



**NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON  
THE LUNDBERG DEPOSIT, BUCHANS AREA,  
NEWFOUNDLAND AND LABRADOR, CANADA**

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Effective Date: February 28<sup>th</sup>, 2019

Report Date: April 15<sup>th</sup>, 2019

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## 1.0 SUMMARY

The purpose of this Technical Report (Report) is to provide scientific and technical information related to the Lundberg Project. It specifically covers the results of a new and updated pit-constrained Mineral Resource Estimate (effective date February 28, 2019) prepared by Mercator Geological Services Limited for Buchans Minerals Corporation's Lundberg base metal deposit, located at the former Lucky Strike mine site, adjacent to the town of Buchans, in Central Newfoundland, Newfoundland and Labrador, Canada. Buchans Minerals Corporation, as well as predecessor companies Buchans River Limited and Royal Roads Corp., is a wholly owned subsidiary of Buchans Resources Limited. These firms are collectively referred to as "Buchans" or "the Company" in this Report.

The Report was prepared by: Michael Cullen, P. Geo., Matthew Harrington, P. Geo. and Shaun O'Connor, P. Geo. of Mercator Geological Services Limited ("Mercator"), Timothy McKeen, P. Eng., of Stantec Consulting Ltd. (Stantec), and Douglas Roy, P. Eng., of MineTech International Limited (MineTech), each of whom is an independent "Qualified Persons" as defined under National Instrument 43-101 (NI 43-101), and Buchans employees Paul Moore, P. Geo., Vice President of Exploration and David Butler, P. Geo, Exploration Manager, who are non-independent "Qualified Persons" as defined under NI 43-101 and as allowed under Section 5.3(3) of the instrument NI 43-101.

### 1.1 Property Description and Location

The Lundberg Deposit is located within Mining Lease 222 (M.L. 222) that is centered at 510,000mE 5,407,900mN UTM NAD 83 Zone 21. The deposit and Mining Lease 222 that contains it are included within the Company's Buchans property that is comprised of 150 Mineral Claims, two Mining Leases and two Fee Simple Mining Grants. Referred to herein collectively as the "Buchans Property", these claims, leases and grants convey mineral exploration and/or mineral rights underlying approximately 5,485 hectares to Buchans.

### 1.2 History

The American Smelting and Refining Company (ASARCO) initiated mining operations at Buchans in 1928. Mining operations at Buchans continuously operated until mine reserves were depleted in 1984 (Neary, 1981). In total, the ASARCO reported to have produced 16,196,876 tonnes of ore from five major orebodies. The average grade of total production is reported to be 14.51% zinc, 7.65% lead, 1.33% copper, 126 g/t silver, and 1.37 g/t gold (Kirkham, 1987).

The property was managed by various operators from 1985 to 2007, mainly BP Resources Canada Inc. and the Buchans River Joint Venture, and exploration was primarily focused on regional geophysical and geochemical programs that supported minor follow-up drill programs (Neary, 1981 and Thurlow, 2010).

Buchans, collectively representing Buchans River Limited, Royal Roads Corporation, Buchans Mineral Corporