Order # (lab use only)	L2161073	ALS Contact: Rick Zolieski	Sampler: D. Vokey

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)		Nitrite	Nitrate					Number of Containers
					Analysis Request: Please indicate below Filtered, Preserved or both (F, P, F/P)											
	LUP-10	07-Sep-18	11:00	Water	X	X	X	X		X	X					4



Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
D. Vokey	7-Sep-18	13:00	OG	7/9	1015	10.8 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 13-SEP-18
Report Date: 24-OCT-18 08:24 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2163999

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers:
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163999-1	L2163999-2	L2163999-3		
	Description	WATER	WATER	WATER		
	Sampled Date	11-SEP-18	12-SEP-18	13-SEP-18		
	Sampled Time	11:00	11:00	11:00		
	Client ID	LUP-10	LUP-10	LUP-10		
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	148	147	150		
	pH (pH)	6.51	6.36	6.76		
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	2.5	2.0	3.6		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	2.5	2.0	3.6		
	Ammonia, Total (as N) (mg/L)	0.0681	0.0614	0.0638		
	Nitrate (as N) (mg/L)	0.563	0.562	0.565		
	Nitrite (as N) (mg/L)	0.0073	0.0072	0.0071		
	Phosphorus (P)-Total (mg/L)		<0.0020			
Cyanides	Cyanide, Total (mg/L)	<0.0050	<0.0050 CNP	<0.0050		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0460	0.0485	0.0460		
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Total (mg/L)	0.00680	0.00826	0.00788		
	Barium (Ba)-Total (mg/L)	0.0143	0.0145	0.0145		
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.046	0.048	0.047		
	Cadmium (Cd)-Total (mg/L)	0.000169	0.000163	0.000178		
	Calcium (Ca)-Total (mg/L)	49.3	50.4	50.1		
	Cesium (Cs)-Total (mg/L)	0.000071	0.000072	0.000068		
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Total (mg/L)	0.0285	0.0279	0.0281		
	Copper (Cu)-Total (mg/L)	0.00260	0.00251	0.00233		
	Iron (Fe)-Total (mg/L)	0.163	0.196	0.186		
	Lead (Pb)-Total (mg/L)	0.000073	0.000065	0.000055		
	Lithium (Li)-Total (mg/L)	0.0211	0.0214	0.0211		
	Magnesium (Mg)-Total (mg/L)	7.48	7.19	7.34		
	Manganese (Mn)-Total (mg/L)	0.754	0.742	0.748		
	Mercury (Hg)-Total (mg/L)		<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Nickel (Ni)-Total (mg/L)	0.0602	0.0592	0.0590		
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Total (mg/L)	3.91	3.78	3.80		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163999-1	L2163999-2	L2163999-3		
	Description	WATER	WATER	WATER		
	Sampled Date	11-SEP-18	12-SEP-18	13-SEP-18		
	Sampled Time	11:00	11:00	11:00		
	Client ID	LUP-10	LUP-10	LUP-10		
Grouping	**Analyte**					
WATER						
Total Metals	Rubidium (Rb)-Total (mg/L)	0.00205	0.00194	0.00191		
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	0.000054		
	Silicon (Si)-Total (mg/L)	1.59	1.54	1.57		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	33.3	32.7	32.7		
	Strontium (Sr)-Total (mg/L)	0.228	0.227	0.228		
	Sulfur (S)-Total (mg/L)	66.2	64.1	64.6		
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Total (mg/L)	0.000022	0.000025	0.000023		
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	0.189	0.187	0.187		
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060		
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB		
	Calcium (Ca)-Dissolved (mg/L)	47.4	46.7	48.4		
	Magnesium (Mg)-Dissolved (mg/L)	7.28	7.27	7.21		
Aggregate Organics	Oil and Grease (mg/L)		<5.0			
Radiological Parameters	Ra-226 (Bq/L)	0.0078	0.011	0.013		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Cobalt (Co)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Nickel (Ni)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2163999-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2163999-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
CNP	Cyanide test sample appears to have been preserved, but pH was <10 at time of testing. Results may be biased low, particularly for Free CN species.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

OGG-SF-VA	Water	Oil & Grease by Gravimetric	BCMOE (2010), EPA1664A

The procedure involves an extraction of the entire water sample with hexane. This extract is then evaporated to dryness, and the residue weighed to determine Oil and Grease.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS
Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Monday, October 22, 2018

Rick Zolkiewski
ALS Environmental
314 Old Airport Road Unit 116
Yellowknife, NT X1A 3T3

Re: ALS Workorder: 1810117
Project Name:
Project Number: L2163999

Dear Mr. Zolkiewski:

Three water samples were received from ALS Environmental, on 10/4/2018. The samples were scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Katie M. OBrien
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
PJ-LA (DoD ELAP/ISO 170250)	95377
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1810117

Radium-226:
The samples were prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1810117
Client Name: ALS Environmental
Client Project Name:
Client Project Number: L2163999
Client PO Number: L2163999

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
L2163999-1	1810117-1		WATER	11-Sep-18	
L2163999-2	1810117-2		WATER	12-Sep-18	
L2163999-3	1810117-3		WATER	13-Sep-18	

Subcontract Request Form

1810117

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
225 COMMERCE DRIVE
FORT COLLINS,CO 80524

NOTES: Please reference on final report and invoice: PO# *L2163999*
ALS requires QC data to be provided with your final results.

Please see enclosed 3 sample(s) in 3 Container(s)

	SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
1	**L2163999-1 LUP-10**		**9/11/2018**	
		Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	9/25/2018	
2	**L2163999-2 LUP-10**		**9/12/2018**	
		Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	9/25/2018	
3	**L2163999-3 LUP-10**		**9/13/2018**	
		Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	9/25/2018	

Subcontract Info Contact: Rick Zolkiewski (867) 873-5593

Analysis and reporting info contact: Rick Zolkiewski
314 OLD AIRPORT ROAD
Unit 116
YELLOWKNIFE,NT X1A 3T3
Phone: (867) 873-5593 Email: Rick.Zolkiewski@alsglobal.com

Please email confirmation of receipt to: Rick.Zolkiewski@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: _____ Date Received: 10/4/18 10:15

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS Yellowknife Workorder No: 1810117

Project Manager: ICO Initials: NG Date: 10/4/18

1.	Are airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
2.	Are custody seals on **shipping** containers intact?	NONE	YES	NO
3.	Are custody seals on **sample** containers intact?	NONE	YES	NO
4.	Is there a COC (chain-of-custody) present?		YES	NO
5.	Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)		YES	NO
6.	Are short-hold samples present?		YES	NO
7.	Are all samples within holding times for the requested analyses?		YES	NO
8.	Were all sample containers received intact? (not broken or leaking)		YES	NO
9.	Is there sufficient sample for the requested analyses?		YES	NO
10.	Are all samples in the proper containers for the requested analyses?		YES	NO
11.	Are all aqueous samples preserved correctly, if required? (excluding volatiles)	N/A	YES	NO
12.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
13.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)	N/A	YES	NO
14.	Were the samples shipped on ice?		YES	NO
15.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1							
Temperature (°C):	4.8							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	10							
Background µR/hr reading:	11							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: **Please provide details here for any NO responses to gray-shaded boxes above, or any other issues noted:**

All client bottle ID's vs ALS lab ID's double-checked by: NG

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: _____ 10/4/18

Form 201r26.xls
(06/29/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

ORIGIN ID:YBYA (604) 253-4188
HARJIT GILL
ALS ENVIRONMENTAL LAB GROUP
LOUGHEED HIGHWAY

BURNABY, BC V5A1W9
CANADA CA

SHIP DATE: 03OCT18
ACTWGT: 10.00 LB MAN
CAD: 0347419/CAFE3210

BILL SENDER

TO SAMPLE RECEVING
ALS ENVIRONMANTAL
225 COMMERCE DRIVE

FORT COLLINS CO 80524 (US)
(970) 490-1511 REF: SUBLETS
DEPT: SUBLET

10-0
4.8°

551C1/88FB/104C

FedEx Express

E

J181118842802uv

10:30A
INTL PRIORITY

TRK# 0430 4432 4287 8174

XH FTCA

80524
CO-US DEN

L110181

After printing this label:

CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH

1. Fold the printed page along the horizontal line.
2. Place label in shipping pouch and affix it to your shipment.

DEFINITIONS: On the Air Waybill 'We', 'Our', 'us' and 'FedEx' refer to Federal Express Corporation, its subsidiaries and branches and their respective employees, agents and independent contractors. 'You' and 'your' refer to the shipper, its employees, principals and agents. If your shipment originates outside the United States, your contract of carriage is with the Federal Express subsidiary, branch or independent contractor who originally accepts the shipment from you. 'Package' means any container or envelope that is accepted by us for delivery, including any such items tendered by you utilizing our automated systems, meters, manifests or waybills. 'Shipment' means all packages, which are tendered to and accepted by us on a single Air Waybill.
AGREEMENT TO TERMS. By giving us your shipment, you agree, regardless of whether you sign the front of this Air Waybill, for yourself and as agent for and on behalf of any other person having an interest in this shipment, to all terms on this NON-NEGOTIABLE Air Waybill. In any applicable tariff, and in our current Service Guide or Standard Conditions of Carriage, copies of which are available upon request. If there is a conflict between this Air Waybill and either the tariff, Service Guide or Standard Conditions then in effect, the tariff and the terms of any customer automation agreement between the shipper and Federal Express will control(the Service Guide or Standard Conditions have secondary priority). No one is authorized to alter or modify the terms of our agreement. This Air Waybill shall be binding on us when the shipment is accepted.
YOUR OBLIGATIONS: You warrant that each article in the shipment is properly described on this Air Waybill and is acceptable for transport by us, and that the shipment is properly marked, addressed (including postal codes) and packaged to ensure safe transportation with ordinary care in handling.
NOTE CONCERNING LIMITATIONS OF LIABILITY. Air Carriage Notice. If the carriage of your shipment by air involves an ultimate destination or stop in a country other than the country of departure, the Warsaw Convention, an international treaty relating to international carriage by air, may be applicable, which treaty would then govern and in most cases limit our liability for loss or delay of or damage to your shipment. In the U.S. the Warsaw Convention limits our liability to U.S. $9.07 per pound (U.S. $20.38 per kilogram). Unless you declare a higher value for carriage as described below. The interpretation of the Warsaw Convention liability limits may vary in other countries. There are no stopping places which are agreed at the time of tender of the shipment and we reserve the right to route shipments in any way we deem appropriate.
Road Transport Notice. Shipments transported partly or solely by road be it explicit agreement to do so or not-in, to, from a country which is party to the Convention on the Contract for the International Carriage of Goods by Road (the 'CMR') are subject to the terms and conditions of the CMR, notwithstanding any other provisions of this Agreement to the contrary. For these shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill the terms of the CMR shall prevail.
Limitation of Liability, if not governed by the Warsaw Convention or the CMR as described above, our maximum liability for loss, damage or delay is limited by this Air Waybill to U.S. $100 per shipment or U.S. $9.07 per pound (U.S. $20.38 per kilo) (or equivalent local currency), whichever is greater, unless you declare a higher value for carriage as described below. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge to each additional U.S. $100 (or equivalent local currency) of described value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx maximum liability will be the lesser of the declared value for carriage or your actual damages.
LIABILITIES NOT ASSUMED. IN ANY EVENT, WE WON'T BE LIABLE FOR ANY DAMAOES WHETHER DIRECT , INCIDENTAL, SPECIAL OR CONSEQUENTIAL , IN EXCESS OF THE DECLARED VALUE FOR CARRIAOE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) WHETHER OR NOT WE HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIOHT BE INCURRED, UNLESS SUCH DAMAOES WERE CAUSED BY OUR OWN WILLFUL MICONDUCT OR OROSS NEOLIOENCE
We won't be liable for your actions or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packing, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment. Also we won't be liable if you (or) the recipient violate any of the terms of our agreement. We won't be liable for loss of or damage to shipments of cash, currency or other prohibited items. We won't be liable for loss, damages or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions mechanical delays, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority.
NO WARRANTIES. We make no warranties, express or implied.
CLAIM FOR LOSS, DAMAGE FOR DELAY. ALL CLAIMS MUST BE NOTIFIED TO US WITHIN 15 DAYS AFTER DELIVERY OF THE SHIPMENT FAILING WHICH NO ACTION FOR DAMAGES MAY BE BROUGHT. All claims for loss, non-delivery or mis-delivery must be received by us within 90 days after the shipment is accepted by us. The right to damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from date on which the shipment should have been delivered. Within 30 days after notification to us (of) the claim, it must be documented by sending us all relevant information about it. We are not obligated to act on any claim until all transportation charges have been paid, the claim amount may not be deducted from those charges. If the recipient accepts the shipment without noting any damage on the delivery record, we will assume the shipment was delivered in good condition. In order for us to consider a claim for damages, the content(s), original shipping cartons, and packing must be available to us for inspection.
RIGHT TO INSPECT. Your shipment may, at our option or at the request of governmental authorities, be opened and inspected by us or such authorities or us at any time.
CUSTOMS CLEARANCE. It is your responsibility to provide proper customs documentation and confirmation, where required.
EXPORT CONTROL. You authorize Federal Express to act as forwarding agent for you for export control and customs purposes. You hereby certify that all statements and information contained in this air waybill relating to exportation are true and correct. Furthermore, you understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements or for the violation of any United States laws on exportation, including but not limited to, 13 USC Sec. 305; 22 USC Sec 401; 18 USC Sec. 1001; 50 USC app. 2410.
MANDATORY LAW. Insofar as any provision contained or referred to in this air Waybill may be contrary to any applicable international treaty, law government regulations, orders or requirements such provision shall remain in effect as a part of our agreement to the extent that it is not overridden. The invalidity or unenforceability of any provision shall not affect any other part of this Air Waybill. Unless otherwise indicated the Sender's address indicated on the face of this Waybill is the place of execution and the place of departure, and Recipient's address listed on the face of this Waybill is the place of destination. Unless otherwise indicated Federal Express Corporation, P.O. Box 727, Memphis, TN 38194 USA is the first carrier of this shipment.

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2163999	**Work Order:**	1810117
Sample ID:	L2163999-1	**Lab ID:**	1810117-1
Legal Location:		**Matrix:**	WATER
Collection Date:	9/11/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**	
Ra-226	0.0078 (+/- 0.0043)	LT	0.004	BQ/l	NA	10/19/2018 13:00
Carr: BARIUM	*94.9*		*40-110*	*%REC*	DL = NA	10/19/2018 13:00

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2163999	**Work Order:**	1810117
Sample ID:	L2163999-2	**Lab ID:**	1810117-2
Legal Location:		**Matrix:**	WATER
Collection Date:	9/12/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1			**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**
Ra-226	**0.011 (+/- 0.0064)**		**0.0073**	**BQ/l**	NA	10/19/2018 13:00
Carr: BARIUM	*92.1*		*40-110*	*%REC*	DL = NA	10/19/2018 13:00

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2163999	**Work Order:**	1810117
Sample ID:	L2163999-3	**Lab ID:**	1810117-3
Legal Location:		**Matrix:**	WATER
Collection Date:	9/13/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1			**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**
Ra-226	**0.013 (+/- 0.0076)**		**0.0087**	**BQ/l**	NA	10/19/2018 13:00
Carr: BARIUM	*92.9*		*40-110*	*%REC*	DL = NA	10/19/2018 13:00

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2163999	**Work Order:**	1810117
Sample ID:	L2163999-3	**Lab ID:**	1810117-3
Legal Location:		**Matrix:**	WATER
Collection Date:	9/13/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

- "Report Limit" is the MDC

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

QC BATCH REPORT

Batch ID: **RE181012-1-1** Instrument ID **Alpha Scin** Method: **Radium-226 by Radon Emanation**

LCS Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.58 (+/- 0.395)	0.0114	1.771		89.1	67-120					P,M3
Carr: BARIUM	16800		17060		98.3	40-110					

LCSD Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.36 (+/- 0.342)	0.0127	1.687		80.7	67-120		1.58	0.4	2.1	P,M3
Carr: BARIUM	15900		17060		93.4	40-110		16800			

MB Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	0.00097 (+/- 0.0041)	0.0077									U
Carr: BARIUM	16200		17060		94.7	40-110					

The following samples were analyzed in this batch: 1810117-1 1810117-2 1810117-3

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 10-366266

Report To				Report Format / Distribution					Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources			☑ Standard	☐ Other				◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis			☑ PDF	☐ Excel	☐ Digital	☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330			Email 1:	klewis@elginmining.com				○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1			Email 2:	lupinlogistics@discoverymining.ca				○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340	Fax:		Email 3:	colleen_prather@golder.com				
Invoice To	Same as Report ?	☑ Yes	☐ No	**Client / Project Information**					**Analysis Request**
Hardcopy of Invoice with Report?		☑ Yes	☐ No	Job #:	Lupin Mine				Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	payables@mandalayresources.com			PO / AFE:					
Contact:				LSD:					
Address:									
Phone:		Fax:		Quote #:	Q68017				
Lab Work Order # (lab use only)	L2163999			**ALS Contact:**	Rick Zolieski	**Sampler:**	D. Vokey		

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	T- Mercury	Nitrite	Nitrate	Oil and Grease (visible Sheen)	Ammonia	Phosphorous			Number of Containers
	LUP-10	11-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
	LUP-10	12-Sep-18	11:00	Water	X	X	X	X	X	X	X	X	X	X			6
	LUP-10	13-Sep-18	11:00	Water	X	X	X	X		X	X		X				4

L2163999-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
D. Vokey	13-Sep-18	13:00		13/9/18	16:00	8.9 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 19-SEP-18
Report Date: 16-OCT-18 11:42 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2166720

Project P.O. #:	NOT SUBMITTED
Job Reference:	LUPIN MINE
C of C Numbers:	09-002571
Legal Site Desc:	

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2166720-1	L2166720-2	L2166720-3	L2166720-4	L2166720-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	14-SEP-18	15-SEP-18	16-SEP-18	17-SEP-18	18-SEP-18
Sampled Time	11:00	11:00	11:00	11:00	11:00
Client ID	LUP-10	LUP-10	LUP-10	LUP-10	LUP-10
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)					480
Hardness (as CaCO3) (mg/L)	150	150	151	146	149
pH (pH)	6.76	6.41	6.39	6.43	6.36
Total Suspended Solids (mg/L)	<3.0	3.0	<3.0	<3.0	<1.0
					<3.0
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	3.9	2.0	2.1	2.1	2.0
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3) (mg/L)	3.9	2.0	2.1	2.1	2.0
Ammonia, Total (as N) (mg/L)	0.0732	0.0637	0.0674	0.0730	0.0690
Chloride (Cl) (mg/L)					27.8
Nitrate (as N) (mg/L)	0.560	0.559	0.560	0.560	0.560
Nitrite (as N) (mg/L)	0.0065	0.0064	0.0064	0.0065	0.0066
Phosphorus (P)-Total (mg/L)					<0.0020
Sulfate (SO4) (mg/L)					178
Cyanides Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Metals Aluminum (Al)-Total (mg/L)	0.0399	0.0398	0.0378	0.0365	0.0399
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00639	0.00685	0.00723	0.00717	0.00739
Barium (Ba)-Total (mg/L)	0.0136	0.0129	0.0135	0.0132	0.0130
Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	0.046	0.049	0.046	0.048	0.047
Cadmium (Cd)-Total (mg/L)	0.000161	0.000156	0.000157	0.000150	0.000152
Calcium (Ca)-Total (mg/L)	43.5	44.2	44.3	45.7	44.9
Cesium (Cs)-Total (mg/L)	0.000067	0.000067	0.000068	0.000071	0.000067
Chromium (Cr)-Total (mg/L)	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total (mg/L)	0.0253	0.0258	0.0261	0.0262	0.0257
Copper (Cu)-Total (mg/L)	0.00204	0.00209	0.00200	0.00196	0.00196
Iron (Fe)-Total (mg/L)	0.156	0.174	0.170	0.170	0.179
Lead (Pb)-Total (mg/L)	0.000060	<0.000050	0.000285	0.000054	0.000070
Lithium (Li)-Total (mg/L)	0.0215	0.0232	0.0225	0.0233	0.0231
Magnesium (Mg)-Total (mg/L)	6.69	6.49	6.67	6.66	6.65
Manganese (Mn)-Total (mg/L)	0.693	0.691	0.677	0.692	0.700
Mercury (Hg)-Total (mg/L)					<0.0000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2166720-1 WATER 14-SEP-18 11:00 LUP-10	L2166720-2 WATER 15-SEP-18 11:00 LUP-10	L2166720-3 WATER 16-SEP-18 11:00 LUP-10	L2166720-4 WATER 17-SEP-18 11:00 LUP-10	L2166720-5 WATER 18-SEP-18 11:00 LUP-10
Sample ID / Description / Sampled Date / Sampled Time / Client ID						
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.0538	0.0551	0.0553	0.0556	0.0547
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.60	3.56	3.80	3.60	3.59
	Rubidium (Rb)-Total (mg/L)	0.00183	0.00185	0.00185	0.00184	0.00182
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	1.47	1.53	1.46	1.46	1.49
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	27.7	26.9	27.7	27.8	27.5
	Strontium (Sr)-Total (mg/L)	0.220	0.214	0.226	0.225	0.217
	Sulfur (S)-Total (mg/L)	57.4	58.0	57.5	57.2	56.2
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00060 DLM
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000021	0.000023	0.000020	0.000019	0.000022
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.169	0.174	0.174	0.174	0.171
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB	LAB
	Calcium (Ca)-Dissolved (mg/L)	48.9	48.8	49.1	47.5	47.4
	Magnesium (Mg)-Dissolved (mg/L)	6.84	6.94	6.91	6.68	7.37
Aggregate Organics	Oil And Grease (Visible Sheen)					no
Radiological Parameters	Ra-226 (Bq/L)	0.012	0.0083	0.0092	0.011	0.012

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Cobalt (Co)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Nickel (Ni)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2166720-1, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2166720-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

OGG-VISIBLE-SHEEN-VA	Water	Oil and Grease - Visible Sheen	AER D50

"Visible Sheen" refers to a qualitative visual observation of the presence or absence of rainbow sheen, iridescence, or non-aqueous phase liquid (NAPL) on the surface of a drilling waste (fluid portion, clear liquid portion, or total waste) or on an aqueous sample. No hold time guidance is available for this test. Field observations should also be recorded, because sample characteristics may change between sampling and time of observation at the laboratory. This is a non-accredited test.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

09-002571

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 09-002571

Report To				Report Format / Distribution				Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources			☑ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis			☑ PDF	☐ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330			Email 1:	klewis@elginmining.com			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1			Email 2:	lupinlogistics@discoverymining.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340	Fax:		Email 3:	colleen_prather@golder.com			
Invoice To	Same as Report ?	☑ Yes	☐ No	Client / Project Information				Analysis Request
Hardcopy of Invoice with Report?		☑ Yes	☐ No	Job #:	Lupin Mine			Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	payables@mandalayresources.com			PO / AFE:				
Contact:				LSD:				
Address:								
Phone:		Fax:		Quote #:	Q68017			
Lab Work Order # (lab use only)	L2166720			ALS Contact:	Rick Zolieski	Sampler:	D. Vokey	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	T- Mercury	Nitrite	Nitrate	Oil and Grease (visible Sheen)	Ammonia	Phosphorous			Number of Containers
1	LUP-10	14-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
2	LUP-10	15-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
3	LUP-10	16-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
4	LUP-10	17-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
5	LUP-10	18-Sep-18	11:00	Water	X	X	X	X		X	X		X				4
6	LUP-10	19-Sep-18	11:00	Water	X	X	X	X	X	X	X	X	X	X			6
7	LUP-10	20-Sep-18	11:00	Water	X	X	X	X		X	X		X				4

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
s. Bimson	20-Sep-18	13:00	OG	19 Sep	8:00	3.6 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 21-SEP-18
Report Date: 24-OCT-18 08:26 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2169165

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers: 10-366267
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2169165-1	L2169165-2	L2169165-3	L2169165-4	L2169165-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	19-SEP-18	19-SEP-18	19-SEP-18	19-SEP-18	19-SEP-18
Sampled Time	08:50	09:30	10:30	10:45	11:00
Client ID	LUP-21	LUP-22	LUP-24	LUP-25	LUP-10
Grouping / **Analyte**					
WATER					
Physical Tests Hardness (as CaCO3) (mg/L)	22.8 HTC	37.5 HTC	9.39 HTC	9.62 HTC	160 HTC
pH (pH)	6.49	6.45	6.49	6.61	5.88
Total Suspended Solids (mg/L)	<3.0	<3.0	5.9	<3.0	10.5
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.6	4.5	2.8	5.0	<1.0
Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO3) (mg/L)	8.6	4.5	2.8	5.0	<1.0
Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	0.0686
Nitrate (as N) (mg/L)	0.0542	0.0954	<0.0050	0.0221	0.635
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0064
Phosphorus (P)-Total (mg/L)	0.0040	0.0076	0.0423	0.0081	0.0037
Cyanides Cyanide, Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Total Metals Aluminum (Al)-Total (mg/L)	0.0317	0.0338	0.0240	0.0165	0.526
Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total (mg/L)	0.00057	0.00056	0.00032	0.00033	0.0423
Barium (Ba)-Total (mg/L)	0.00507	0.00779	0.00369	0.00351	0.0176
Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00021
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	0.011	<0.010	<0.010	0.047
Cadmium (Cd)-Total (mg/L)	0.0000270	0.0000337	0.0000069	0.0000084	0.000271
Calcium (Ca)-Total (mg/L)	6.45	11.1	2.41	2.51	50.5
Cesium (Cs)-Total (mg/L)	0.000020	0.000027	0.000013	0.000011	0.000103
Chromium (Cr)-Total (mg/L)	0.00021	0.00017	0.00012	<0.00010	0.00041
Cobalt (Co)-Total (mg/L)	0.00191	0.00264	0.00035	0.00037	0.0398
Copper (Cu)-Total (mg/L)	0.00112	0.00106	0.00081	0.00077	0.0157
Iron (Fe)-Total (mg/L)	0.088	0.040	0.028	0.020	1.53
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000614
Lithium (Li)-Total (mg/L)	0.0036	0.0056	0.0016	0.0017	0.0227
Magnesium (Mg)-Total (mg/L)	1.63	2.38	0.822	0.816	8.31
Manganese (Mn)-Total (mg/L)	0.0498	0.0723	0.00962	0.0103	0.910
Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total (mg/L)	0.00838	0.0152	0.00312	0.00316	0.0932
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	0.727	1.04	0.490	0.490	4.41
Rubidium (Rb)-Total (mg/L)	0.00135	0.00151	0.00121	0.00115	0.00281

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2169165-1	L2169165-2	L2169165-3	L2169165-4	L2169165-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	19-SEP-18	19-SEP-18	19-SEP-18	19-SEP-18	19-SEP-18
	Sampled Time	08:50	09:30	10:30	10:45	11:00
	Client ID	LUP-21	LUP-22	LUP-24	LUP-25	LUP-10
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000060
	Silicon (Si)-Total (mg/L)	0.67	0.83	0.25	0.26	2.38
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	4.10	7.12	1.50	1.58	31.8
	Strontium (Sr)-Total (mg/L)	0.0301	0.0516	0.0116	0.0126	0.231
	Sulfur (S)-Total (mg/L)	8.38	15.0	2.90	2.93	68.1
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.00043	<0.00030	0.00381
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000030	0.000040	0.000030	0.000030	0.000150
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0223	0.0363	0.0079	0.0076	0.550
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060
Radiological Parameters	Ra-226 (Bq/L)	<0.0072	0.0052	<0.0062	<0.0033	<0.0075

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2169165-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2169165-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2169165-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2169165-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2169165-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L2169165-1, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2169165-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2169165-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2169165-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2169165-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2169165-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2169165-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA	Water	Total Cyanide in water by CFA	ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-366267

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Monday, October 22, 2018

Rick Zolkiewski
ALS Environmental
314 Old Airport Road Unit 116
Yellowknife, NT X1A 3T3

Re: ALS Workorder: 1809572
Project Name:
Project Number: L2169165

Dear Mr. Zolkiewski:

Five water samples were received from ALS Environmental, on 9/27/2018. The samples were scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Katie M. OBrien
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
PJ-LA (DoD ELAP/ISO 170250)	95377
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1809572

Radium-226:
The samples were prepared and analyzed according to the current revision of SOP 783.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1809572
Client Name: ALS Environmental
Client Project Name:
Client Project Number: L2169165
Client PO Number: L2169165

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
L2169165-1	1809572-1		WATER	19-Sep-18	
L2169165-2	1809572-2		WATER	19-Sep-18	
L2169165-3	1809572-3		WATER	19-Sep-18	
L2169165-4	1809572-4		WATER	19-Sep-18	
L2169165-5	1809572-5		WATER	19-Sep-18	

ALS Environmental

L2169165

1809572 YELLOWKNIFE

Subcontract Request Form

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
225 COMMERCE DRIVE
FORT COLLINS,CO 80524

NOTES: Please reference on final report and invoice: PO# *L2169165*
ALS requires QC data to be provided with your final results.

Please see enclosed 5 sample(s) in 5 Container(s)

	SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
1	**L2169165-1 LUP-21**	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	**9/19/2018** 10/16/2018	
2	**L2169165-2 LUP-22**	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	**9/19/2018** 10/16/2018	
3	**L2169165-3 LUP-24**	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	**9/19/2018** 10/16/2018	
4	**L2169165-4 LUP-25**	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	**9/19/2018** 10/16/2018	
5	**L2169165-5 LUP-10**	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	**9/19/2018** 10/16/2018	

Subcontract Info Contact: Rick Zolkiewski (867) 873-5593

Analysis and reporting info contact: Rick Zolkiewski
314 OLD AIRPORT ROAD
Unit 116
YELLOWKNIFE,NT X1A 3T3
Phone: (867) 873-5593 Email: Rick.Zolkiewski@alsglobal.com

Please email confirmation of receipt to: **Rick.Zolkiewski@alsglobal.com**

Shipped By: Mel Date Shipped: 09/26/2018

Received By: HA Date Received: 9/25 + 11:45am

Verified By: [signature] Date Verified: 9/27/18 10:20

Temperature: 8 (Avg of 6)

Sample Integrity Issues:

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS Burnaby Workorder No: ~~R~~ 1809572

Project Manager: KMO Initials: JK Date: 9/27/18

1.	Are airbills / shipping documents present and/or removable?	DROP OFF	(YES)	NO
2.	Are custody seals on **shipping** containers intact?	(NONE)	YES	NO
3.	Are custody seals on **sample** containers intact?	(NONE)	YES	NO
4.	Is there a COC (chain-of-custody) present?		(YES)	NO
5.	Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)		(YES)	NO
6.	Are short-hold samples present?		YES	(NO)
7.	Are all samples within holding times for the requested analyses?		(YES)	NO
8.	Were all sample containers received intact? (not broken or leaking)		(YES)	NO
9.	Is there sufficient sample for the requested analyses?		(YES)	NO
10.	Are all samples in the proper containers for the requested analyses?		(YES)	NO
11.	Are all aqueous samples preserved correctly, if required? (excluding volatiles)	N/A	(YES)	NO
12.	Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
13.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)	(N/A)	YES	NO
14.	Were the samples shipped on ice?		(YES)	NO
15.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 (#3) #4	(RAD ONLY)	YES	(NO)

Cooler #:	1							
Temperature (°C):	7.8							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information: External µR/hr reading:	10							
Background µR/hr reading:	11							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: **Please provide details here for any NO responses to gray-shaded boxes above, or any other issues noted:**

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 4/28/13

Form 201r26.xls
(06/29/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

ORIGIN ID:YBYA (604) 253-4188
MELISSA YAGI
ALS ENVIRONMENTAL LAB GROUP
8081 LOUGHEED HIGHWAY
SUITE 100
BURNABY, BC V5A1W9
CANADA CA

SHIP DATE: 26SEP18
ACTWGT: 35.00 LB MAN
CAD: 0347419/CAFE3210

BILL SENDER

1809572

7.8

TO SAMPLE RECEVING
ALS ENVIRONMANTAL
225 COMMERCE DRIVE

FORT COLLINS CO 80524
(970) 490-1511 REF: SUBLET

(US)

10-0

551C1/F78C/104C

DEPT: SUBLET

FedEx. Express

E

J181118042802uv

10:30A

TRK# 4432 4287 7969
0430

INTL PRIORITY

XH FTCA

80524
CO-US DEN

After printing this label:
CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH
1. Fold the printed page along the horizontal line.
2. Place label in shipping pouch and affix it to your shipment.

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-1	**Lab ID:**	1809572-1
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1			**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**
Ra-226	0.0023 (+/- 0.0042)	U	0.0072	BQ/l	NA	10/19/2018 12:01
Carr: BARIUM	*81.7*		*40-110*	*%REC*	DL = NA	10/19/2018 12:01

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-2	**Lab ID:**	1809572-2
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**	
Ra-226	0.0052 (+/- 0.0041)	LT	0.0048	BQ/l	NA	10/19/2018 12:01
Carr: BARIUM	*77.8*		*40-110*	*%REC*	DL = NA	10/19/2018 12:01

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-3	**Lab ID:**	1809572-3
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**	
Ra-226	0.0012 (+/- 0.0034)	U	0.0062	BQ/l	NA	10/19/2018 12:01
Carr: BARIUM	*89.6*		*40-110*	*%REC*	DL = NA	10/19/2018 12:01

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-4	**Lab ID:**	1809572-4
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**	
Ra-226	0.0027 (+/- 0.0026)	U	0.0033	BQ/l	NA	10/19/2018 12:01
Carr: BARIUM	*92*		*40-110*	*%REC*	DL = NA	10/19/2018 12:01

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-5	**Lab ID:**	1809572-5
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1			**SOP 783**		Prep Date: **10/12/2018**	PrepBy: **ASZ**
Ra-226	0.0069 (+/- 0.0056)	U	0.0075	BQ/l	NA	10/19/2018 12:01
Carr: BARIUM	*76.4*		*40-110*	*%REC*	DL = NA	10/19/2018 12:01

Client:	ALS Environmental	**Date:**	*22-Oct-18*
Project:	L2169165	**Work Order:**	1809572
Sample ID:	L2169165-5	**Lab ID:**	1809572-5
Legal Location:		**Matrix:**	WATER
Collection Date:	9/19/2018	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

- "Report Limit" is the MDC

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
G - Sample density differs by more than 15% of LCS density.
D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

QC BATCH REPORT

Batch ID: **RE181012-1-1** Instrument ID **Alpha Scin** Method: **Radium-226 by Radon Emanation**

LCS Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.58 (+/- 0.395)	0.0114	1.771		89.1	67-120					P,M3
Carr: BARIUM	16800		17060		98.3	40-110					

LCSD Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.36 (+/- 0.342)	0.0127	1.687		80.7	67-120		1.58	0.4	2.1	P,M3
Carr: BARIUM	15900		17060		93.4	40-110		16800			

MB Sample ID: **RE181012-1** Units: **BQ/l** Analysis Date: **10/19/2018 13:42**

Client ID: Run ID: **re181012-1a** Prep Date: **10/12/2018** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	0.00097 (+/- 0.0041)	0.0077									U
Carr: BARIUM	16200		17060		94.7	40-110					

The following samples were analyzed in this batch:

1809572-1	1809572-2	1809572-3
1809572-4	1809572-5	

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 10-366267

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis	☑ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330	Email 1: klewis@elginmining.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1	Email 2: lupinlogistics@discoverymining.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340 Fax:	Email 3: collen_prather@golder.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Lupin Mine	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:	payables@mandalayresources.com	PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q68020	
Lab Work Order # (lab use only)	L2169165	ALS Contact: Rick Zolieski	Sampler: D. Vokey

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	Radium 226	Nitrite	Nitrate	Ammonia (NH4)	Phosphorous	Number of Containers
1	LUP-21	19-Sep-18	8:50	Water	X	X	X	X	X	X	X	X	X	5
2	LUP-22	19-Sep-18	9:30	Water	X	X	X	X	X	X	X	X	X	5
3	LUP-24	19-Sep-18	10:30	Water	X	X	X	X	X	X	X	X	X	5
4	LUP-25	19-Sep-18	10:45	Water	X	X	X	X	X	X	X	X	X	5

L2169165-COFC

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
S. Bimson	20-Sep-18	13:00		21/9	16 00	7.3 °C				

LUPIN MINES INCORPORATED
ATTN: Karyn Lewis
76 Richmond Street
Suite 330
Toronto ON M5C 1P1

Date Received: 27-SEP-18
Report Date: 16-OCT-18 11:45 (MT)
Version: FINAL

Client Phone: 778-386-7340

Certificate of Analysis

Lab Work Order #: L2172220

Project P.O. #: NOT SUBMITTED
Job Reference: LUPIN MINE
C of C Numbers: 09-002572
Legal Site Desc:

Rick Zolkiewski
General Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2172220-1				
	Description	WATER				
	Sampled Date	27-SEP-18				
	Sampled Time	11:00				
	Client ID	LUP-10				
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	167				
	pH (pH)	6.27				
	Total Suspended Solids (mg/L)	7.3				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	6.2				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	6.2				
	Nitrate (as N) (mg/L)	0.501				
	Nitrite (as N) (mg/L)	0.0039				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Total Metals	Aluminum (Al)-Total (mg/L)	0.153				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.0205				
	Barium (Ba)-Total (mg/L)	0.0198				
	Beryllium (Be)-Total (mg/L)	0.00011				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.048				
	Cadmium (Cd)-Total (mg/L)	0.000248				
	Calcium (Ca)-Total (mg/L)	50.7				
	Cesium (Cs)-Total (mg/L)	0.000115				
	Chromium (Cr)-Total (mg/L)	0.00081				
	Cobalt (Co)-Total (mg/L)	0.0368				
	Copper (Cu)-Total (mg/L)	0.00778				
	Iron (Fe)-Total (mg/L)	2.04				
	Lead (Pb)-Total (mg/L)	0.000217				
	Lithium (Li)-Total (mg/L)	0.0207				
	Magnesium (Mg)-Total (mg/L)	8.72				
	Manganese (Mn)-Total (mg/L)	0.929				
	Molybdenum (Mo)-Total (mg/L)	0.000054				
	Nickel (Ni)-Total (mg/L)	0.0804				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	4.35				
	Rubidium (Rb)-Total (mg/L)	0.00343				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	2.95				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2172220-1				
	Description	WATER				
	Sampled Date	27-SEP-18				
	Sampled Time	11:00				
	Client ID	LUP-10				
Grouping	**Analyte**					
WATER						
Total Metals	Silver (Ag)-Total (mg/L)	0.000012				
	Sodium (Na)-Total (mg/L)	33.0				
	Strontium (Sr)-Total (mg/L)	0.218				
	Sulfur (S)-Total (mg/L)	62.7				
	Tellurium (Te)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	0.000010				
	Thorium (Th)-Total (mg/L)	<0.00010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00234				
	Tungsten (W)-Total (mg/L)	<0.00010				
	Uranium (U)-Total (mg/L)	0.000075				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	0.283				
	Zirconium (Zr)-Total (mg/L)	0.000160				
Dissolved Metals	Dissolved Metals Filtration Location	LAB				
	Calcium (Ca)-Dissolved (mg/L)	52.2				
	Magnesium (Mg)-Dissolved (mg/L)	8.89				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2172220-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2172220-1
Matrix Spike	Aluminum (Al)-Total	MS-B	L2172220-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2172220-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2172220-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2172220-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2172220-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2172220-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CN-T-CFA-VA Water Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

09-002572

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # 09-002572

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	Mandalay Resources	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Karyn Lewis	☑ PDF ☐ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	76 Richmond Street Suite 330	Email 1: klewis@elginmining.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	toronto, ON M5C 1P1	Email 2: lupinlogistics@discoverymining.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	778-386-7340 Fax:	Email 3: colleen_prather@golder.com	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	
Hardcopy of Invoice with Report?	☑ Yes ☐ No	Job #: Lupin Mine	
Company:	payables@mandalayresources.com	PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q68017	
Lab Work Order # (lab use only)	L2172220	ALS Contact: Rick Zolieski	Sampler: D. Vokey

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, alkalinity, hardness	TSS	T-Cyanide	T-Metals (ICP Metals Scan)	T- Mercury	Nitrite	Nitrate	Oil and Grease (visible Sheen)	Ammonia					Number of Containers
	LUP-10	21-Sep-18	11:00	Water	X	X	X	X		X	X							4
	LUP-10	22-Sep-18	11:00	Water	X	X	X	X		X	X							4
	LUP-10	23-Sep-18	11:00	Water	X	X	X	X		X	X							4
	LUP-10	24-Sep-18	11:00	Water	X	X	X	X		X	X							4
	LUP-10	25-Sep-18	11:00	Water	X	X	X	X		X	X							4
	LUP-10	26-Sep-18	11:00	Water	X	X	X	X	X	X	X	X	X					6
	LUP-10	27-Sep-18	11:00	Water	X	X	X	X		X	X							4

L2172220-COFC

Special Instructions / Regula

ME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
s. Bimson	27-Sep-18	7:30 ~~13:00~~	MA	Sept 27	1:50 pm	6.2 °C				

APPENDIX C – INSPECTION REPORTS

WATER LICENCE INSPECTION FORM

☒ **Original**
☐ **Follow-Up Report**

Licensee	**Licensee Representative**
Lupin Mines Inc	Karyn Lewis
Licence No. / Expiry	**Representative's Title**
2AM-LUP1520 / Expiry 18 Aug 2020	Project Manager
Land / Other Authorizations	**Land / Other Authorizations**
Date of Inspection	**Inspector**
05 August 2018	Baba Pedersen

Activities Inspected

☒ Camp ☐ Drilling ☐ Mining ☐ Construction ☒ Reclamation ☐ Fuel Storage
☐ Roads/Hauling ☐ Other: ☐ Other:

Conditions: **A - Acceptable** **C - Concern** **U - Unacceptable** **NA – Not Applicable** **NI – Not Inspected**

Water Use	Condition	Comment	**Site Conditions**	Condition	Comment	**Haz/Mat Management**	Condition	Comment
Intake/Screen	A	3	Water Management Structures			Storage	A	7
Flow Measure. Device	A	6	Culverts / Bridges			Spills		
Source:			Drainage			Spill Plan		
Water Use:	A	1	Erosion / Sediment					
Recirculation (y /n)			Mitigation Measures	NI	9 & 10	**Administrative**		
			Reclamation Activities	A	4,5,8,11&12	Records		
			Materials Storage			Reports		
Waste Disposal			Signage	C	2,3 & 11	Plans	A	14&15
Waste Water	A	2				Notifications	A	14&15
Solid Waste			**Monitoring**			**Other**		
Hazardous Waste			Sample Collection / Analysis			Borrow Pit	A	13

**The number in the comments field will correspond with specific comments provided below.*

Samples taken by Inspector:	Location(s): No Samples were taken during this Inspection
☐ Yes ☒ No	

SECTION 1 ☒ **Comments** (s.__) ☐ **Non-Compliance with Act or Licence** (s.__) ☐ **Action Required** (s.__)

I Inspected the Lupin Mine Site (Photo 1) Reclamation on August 5, 2018. I was accompanied by Karyn Lewis, Project Manager and Johnny, Acting Camp Manager for Lupin Mines Incorporated.

SECTION 2 ☒ **Comments** ☐ **Non-Compliance with Act or Licence** ☐ **Action Required**

I saw; 1. The Water Usage Records (Photo 2) 2. The Sewage Lagoon Pond and Decant Area (Photos 3, 4 & 5), 3. The Raw Water Intake (Photo 6), 4. The Satellite Tank Farm (Photo 7), 5. The Land Farm Area (Photo 8), 6. The Water Storage and Usage Meter Container (Photo 9), 7. Main Fuel Tank Farm (Photo 10), 8. Cell 5, 9. Dam M, 10. DAM 1A, 11. Pond 2 aka The Polishing Pond (Photos 11 & 12), 12. Cell 3 (Photo 13), and 13. The Fingers Lake Borrow Pit (Photo 14). 14. Their Water License Renewal Application and Final Closure Plan were submitted to the NWB last week (late July 2018). 15. Five associated Land Lease Renewal Applications were signed and submitted to INAC Lands in July 2018.

SECTION 3 ☐ **Comments** ☐ **Non-Compliance with Act or Licence** ☒ **Action Required**

1. YTD Water Usage since opening on April 29, 2018 is 339.5 Cubic Meters, well within allowable limits. 2. The Sewage Lagoon Decant Program is complete for this season. Signage for Sample Station LUP-14 was faded and requires Replacement. 3. Signage must be placed at the Raw Water Intake to show Sample Location. 4. The Satellite Tank Farm Tanks will all be cleaned and certified by a Mechanical Engineer within 2 weeks, then moved to the Bone Yard for Cutting Up. 5. The Contaminated Soils in the Land Farm are being treated. The plan is to place all this underground during Site Reclamation. 6. Water Usage Records are acceptable. 7. Tank #4 has about 4 feet of P-50 and Tank #3 has about 12 inches of P-50. There is a small amount of Jet Fuel in the Dark Brown Tank. All on site fuel is expected to be used up during the Site Reclamation. 8. Cell 5 is scheduled to be covered in 2019. 9. Observation Only. 10. Observation Only. 11. They were actively adding Lime to Pond 2 in order to bring the Ph Level up before a planned discharge. Environment Canada is sampling to provide approvals. Signage for Sample Station LUP-10 has been blown away and needs Replacement. 12. Cell 3 is scheduled to be covered in 2019. 13. They are actively using the Fingers Lake Borrow Pit, I have no issues here. 14. Thank you for submitting this to the NWB. 15. Thank you for submitting these to INAC Lands.

Licensee or Representative	Inspector's Name
	Baba Pedersen
Signature	**Signature**
	Signed Original on File
Date	**Date**
	23 January 2019

Office Use Only:	Follow-up report to be issued by Inspector	☐ Yes	☒ No

cc. CIRNAC, Manager Field Operations, Iqaluit, justin.hack@canada.ca

Nunavut Water Board, Manager of Licensing, Gjoa Haven, licensing@nwb-oen.ca

PHOTO LOG

Date	Camera	Inspector	Authorization
05 August 2018	Sony DSC-HX50V	Baba Pedersen	2AM-LUP1520

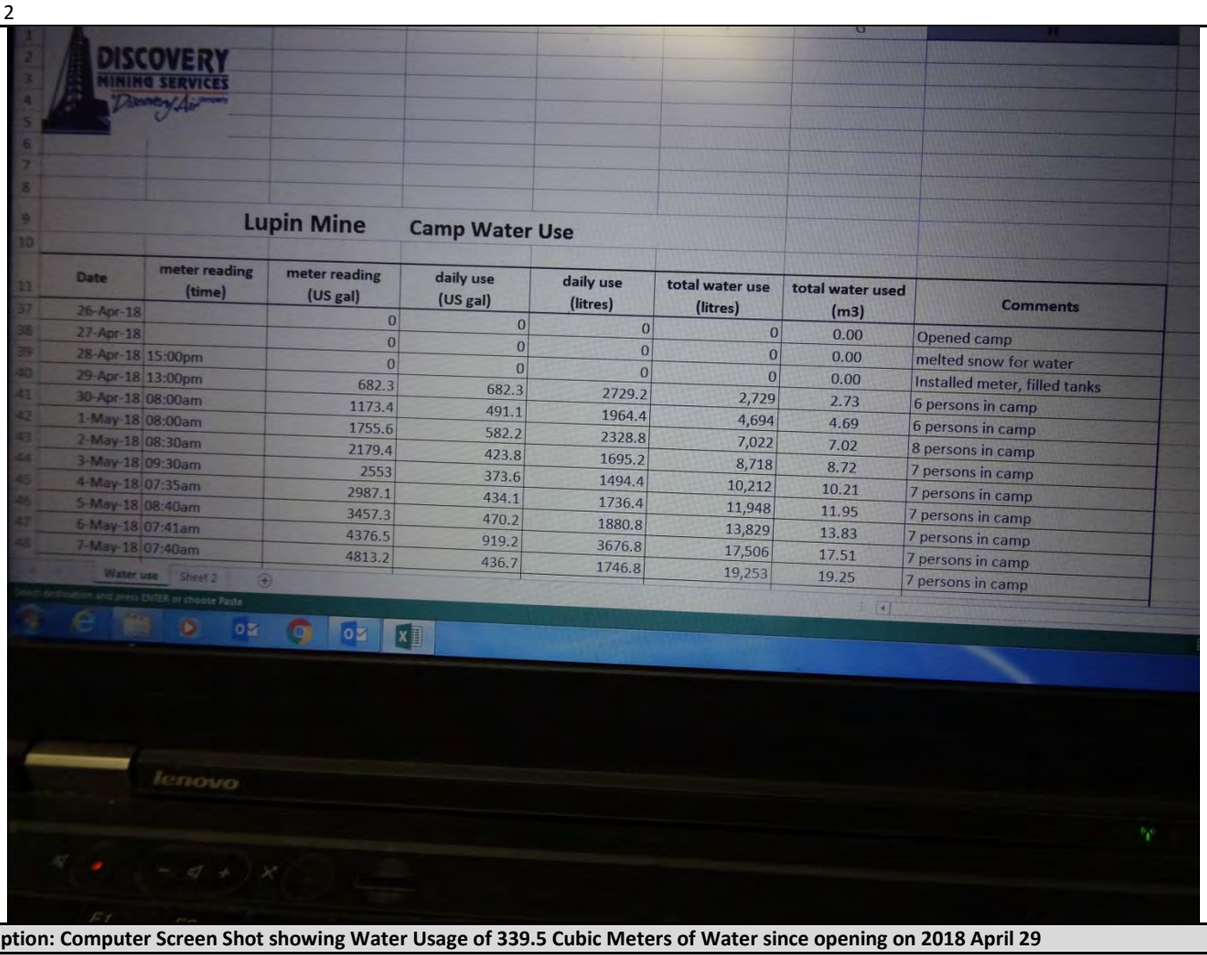
Photo Log # DSC03981

Photo 1

Description: Aerial View of Lupin Mine Site

Photo Log # DSC03999

Photo 2



DISCOVERY MINING SERVICES

Lupin Mine Camp Water Use

Date	meter reading (time)	meter reading (US gal)	daily use (US gal)	daily use (litres)	total water use (litres)	total water used (m3)	Comments
26-Apr-18		0	0	0	0	0.00	Opened camp
27-Apr-18		0	0	0	0	0.00	melted snow for water
28-Apr-18	15:00pm	0	0	0	0	0.00	Installed meter, filled tanks
29-Apr-18	13:00pm	682.3	682.3	2729.2	2,729	2.73	6 persons in camp
30-Apr-18	08:00am	1173.4	491.1	1964.4	4,694	4.69	6 persons in camp
1-May-18	08:00am	1755.6	582.2	2328.8	7,022	7.02	8 persons in camp
2-May-18	08:30am	2179.4	423.8	1695.2	8,718	8.72	7 persons in camp
3-May-18	09:30am	2553	373.6	1494.4	10,212	10.21	7 persons in camp
4-May-18	07:35am	2987.1	434.1	1736.4	11,948	11.95	7 persons in camp
5-May-18	08:40am	3457.3	470.2	1880.8	13,829	13.83	7 persons in camp
6-May-18	07:41am	4376.5	919.2	3676.8	17,506	17.51	7 persons in camp
7-May-18	07:40am	4813.2	436.7	1746.8	19,253	19.25	7 persons in camp

Water use | Sheet 2

Description: Computer Screen Shot showing Water Usage of 339.5 Cubic Meters of Water since opening on 2018 April 29

Photo Log # DSC04009	Location : Sewage Lagoon Pond

Photo 3

Description: Sewage Lagoon Pond showing Decant Intake Lines

Photo Log # DSC04010	Location : Sewage Lagoon Pond

Photo 4

Description: Sewage Lagoon Pond showing Decant Outflow Lines

Photo Log # DSC04015	Location : Sewage Lagoon Pond
Photo 5	

Description: Sample Station LUP-14 at Sewage Lagoon Pond Decant Outflow showing faded Signage that requires REPLACEMENT

Photo Log # DSC04025	Location : Water Intake
Photo 6	N 65*46'38.4" W 111*13'01.2"

Description: Water Intake location on Contwoyto Lake showing NO SIGNAGE

Photo Log # DSC04047	Location : Satellite Tank Farm

Photo 7

Description: Satellite Tank Farm waiting to be Cleaned and Certified before being moved to Bone Yard to be Cut Up for Disposal

Photo Log # DSC04048	Location : Land Farm

Photo 8

Description: Contaminated Soil being treated in Land Farm prior to planned placement Underground for Permanent Storage

Photo Log # DSC04055	Location : Water Storage Container

Photo 9

Description: Inside view of Container used for Water Storage Tank and Usage Meter

Photo Log # DSC04063	Location : Main Fuel Tank Farm

Photo 10

Description: View of some of the Tanks in Main Tank Farm

Photo Log # DSC04084	Location : Pond 2 (aka Polishing Pond)

Photo 11

Description: Project to add Lime to raise Ph Level prior to Discharge

Photo Log # DSC04092	Location : Pond 2 (aka Polishing Pond)

Photo 12

Description: Decant Outflow Area, Sample Station LUP-10 SIGNAGE NEEDS REPLACEMENT

Photo Log # DSC04099	Location : Cell 3

Photo 13

Description: Cell 3 (and Cell 5) which are to be Covered in 2019

Photo Log # DSC04106	Location : Fingers Lake Borrow Pit

Photo 14

Description: Partial View of Fingers Lake Borrow Pit

Reply all | Delete Junk | •••

RE: Pond 2 Discharge Notice and Samples- Permission to waiver 10 days notice

Pedersen, Baba (AADNC/AANDC) <baba.pedersen@canada.ca>

Reply all |

Mon 2018-08-20, 3:27 PM

Karyn Lewis; licensing@nwb-oen.ca; Aussenegg, Mark (EC) <mark.aus

Action Items

Hello Karyn,

All looks well, thanks for the notice of your intention to discharge from Pond 2. I have no problem with you starting your discharge program at any time.
Please remember to sample again half way through your program and again at the end of the program.

Koana,
Baba

From: Karyn Lewis [mailto:k.lewis@mandalayresources.com]
Sent: Monday, August 20, 2018 2:43 PM
To: Pedersen, Baba (AADNC/AANDC)
Cc: licensing@nwb-oen.ca; Aussenegg, Mark (EC)
Subject: Pond 2 Discharge Notice and Samples- Permission to waiver 10 days notice

Hi Baba,

Please find attached LMI's notice to discharge from Pond 2. We are requesting to have the 10 day notice waived and have attached the sample results that are all within the water licence criteria.

Thanks.

Regards,
Karyn Lewis

APPENDIX D – GEOTECHNCIAL

2018 Lupin Mine Tailings Area Inspection Report

Annual Geotechnical Inspection of the Tailings Containment Area

November 16, 2018

Prepared for:

Lupin Mines Incorporated

Prepared by:

Alvin Tong, P.Eng.

Revision	Description	Author		Quality Check		Independent Review	
A	Draft	AT	Nov, 14			TP	Nov, 15
1	Final	AT	Nov, 16	JB	Nov, 16		

Sign-off Sheet

This document entitled 2018 Lupin Mine Tailings Area Inspection was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Lupin Mines Inc. (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by _____
(signature)

Alvin Tong, P.Eng.

Reviewed by _____
(signature)

Tim Peterson, P.Eng.

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1.0 INTRODUCTION

Lupin Mines Incorporated (LMI) retained Stantec Consulting (Stantec) to complete the annual geotechnical dam inspection at the Lupin Mine tailings containment area (TCA). The Lupin Mine site is currently under care and maintenance status and operates under the Nunavut Water License 2AM-LUP1520 (NWB 2015) for LMI. LMI is a wholly-owned indirect subsidiary of Mandalay Resources.

The Lupin Mine is located on the northwest shore of Contwoyto Lake, approximately 400km northeast of Yellowknife, Northwest Territories (Figure 1). The site consists of a mill, camp and support facilities, fuel storage, airstrip, and the TCA (Figure 2). A detailed view of the mill site is provided in Figure 3 and of the TCA in Figure 4.

The water license explicitly requires an annual geotechnical inspection to be completed for the TCA perimeter dams, TCA reclamation covers, including a quantitative assessment of any seepage from the TCA (NWB 2015). Stantec has provided a qualified person to conduct the geotechnical inspection to fulfill the requirements listed in Part E, Item 6 of the water license, which stipulates the following:

“The tailings containment area shall be constructed, operated and maintained to engineering standards such that:

- A minimum freeboard of 1.0 metre shall be maintained at all times or as recommended by a geotechnical engineer and as approved by the Board in writing;
- Seepage from the Tailings Containment Area is minimized;
- Any seepage that occurs is collected and returned immediately to the Tailings Containment Area;
- Erosion of constructed facilities is addressed immediately;
- The solids fraction of the mill tailings shall be permanently contained within the Tailings Containment Area or underground as backfill.
- Implement measures to ensure that the Tailings Containment Area is adequately covered or managed, including the use of approved binding agents, so as to prevent windblown tailings from impacting other areas of the project site;
- During care and maintenance, inspection shall be carried out on a bi-weekly basis during the freshet (approx. May and June), and monthly during the reminder of the open water period (approx. July – October) of the following:
  - Collection and return of seepage in Dam 2;
  - Water levels in ponds 1 and 2, and cells 3 and 5;
  - General surface erosion and anomalies on dams; and,
  - Tension crack in Dam M. If water level in the ponds rise, then inspection shall be carried out bi-weekly during the open water season (approx. May – October);
  - Records of these inspection shall be kept for review upon the request of an Inspector, or as otherwise approved by the Board. More frequent inspections shall be performed at the requested of an Inspector.
  - More frequent inspections shall be performed at the requests of an Inspector;
  - An inspection of the Tailings Containment Area shall be carried out annually during ice free, open water condition by a geotechnical Engineer. The Engineer’s report shall be submitted to the Board within sixty (60) days following the inspection and shall include a cover letter from the Licensee outlining an implementation plan to respond to the Engineer’s recommendations.”

This report summarizes Stantec's observations of the TCA's condition in 2018 and presents our recommendations. Previous annual inspections, safety reviews, and risk assessments with respect to the TCA made available to Stantec include:

- Inspection Report from 2017 by Norwest Corporation;
- Inspection Report from 2016 by Norwest Corporation;
- Inspection Report from 2012-2015 by SRK Consulting;
- 2015 Dam Safety Review Report by SRK Consulting; and,
- 2012 TCA Risk Assessment and Water Quality Review by SRK Consulting.

While the annual inspection is carried out to satisfy the license requirements, the format and methodology used are in accordance to the best engineering practice using the Inspection and Maintenance of Dams Safety Guidelines issued by the Province of British Columbia, Water Management Branch (BCWMB 2011) and the Mining Association of Canada (MAC) Guidelines.

1.1 PROJECT DESCRIPTION

1.1.1 Location and Access

The Lupin Mine is only assessible by air or winter road. The air access is serviced by a gravel runway, capable of handling large aircraft such as Hercules C-130 and Boeing 737 jets. Charter flights are typically deployed from Yellowknife for worker rotation and re-supply during the open water seasons. When the mine was in operation, it used the Tibbitt to Contwoyto Winter Road to resupply the mine. This winter road currently ends at the Ekati Diamond Mine and has not been extended to the Lupin Mine since 2005, when the mine went into care and maintenance status.

1.1.2 History and Current Status

Currently the Lupin Mine is in care and maintenance status and licensed accordingly. Mining operations ceased in 2005. Current care and maintenance operations include, but are not limited to, earthwork maintenance, water treatment and discharge as needed, water quality monitoring, and waste management as needed.

1.1.3 Site Infrastructure

The mine site consists of the following main structures: mill site, camp and support facilities, fuel storage, airstrip, and tailings containment area (TCA).

- The mill site included an underground hoist and wheelhouse, ball mill, concentrator, and a paste backfill plant (now decommissioned).
- The camp and support facilities included multiple wings of accommodations for workers, an office building, recreation facilities, cool and warm storage, generators, sewage lagoons and dams, and waste management facilities. Gravel roads are in place to connect the facilities.
- Fuel storage includes the main tank farm that contains diesel fuel for annual operation, along with fuel for aircraft. Fuel is pumped to a satellite tank farm as needed for equipment fueling and power generation to minimize the risk of spillage and accidents from using the large fuel tanks at the main farm.
- The airstrip is a gravel runway that can accommodate aircraft up to the size of a Boeing 737 jet.

- The TCA consists of a number of frozen core dams that provide a closed system for tailings and water treatment. Tailings are contained in a number of cells and progressive reclamation is ongoing and has now been completed at several cells. Water treatment is carried out using Pond 1 as a holding pond for effluent, treating the water in a plant, and then using Pond 2 as a polishing pond to allow the solids to precipitate prior to discharge to the environment. Details of the TCA configuration are described in Section 2 of this report.

1.2 CLIMATE

Stantec evaluated the climate data from an automated weather station known as Lupin (CWIJ) available in the Weather Underground database (WU 2016). Intermittent climate data is also available from the Environment Canada database under station Lupin CS Climate ID 230N002. The climate data evaluation was done from May 2005 to April 2017. The climate data evaluation was not updated in 2018 as the data was not made publicly available. The evaluation results indicate the station reported an annual mean temperature of -13°C. The average winter temperature, from October to April, was around -21°C. The average summer temperature, from May to September, was around 8°C. Annual total precipitation was averaged to be around 592mm, where the data does not differentiate between snow and rain. The mean wind direction was south-southeast, with average wind speed of 16km/h and high of 50km/h.

1.3 SITE GEOLOGICAL CONDITIONS

The Lupin Mine is located in the Archean metaturbidite sequence of the Contwoyto Formation. The rocks have been subjected to both regional and contact metamorphism, including deformations and intrusions.

The area was glaciated, and experienced isostatic rebound after the melt. The glaciers and runoff from the melt washed out the erodible soils and formed lakes in low lying areas. The easily erodible glaciolacustrine and glacio-fluvial sands were reworked and displaced by the meltwater and resulted in the outcrops present with thin soil veneers, abandoned beaches and esker formations (Kinross 2005). Where bedrock is not present at the surface, the overburden typically consists of coarse grained glacial till which is intermittently covered by glaciolacustrine and glacial-fluvial deposits. The till is a silty sand with gravel and boulders, with low plasticity and ice depending on the depth.

1.4 PERMAFROST AND DAM GEOTECHNICAL CONDITIONS

The site is within a continuous permafrost region. The active layer is observed to be variable between the depth of 1m to 3m based on available data. During operation, scheduled monitoring was completed of all instrumentation, recording water levels, water quality and production volumes. This monitoring program was reduced accordingly during the care and maintenance period and is now carried out when work is being done on site. Thermistors are installed in several dams and in the tailings cover to monitor their performance. Some of the thermistors are no longer functional or damaged beyond repair. The remaining thermistors are read at least once annually during the geotechnical inspection and more often when site access allows. The thermistor readings indicate that permafrost remains within the dams and reclaimed tailings, and the readings are consistent with historical variation and limits.

2.0 TAILINGS CONTAINMENT AREA DAMS

The tailings produced are primarily comprised of amphibole and quartz, which account for 80% of the volume. Pyrrhotite and arsenopyrite make up an additional 17%. The tailings have been shown through various studies to have a potential for acid generation (Kinross 2005). All of the tailings are contained within the TCA.

The Lupin Mine TCA consists of eight (8) perimeter dams and nine (9) internal dams. The perimeter dams are Dam 1A, 1B, 1C, and Dams 2 through 6. The internal dams are Dam 3a through 3e, Dams J through N, and the Divider Dykes. Combinations of the perimeter dams and internal dams form Tailings Cell 1 through 5 for containment. As the progressive reclamation is being completed, some of the internal dams (3a, 3b, 3c, 3e) are incorporated into the cover and are no longer considered as individual dams. Currently, Cells 1 and 2 are completely reclaimed, while Cell 3 is approximately 80% covered and Cell 5 is approximately 70% covered. About 84% of the entire tailings area is reclaimed with at least 1m of sand/gravel cover. No new tailings have been produced since 2005 when the site went into care and maintenance status.

All dams are constructed from esker sands and gravels, with the perimeter dams incorporating a geosynthetic liner for seepage control. All the perimeter dams are designed as frozen core dams founded on permafrost. Generally, the perimeter dams ranged in height from 1 to 8 metres. The internal dam heights range from 6 to 12 metres.

The care and maintenance procedures for water management, direct runoff and seepage from Cell 3 into Cell 4. The water in Cell 4 then flows through the Divider Dykes either though the control structure or seepage into Pond 1. Cell 5 runoff is pumped directly into Pond 1. The pond 1 water level is managed by siphoning water into Pond 2. Water treatment is carried out by treating the water in-situ in Pond 2, by adding lime to raise the pH. Precipitates from this treatment are deposited in Pond 2. The treated water in Pond 2 is siphoned into the environment in accordance with the Water License requirements (NWB 2015). Pond 2 does not have any flood overflow structures, such as a spillway or a control gate, to manage the water level. All water is retained, and discharge is restricted until water quality meets the discharge requirement outlined in the Water License (NWB 2015).

2.1 DAM CONSEQUENCE CLASSIFICATIONS

Stantec utilized the Canadian Dam Association Guidelines (CDA 2014) to classify the consequence classification of each dam. The CDA consequence classifications are shown in

Table 2.1.

The dam consequence classifications of the dams based on Norwest's 2017 inspection are outlined in

Table 2.2. These consequence classifications are in line with the classifications outlined in the 2015 Dam Safety Review (SRK 2015).

An emergency preparedness plan (EPP) is noted by the DSR (SRK 2015) to be in place and deemed appropriate for care and maintenance status. Stantec did not review the EPP. Due to the lack of transportable tailings, permanent population, or infrastructure downstream of the perimeter dams, a detailed inundation study is deemed non-applicable.

Table 2.1: CDA Dam Consequence Classifications

Dam Class	Population at Risk[1]	Incremental Losses		
		Loss of Life[2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	• Minimal short-term loss; • No long-term loss	Low economic losses Area contains limited infrastructure or services
Significant	Temporary only	Unspecified	• No significant loss or deterioration of fish or wildlife habitat • Loss of marginal habitat only • Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	• Significant loss or deterioration of important fish or wildlife habitat • Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or fewer	• Significant loss or deterioration of critical fish or wildlife habitat • Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services (e.g. highway, industrial facility, storage facilities for dangerous substances)
Extreme	Permanent	More than 100	• Major loss of critical fish or wildlife habitat • Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services (e.g. hospital, major industrial complex, major storage facilities for dangerous substances)

Note 1. Definition for population at risk:
None - There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure. Temporary - People are only temporary in the dam-breach inundation zone (e.g. seasonal cottage use, passing through on transportation routes, participating in recreational activities). Permanent - The population at risk is ordinarily located in the dam-breach inundation zone (e.g. as permanent resident); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimate of potential loss life (to assist in decision-making if the appropriate analysis is carried out).
Note 2. Implication for loss of life:
Unspecified - The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

Table 2.2: Lupin TCA Dam Consequence Classifications

Dam		Consequence Classification	Rationale
Perimeter Dams	1A	Significant	Release of water that might not meet discharge criteria into the environment
	1B	Significant	Release of water that might not meet discharge criteria into the environment
	1C	Significant	Release of water that might not meet discharge criteria into the environment
	2	Significant	Release of water that might not meet discharge criteria into the environment
	3	Low	No free-standing water; Stable reclaimed tailings with very limited impact consequence upon failure
	4	Significant	Release of water that might not meet discharge criteria into the environment
	5	Low	No free-standing water; Stable reclaimed tailings with very limited impact consequence upon failure
	6	Low	No free-standing water; Stable reclaimed tailings with very limited impact consequence upon failure
Internal Dams	3D	Low	Any release of effluent or tailings are contained within the TCA
	J	Low	Any release of effluent or tailings are contained within the TCA
	K	Low	Any release of effluent or tailings are contained within the TCA
	L	Low	Any release of effluent or tailings are contained within the TCA
	M	Low	Any release of effluent or tailings are contained within the TCA
	N	Low	Any release of effluent or tailings are contained within the TCA
	Divider Dykes	Low	Any release of effluent or tailings are contained within the TCA

3.0 2018 TCA INSPECTION

3.1 GENERAL

Mr. Alvin Tong, PEng., a Senior Geotechnical Engineer with Stantec, conducted the geotechnical inspection on the 13th and 14th of September 2018. Detailed visual inspection was completed on all TCA components, along with readings of instrumentation. Mr. Dave Vokey, representative of LMI, was on site for communication and organization, but did not accompany Stantec on the inspection.

The weather during inspection was below freezing and overcast with periods of flurries. Detailed inspection and photograph logs are provided in Appendix A.

The general observations indicated that the perimeter dams are in stable condition. The divider dykes and Dam K should be considered for maintenance and repairs and Stantec communicated this to Mr. Vokey on site. The pond 2 water level was significantly lower than last year's level due to water treatment, with a freeboard upwards of 3.5m at the perimeter dams.

Since the inspection in September, LMI continued to lower the water level in Pond 2 until late September, due to discharge from water treatment, thus the freeboard should have now increased slightly.

3.2 INSTRUMENTATION

3.2.1 Thermistors

Thermistors were installed in the TCA between 1995 and 2004 to monitor the performance of the dams and tailings covers. From the existing records, there were thirteen thermistors installed in the dams, but only seven of them are currently functional. Of the seven functioning thermistors, five are in the perimeter dams and two are in the internal dams. There are an additional seven thermistors installed in the reclaimed tailings cover, but three of them do not have calibration data on record to evaluate the results. This report focuses on the thermistor readings from dams, using the thermistor readings from the cover for reference and comparison.

The thermistors were read monthly during operation up until 2006, and then read semi-annually during care and maintenance. Not all the functioning thermistors were read consistently throughout the care and maintenance period. To provide a point of reference in this report, selected data series between August and September, from year 2010 to 2018, are shown for comparison, while maximum values are calculated from the entire series from the first available records to 2018.

For the perimeter dams, the five functioning thermistors are less than 20m deep. The five thermistor readings are shown in the figures below. The data suggests the 2018 readings are within the historical variations, taking into account annual climatic variations and time of reading. Generally, the active layer (thaw zone) ranges from 2m to 3m depth, as interpolated by the 0°C gradient line. The largest historical variation in the given data set is approximately 2.2°C (between -2.5°C and -4.7°C) in Dam 2 (D2-00-02n) at the depth of 6m.

Figure 3-1: Thermistor Reading for Dam 1A

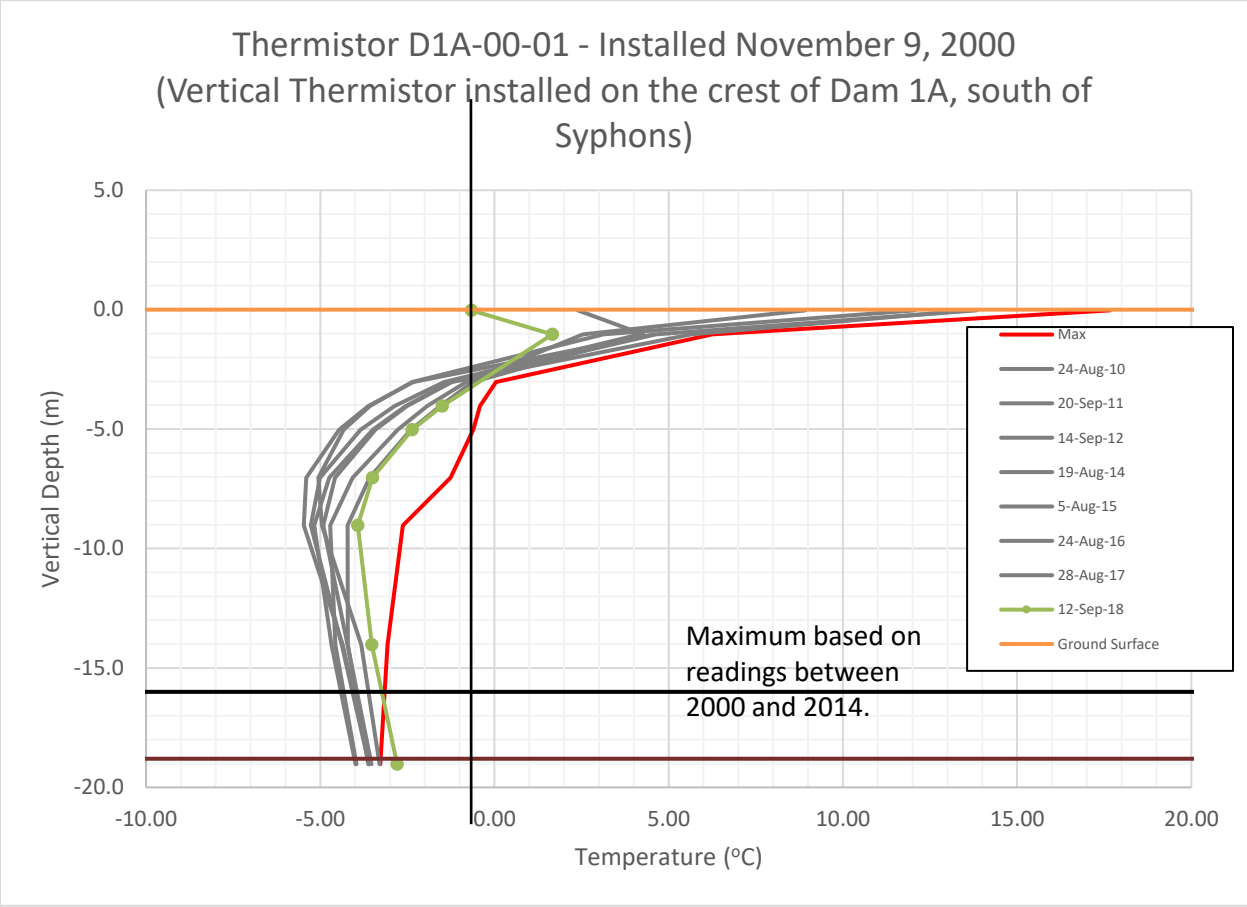


Figure 3-2: Thermistor Reading for Dam 2

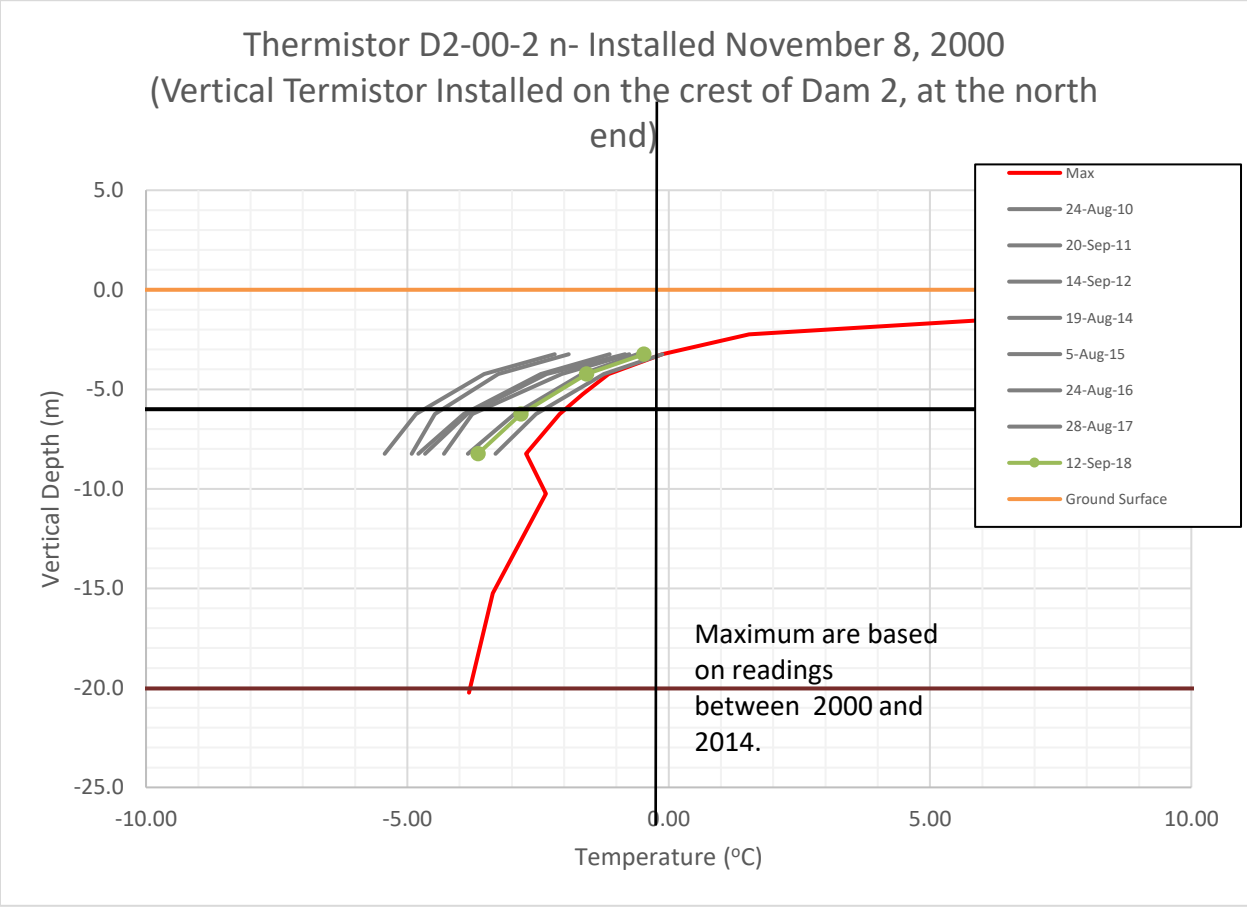


Figure 3-3: Thermistor Reading for Dam 4-1

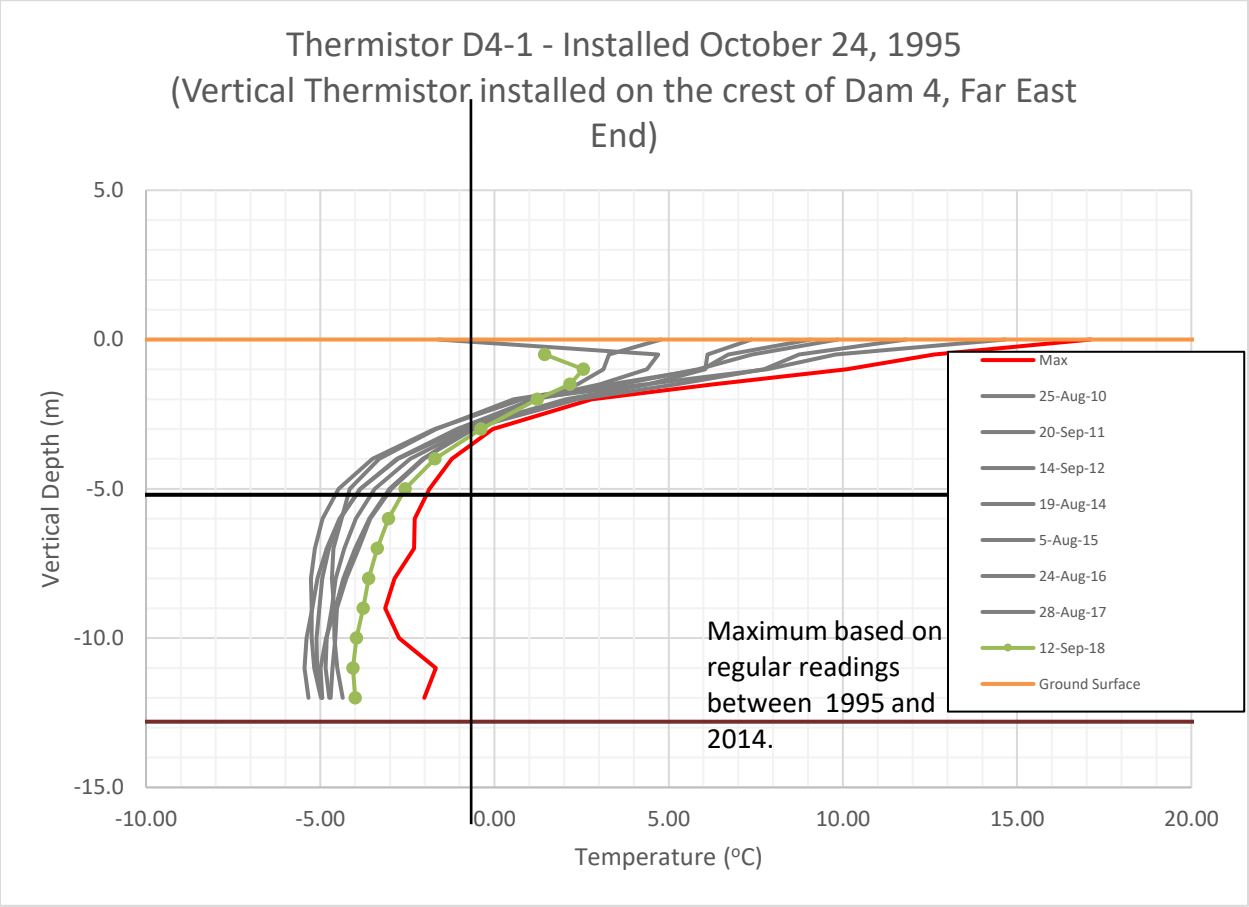


Figure 3-4: Thermistor Reading for Dam 4-3

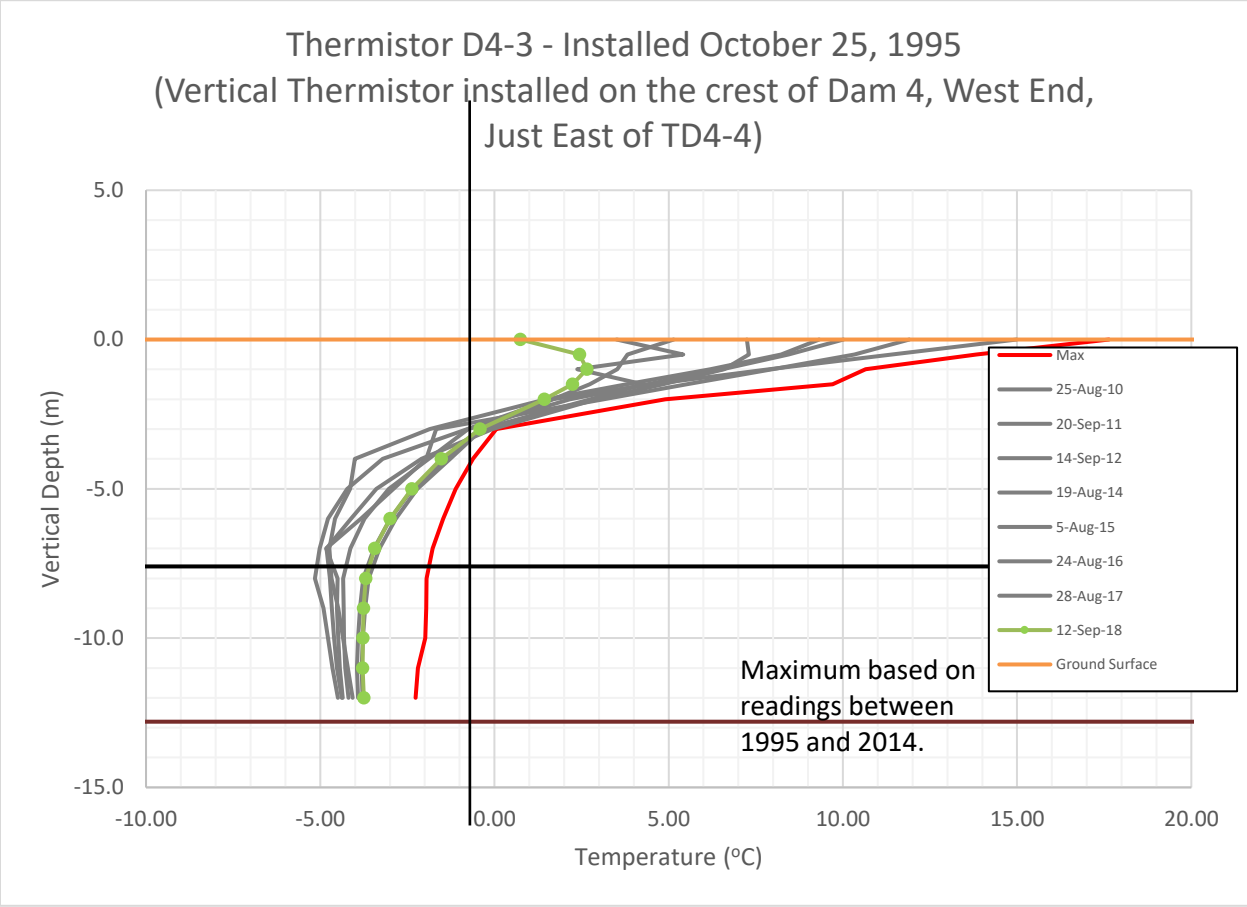
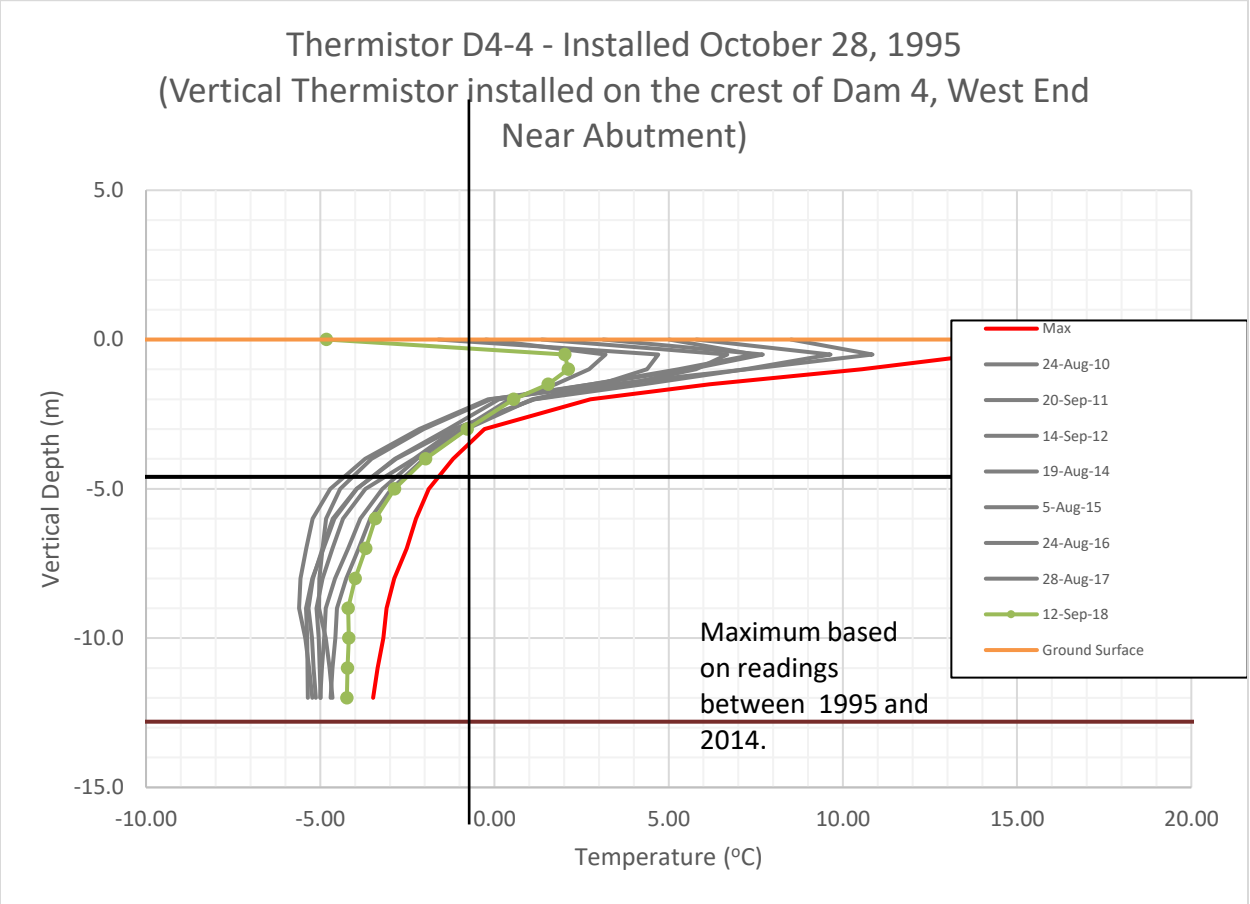


Figure 3-5: Thermistor Reading for Dam 4-4



For the internal dams, the two functional thermistors are also less than 20m deep. These were not monitored as rigorously as the ones installed in the perimeter dams, and only have recent data between 2014 and 2017. The two thermistor readings are shown in the figures below. The active layer is observed to be between 2m to 3m, as interpolated by the 0°C gradient line. The variations between the data set are less than 2°C and generally occur below the historical maximum.

Figure 3-6: Thermistor Reading for Dam 3D

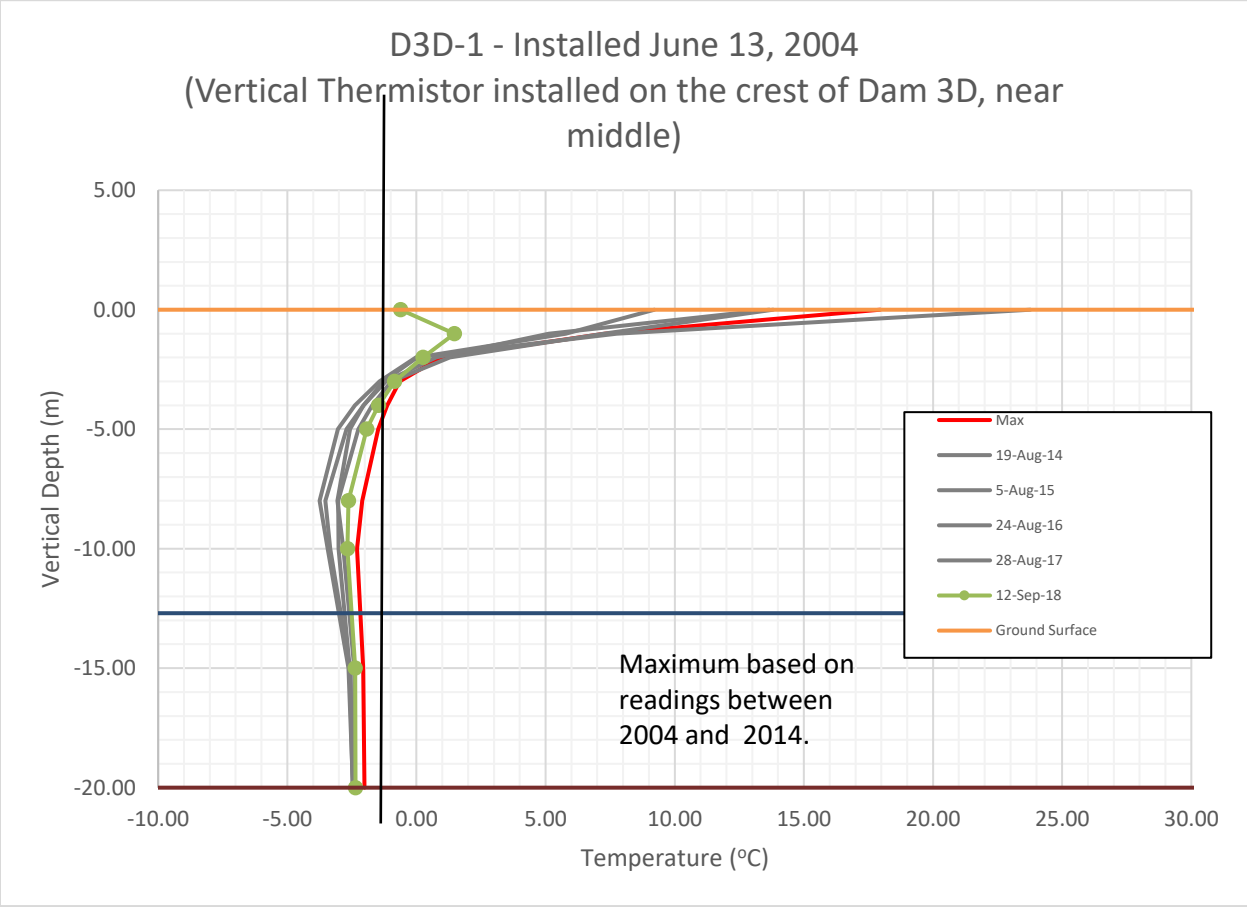
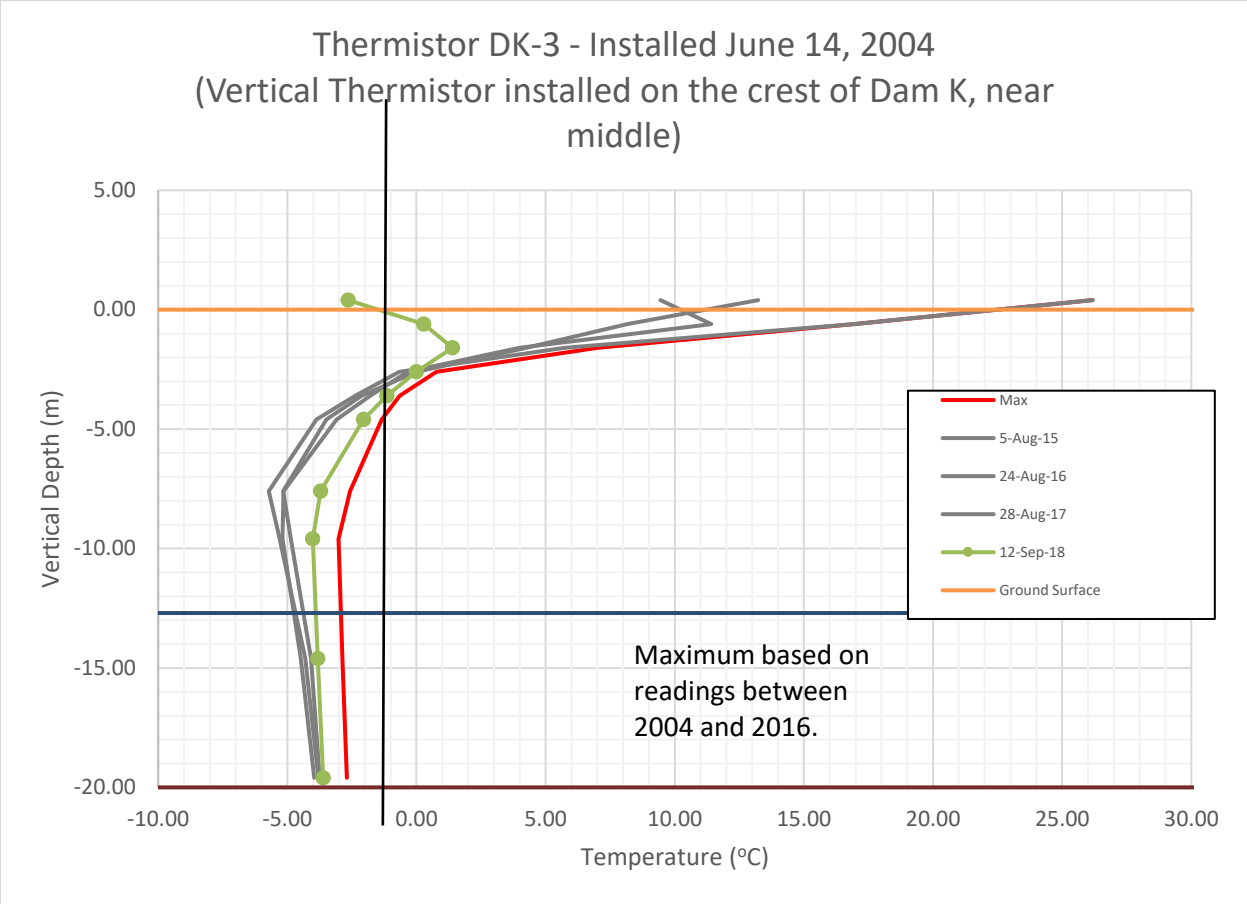


Figure 3-7: Thermistor Reading for Dam K



Readings from the four thermistors in the tailings cover are not presented in this report. The results are comparable to the readings from the dams. All the observed larger temperature variations remained below 0°C and well below the active layer. The observed active layer depths remain consistent with the site recorded data and information provided by national research (Penner 1983). The thermistor readings indicate that the frozen cores within the monitored dams are frozen below the active layer and are performing well.

3.2.2 Moisture Sensors

To provide insight into the performance of the cover, volumetric moisture sensors were installed in the Cell 2 and Cell 3 covers in 2018. The intent of the sensor readings is to define the degree of saturation throughout the year at the depths near the cover and tailings contact. The sensors are TEROS-12 VWC sensors that measure volumetric water content, temperature and electric conductivity. The sensor readings are set to read once every 12 hours and the readings are recorded by dataloggers. Cell 2 and 3 each have one string of five sensors in installed within the cover (C2VWC and C3VWC). The sensors are spaced 0.2m apart and installed between 1m to 1.5m below the cover surface. The initial sets of readings will be available in the new year.

3.3 TCA PERIMETER DAMS

The perimeter dams (Dam 1A through Dam 6) were observed to be in stable condition, although some erosion was observed on the dam slopes from either surface runoff or wave action below the high water mark (HWM). While most of the surface erosion was observed to be minor, repair work should be considered on the downstream face of Dam 1A and some areas along Dam 4. The rest of the dams should be monitored and repaired as needed, to prevent the erosion from becoming worse and creating preferential surface flow paths.

Previous annual inspections noted seepage from the northern toe buttress of Dam 2 into the seepage collection pond adjacent to Dam 2 Lake. This seepage was not observed during this inspection due to winter conditions, but a small amount of open water was present in the seepage collection pond. It is assumed that a small, undetermined amount of leakage is continuing.

The observed freeboard at the perimeter dams was more than 3.5m. This well exceeds the minimum requirement of 1m freeboard as stated in the water license. Dam 1B, 1C, Dam 5 and Dam 6 do not have water on the upstream face of the dams.

3.4 INTERNAL DAMS

All of the internal dams have some erosion on their downstream slopes, associated with either surface runoff or wave action at the HWM. Dam 3D also has some crest erosion from the surface runoff. Dam J and Dam L both have wave action erosion at the HWM that has reduced their crest widths. Maintenance should be considered to repair the erosion on the slopes of Dam 3D, Dam J and Dam L.

Dam K has experienced considerable undercutting at the toe from Pond 2 wave action. There are five large erosion gullies at the downstream crest from overland flow over the cover. These gullies are sufficiently wide and deep that the permafrost within the structure could be compromised. This area should be prioritized for repairs in the next construction season.

Dam M was repaired with a reinforcement buttress and crest surface backfill in 2016 (Norwest 2016). The toe of the buttress has experienced some wave erosion at the HWM. The water level has been lowered following water treatment and discharge and the buttress toe are now currently protected by the original riprap armor as per original construction. Repair should be considered for the toe erosion when practicable.

Dam N was observed to be in stable condition, but with only 0.5m freeboard between it and Pond 2. This was communicated with LMI site personnel, and the need to increase the freeboard to 1m to meet water license requirement was highlighted. It was agreed that the water behind Dam N would be lowered after water treatment operations when practicable. Dam N and its contents were submerged in previous years and this did not appear to have had any adverse impact on its geotechnical stability. The reduced freeboard does not create any geotechnical and environmental concerns as Dam N and its contents are contained within Pond 2.

The northern section of the divider dykes at the east end of Cell 4 is in poor condition, while the southern section has been repaired. Signs of erosion, cracks, and sloughing were noted on the upstream and downstream sides of both dykes. Deformations have created an uneven crest and reduced its width to approximately 2m in some areas. The

south divider dyke has experienced sufficient sloughing to create a low spot with a freeboard of around 1m. The slopes of the dykes vary between 2H:1V to 1H:1V in some areas that is caused by undercutting and sloughing.

4.0 RECOMMENDATIONS

Table 4.1 summarizes the observations and recommendations from the 2018 inspection, together with the findings from the 2017 inspection for comparison.

Table 4.1: Inspection Observation and Recommendations

Inspection Item	2018 Inspection			2017 Inspection	
	Estimated Freeboard (m)	Observation	Recommendations	Observations	Recommendations
Perimeter Dams					
Dam 1A	3.6	Minor erosion on slopes with some deep erosion gullies	Repair deep erosion gullies.	Minor erosion on slopes with some deep erosion gullies	Repair deep erosion gullies.
Dam 1B	N/A(1)	Pond 2 water wa approximately 50m upstream from the dam.	Surface maintenance, e.g. grading and backfilling.	Minor erosion in the slopes.	Surface maintenance, e.g. grading and backfilling.
Dam 1C	N/A(1)	Pond 2 water was approximately 100m upstream from the dam.	Surface maintenance e.g. grading and backfilling.	Minor erosion in the slopes.	Surface maintenance e.g. grading and backfilling.
Dam 2	3.2	Minor erosion in the slopes. Seepage was not observed due to weather conditions. The seepage is assumed to be ongoing as a small amount of open water was found in the seepage collection pond.	Surface maintenance e.g. grading and backfilling. Monitor the seepage and pump back into Pond 2 as necessary.	Minor erosion in the slopes. Seepage at northern abutment estimated at 1L/min. Seepage was collected and pumped back into Pond 2.	Surface maintenance e.g. grading and backfilling. Monitor the seepage and pump back into Pond 2 as necessary.
Dam 3	No water is impounded by this dam	Minor erosion in the downstream slope.	Surface maintenance e.g. grading and backfilling.	Minor erosion in the downstream slope.	Surface maintenance e.g. grading and backfilling.
Dam 4	3.6	Minor erosion in the slopes and wave erosion at HWM. Geogrid was not observed due to	Surface and toe maintenance e.g. grading and backfilling.	Minor erosion in the slopes. Historical exposed geogrid at the east abutment in	Surface maintenance e.g. grading and backfilling. Monitor the exposed geogrid

Inspection Item	2018 Inspection			2017 Inspection	
	Estimated Freeboard (m)	Observation	Recommendations	Observations	Recommendations
		snow cover on the ground.		similar condition as observed previously.	for changes and deformations.
Dam 5	N/A(1)	Pond 2 water is approximately 50m upstream from the dam. Minor erosion on surface.	Surface maintenance e.g. grading and backfilling.	Minor erosion in the slopes.	Surface maintenance e.g. grading and backfilling.
Dam 6	N/A(1)	Ponding in a natural low at the south abutment. Erosion gullies in the downstream slope.	Surface maintenance e.g. grading and backfilling. Monitor the ponded water level in the south abutment.	Ponding in a natural low at the south abutment. Erosion gullies in the downstream slope.	Surface maintenance e.g. grading and backfilling. Monitor the ponded water level in the south abutment.
Internal Dams					
Dam 3D	No water is impounded by this dam	Minor erosion in the slopes.	Surface and slope maintenance e.g. grading and backfilling.	Minor erosion in the slopes.	Surface and slope maintenance e.g. grading and backfilling.
Dam J	1.1(2)	Over steepened slope due to erosion and reduced crest width in some sections.	Repair the eroded slope and crest with compacted sand and gravel.	Erosion gullies on slopes. Over steepened slope due to erosion and reduced crest width in some sections.	Repair the eroded slope and crest with compacted sand and gravel.
Dam K	N/A(1)	Erosion at HWM and five large erosion gullies in the downstream crest. Near vertical slope at the eroded toe.	Prioritize the repair the eroded gullies at the crest and toe, and armor the slope up to the HWM with boulders to limit further erosion. Repair should be done while the Pond 2 water level is lowered for access.	Erosion at HWM and erosion gullies in the downstream crest. Near vertical slope at the eroded toe.	Repair the eroded gullies at the crest and toe, and armor the slope up to the HWM with boulders to limit further erosion. Monitor the crest for cracks and sloughing until repairs are completed. Repair should be done while the Pond 2 water level is lower for access.
Dam L	1.5(2)	Erosion in the crest and slopes.	Repair the eroded upstream slope, crest and armor the downstream toe for protection.	Erosion in the crest and slopes.	Repair the eroded slope and armor the toe for protection. Monitor the water level in Cell 3 and manage as necessary.

Inspection Item	2018 Inspection			2017 Inspection	
	Estimated Freeboard (m)	Observation	Recommendations	Observations	Recommendations
Dam M	2.5	Minor erosion at the downstream toe above the riprap protection	Repair the eroded toe areas.	Tension cracks have been excavated and backfilled, and over steepened slopes have been buttressed and armored at the toe.	Monitor the repair for erosion and settlements.
Dam N	0.5(2)	Minor wave action erosion at HWM.	Monitor the water level behind Dam N and lower the water when practicable to yield minimum 1m freeboard.	Minor wave action erosion at HWM.	Monitor the water level behind Dam N and manage it as necessary to yield minimum 1m freeboard.
Divider Dykes	0.4(2)	Erosion, sloughing and cracks along upstream and downstream of the northern portion of the dyke. Uneven crest level and reduced crest width.	Second priority to complete the repair to the northern section	Erosion, sloughing and cracks along upstream and downstream of the northern portion of the dyke. Uneven crest level and reduced crest width.	Repair has been done to the southern section of the dyke. Complete similar repair to the northern section

Notes: 1. Water is not adjacent to the dam to determine available freeboard.

2. Freeboard at the lowest point of the dam and below the minimum requirement stated in the Water License (NWB 2015).

4.1 MITIGATION FOR DAM K TOE AND CREST EROSION

The Dam K toe has significant erosion below the HWM from the wave action in Pond 2. The erosion has undercut the toe of the dam and created near vertical slopes in several areas. The downstream crest has five significant erosion gullies cause by surface overflow from the cover. These gullies are sufficiently wide and deep that the slopes of the dam and permafrost condition within the structure could be compromised. Initial maintenance and repair should be completed to replace the eroded material at the toe with compacted sand and gravel armored with boulders/riprap for wave protection. Once the repair at the toe is complete, loose crest material should be removed and additional compacted fill should be place in lifts to repair the erosion gullies. All the proposed work should be endorsed by the Engineer-of-Record prior to commencement.

The water level in Pond 2 was lowered in 2017 following water treatment and discharge. LMI should consider the timing and planning of the repair work in 2019 when the Pond 2 water level is still below the eroded zone at the toe.

4.2 MAINTENANCE AND REPAIRS PRIORITIES

Of the repairs and maintenance recommended in Table 3, the following repairs should be prioritized:

1. Repair the erosion gullies and toe at Dam K. Repair the eroded toe at Dam K with compacted sand and gravel to restore the original design configuration and armor the repaired toe with boulders/riprap for wave protection. Once that is completed, remove any loose crest material and repair the crest with compacted sand and gravel.

2. Repair the northern section of the Divider Dykes with compacted sand and gravel to restore the original design configuration, including side slopes, a leveled crest and armoring up to the HWM, as directed by the Engineer-of-Record.

3. Monitor the water level behind Dam N and lower the water level to maintain a minimum 1m freeboard.

After the completion of the priority repairs, LMI should consider carrying out the following repairs:

- Monitor the seepage at Dam 2 and manage it as necessary by pumping the seepage back into Pond 2.
- LMI is currently monitoring and managing the water in Cell 5 as part of the cover construction work. This monitoring and water management should continue to prevent damage to newly repaired Dam M.
- General repairs on surface and slope erosion at the HWM.

All observations and records from monitoring should be included in the annual inspection report and should be sent to Stantec and the Engineer-of-Record for review.

5.0 REFERENCES

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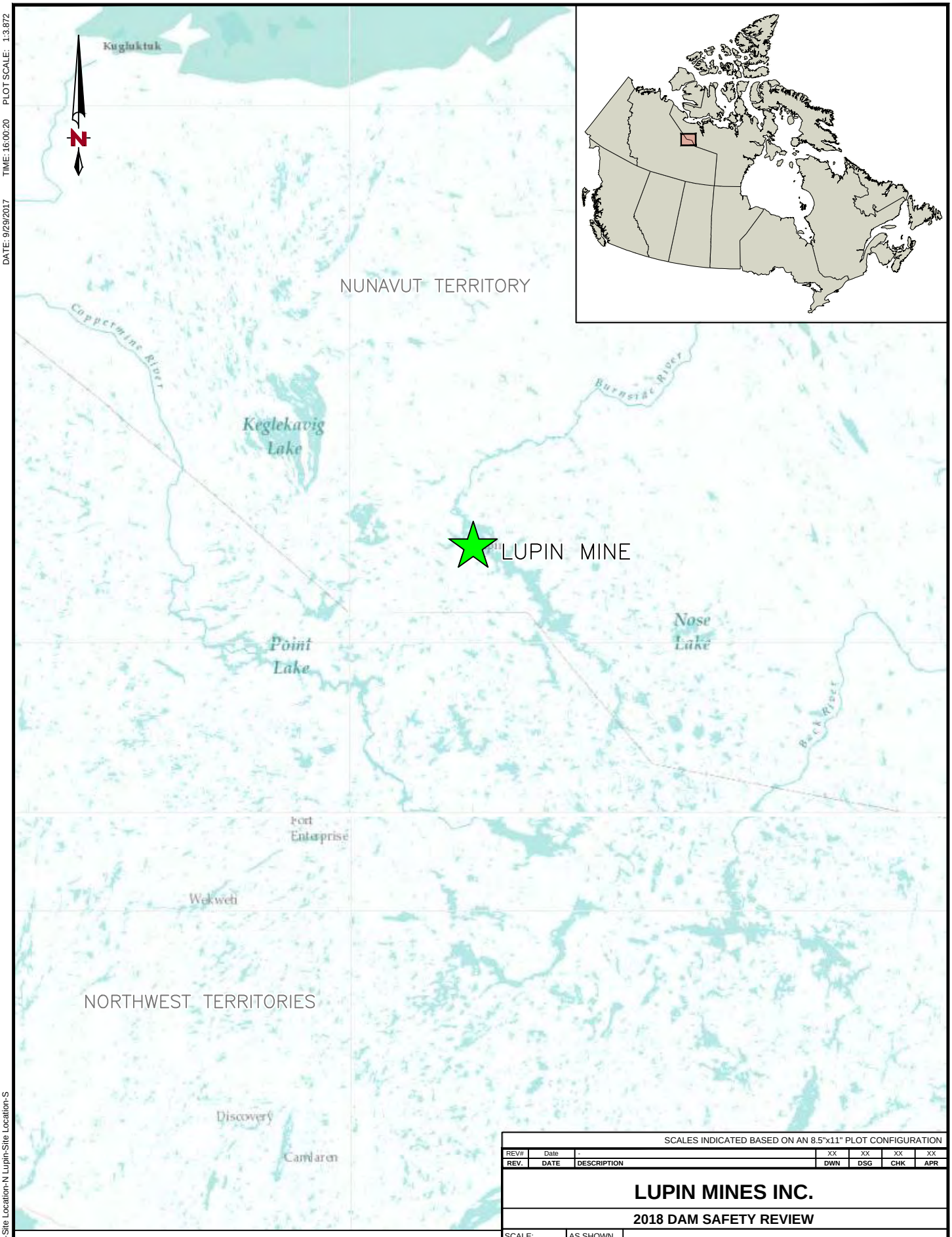

SCALES INDICATED BASED ON AN 8.5"x11" PLOT CONFIGURATION

REV#	Date	-	XX	XX	XX	XX
REV.	DATE	DESCRIPTION	DWN	DSG	CHK	APR

LUPIN MINES INC.

2018 DAM SAFETY REVIEW

SCALE:	AS SHOWN
DATE:	2016-10-20
CO-ORD. SYS.:	UTM-NAD83-12
DRW'N BY:	KM
DSG'N BY:	--
REV'D BY:	AT
APP'D BY:	SE

SITE LOCATION

Stantec

PROJECT NO.:	FIG. NO.:	REV.:
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DATE: 9/29/2017 TIME: 16:00:20 PLOT SCALE: 1:3,872

FILENAME: Z:\924-2_DSI\DISC\DRAFTING\01.SITE LOCATION.DWG
XREF FILE(S):
IMAGE FILE(S): Lupin-Site Location-N Lupin-Site Location-S

1000m 500 0 1000 2000 3000m

SCALE 1:50,000

SCALES INDICATED BASED ON AN 8.5"x11" PLOT CONFIGURATION

REV#	Date	-	XX	XX	XX	XX
REV.	DATE	DESCRIPTION	DWN	DSG	CHK	APR

LUPIN MINES INC.

2018 DAM SAFETY REVIEW

SCALE:	AS SHOWN
DATE:	2016-10-20
CO-ORD. SYS.:	UTM-NAD83-12
DRW'N BY:	KM
DSG'N BY:	--
REV'D BY:	AT
APP'D BY:	SE

SITE OVERVIEW

Stantec

PROJECT NO.:	FIG. NO.:	REV.:
129500082	2	A

PLOT SCALE: 1:3,872
TIME: 16:03:34
DATE: 9/29/2017

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IMAGE FILE(S): Lupin-NE Lupin-NW Lupin-SW lupin_mine_wv2_2012aug21_north lupin_mine_wv2_2012aug21_south

100m 0 100 200 400m

SCALE 1:6000

SCALES INDICATED BASED ON AN 8.5"x11" PLOT CONFIGURATION

REV#	Date	-	XX	XX	XX	XX
REV.	DATE	DESCRIPTION	DWN	DSG	CHK	APR

LUPIN MINES INC.

2018 DAM SAFETY REVIEW

SCALE:	AS SHOWN
DATE:	2016-10-20
CO-ORD. SYS.:	UTM-NAD83-12
DRW'N BY:	KM
DSG'N BY:	--
REV'D BY:	AT
APP'D BY:	SE

MILL SITE AND SUPPORT FACILITY PLAN

Stantec

PROJECT NO.:	FIG. NO.:	REV.:
129500082	3	A

PLOT SCALE: 1:3,872
TIME: 16:06:18
DATE: 9/29/2017

FILENAME: Z:\924-2_DS\IDIS\DRAFTING\03.MILL SITE AND SUPPORT FACILITY.DWG
XREF FILE(S):
IMAGE FILE(S): lupin mine ww2 2012aug21 north

LEGEND

THERMISTORS STATUS

- ACTIVELY MONITORED
- DAMAGED
- MONITORED DURING DSR-NO CALIBRATION DATA
- UNLOCATED-LOCATION ESTIMATED FROM HISTORICAL MAP
- VOLUMETRIC WATER CONTENT SENSOR STRINGS

500m 0 500 1000m

SCALE 1:20,000

SCALES INDICATED BASED ON AN 8.5"x11" PLOT CONFIGURATION

REV#	Date	-	XX	XX	XX	XX
REV.	DATE	DESCRIPTION	DWN	DSG	CHK	APR

LUPIN MINES INC.

2018 DAM SAFETY REVIEW

SCALE:	AS SHOWN
DATE:	2016-10-20
CO-ORD. SYS.:	UTM-NAD83-12
DRW'N BY:	KM
DSG'N BY:	--
REV'D BY:	AT
APP'D BY:	SE

TAILINGS CONTAINMENT AREA

Stantec

PROJECT NO.:	FIG. NO.:	REV.:
129500083	4	A

FILENAME: V:\1295\ACTIVE\129500082\DISC\DRAFTING\04.TAILINGS CONTAINMENT AREA.DWG
XREF FILE(S):
IMAGE FILE(S): lupin_mine_ww2_2012aug21_north lupin_mine_ww2_2012aug21_south
DATE: 11/16/2018 TIME: 16:31:12 PLOT SCALE: 1:3,872

Appendix A Photographic Log

Photo 1: Looking northwest at the downstream slope of Dam 1A

Photo 2: Looking northwest at the crest of Dam 1A

Photo 3: Looking northwest at the upstream slope of Dam 1A

Photo 4: Looking south at the upstream slope of Dam 1B.

Photo 5: Looking south at the downstream slope of Dam 1B.

Photo 6: Looking east at the edge of Pond 2 to the upstream slope of Dam 1B.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 1A and 1B			
Stantec	PN: 129500082	FIGURE 1	REV. A

Photo 7: Looking south at the crest of Dam 1C

Photo 8: Looking south at the upstream slope of Dam 1C.

Photo 9: Looking east at the edge of Pond 2 from the upstream slope of Dam 1C.

Photo 10: Looking southwest at the upstream slope of Dam 2.

Photo 11: Looking southwest at the downstream slope of Dam 1 with the seepage collection pond.

Photo 12: The small amount of open water at the seepage collection pond.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 1C and 2			
Stantec	PN: 129500082	FIGURE 2	REV. A

Photo 13: Looking northwest at the surface ditch along Dam 3.

Photo 14: Looking northwest at the crest of Dam 3.

Photo 15: Looking northeast at the surface ditch spillway on Dam 3.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 3			
Stantec	PN: 129500082	FIGURE 3	REV. A

Photo 16: Looking east from the west abutment at the upstream slope of Dam 4

Photo 17: Looking east from the west abutment at the downstream slope of Dam 4

Photo 18: Looking east at the upstream slope of Dam 4.

Photo 19: Looking south at an erosion gully near the east abutment of Dam 4.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 4			
Stantec	PN: 129500082	FIGURE 4	REV. A

Photo 20: Looking south at the crest of Dam 5

Photo 21: Looking south at the downstream slope of Dam 5.

Photo 22: Looking southwest at one of the erosion gullies at the downstream crest of Dam 5.

Photo 23: Looking east at the crest of Dam 6

Photo 24: Looking east at the downstream slope of Dam 6.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 5 and 6			
Stantec	PN: 129500082	FIGURE 5	REV. A

Photo 25: Looking south at the upstream crest of Dam J, adjacent to Pond 1.

Photo 26: Looking south at the downstream crest of Dam J adjacent to Pond 2.

Photo 27: Looking south at the eroded downstream slope of Dam J.

Photo 28: Looking southeast from the west abutment at the downstream slope of Dam 3D.

Photo 29: Looking southeast from the west abutment at the downstream crest of Dam 3D.

Photo 30: Looking northwest from the east abutment at the downstream crest of Dam 3D.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam 3D and J			
Stantec	PN: 129500082	FIGURE 6	REV. A

Photo 31: Looking southwest from the east abutment of the eroded toe at Dam K

Photo 31: Looking northwest at one of the five erosion gullies along the upstream crest of Dam K

Photo 32: Looking northwest, down toward the toe at one of the five erosion gullies along the upstream crest of Dam K

Photo 33: Looking northwest at another one of the five erosion gullies along the upstream crest of Dam K

Photo 34: Looking southwest from near the east abutment along the downstream crest of Dam K at the erosion gullies.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam K			
Stantec	PN: 129500082	FIGURE 7	REV. A

Photo 35: Looking north at the Dam L crest from the south abutment.

Photo 36: Looking north at the downstream slope of Dam L from the south abutment.

Photo 37: Looking south at the Dam L downstream slope.

Photo 38: A string of 5 sensors mount on post, spaced 20cm apart waiting in preparation for installation.

Photo 39: Close up of one of the sensors with the probe exposed.

Photo 40: Installation of the sensor string at the tailings and cover contact, 1m below cover surface.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam L and VWC Installation			
Stantec	PN: 129500082	FIGURE 8	REV. A

Photo 41: Looking northwest at the reinforcement buttress at Dam M.

Photo 42: Looking southeast at the reinforcement buttress of Dam M.

Photo 43: Looking southwest at the riprap armor at the toe of reinforcement buttress.

Photo 44: Looking north at the upstream crest of Dam M with the ongoing cover construction in the background.

Photo 45: Looking north at the downstream slope of Dam N with Pond 2.

Photo 46: Looking north at the crest of Dam N and ponding water with less than 1m freeboard.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Dam M and N			
Stantec	PN: 129500082	FIGURE 9	REV. A

Photo 47: Looking north at the repaired upstream slope and crest of the southern divider dyke.

Photo 48: Looking north at the culvert intake at the divider dyke.

Photo 49: Looking west at the culvert discharge at the divider dyke.

Photo 50: Looking north at the eroded crest slopes and sloughed crest of northern divider dyke.

LMI	**Lupin Mine Incorporated**		
	2018 Dam Safety Inspection		
Site Inspection Photograph Log for Divider Dykes			
Stantec	PN: 129500082	FIGURE 10	REV. A

Lupin Mines Incorporated

December 10, 2018

Manager of Licensing
Nunavut Water Board P.O. Box 119
Gjoa Haven, NU X0B 1J0

To whom it may concern,

RE: 2018 Annual Geotechnical Inspection – Lupin Mine Tailings Containment Area, Nunavut
Lupin Mine, Nunavut, License Number 2AM-LUP1520

Please accept this cover letter with plan and timelines to implement the engineer's recommendations. The 2018 Lupin Geotechnical Inspection Report (the "Report"), completed by Stantec, to fulfil part E, item 6 (i) of our water licence was submitted to the Nunavut Water Board. Stantec makes the following general recommendations:

Of the repairs and maintenance recommended in Table 3 of the Report, the following repairs should be prioritized:

1. Repair the erosion gullies and toe at Dam K. Repair the eroded toe at Dam K with compacted sand and gravel to restore the original design configuration and armor the repaired toe with boulders/riprap for wave protection. Once that is completed, remove any loose crest material and repair the crest with compacted sand and gravel.
2. Repair the northern section of the Divider Dykes with compacted sand and gravel to restore the original design configuration, including side slopes, a leveled crest and armoring up to the HWM, as directed by the Engineer-of-Record.
3. Monitor the water level behind Dam N and lower the water level to maintain a minimum 1m freeboard.

After the completion of the priority repairs, LMI should consider carrying out the following repairs:

- Monitor the seepage at Dam 2 and manage it as necessary by pumping the seepage back into Pond 2.
- LMI is currently monitoring and managing the water in Cell 5 as part of the cover construction work. This monitoring and water management should continue to prevent damage to newly repaired Dam M.
- General repairs on surface and slope erosion at the HWM.

All observations and records from monitoring should be included in the annual inspection report and should be sent to Stantec and the Engineer-of-Record for review.

Lupin Mines Incorporated

LMI will carry out the following work and/or inspections during the 2019 season, where practical, to include the following:

- Repair the erosion gullies and toe at Dam K as per the Geotechnical engineer's recommendations.
- Repair the northern section of the Divider Dykes with compacted sand and gravel to restore the original design configuration, including side slopes, a leveled crest and armoring up to the HWM, as directed by the Engineer-of-Record.
- Monitor the water level behind Dam N and lower the water level to maintain a minimum 1m freeboard.
- Monitor the seepage at Dam 2 and manage it as necessary by pumping the seepage back into Pond 2.
- Continue monitoring and managing the water in Cell 5 as part of the cover construction work.
- General repairs on surface and slope erosion at the HWM.

If you have any questions regarding the above, please do not hesitate to contact me.

Sincerely,

Lupin Mines Incorporated

"Karyn Lewis"

Karyn Lewis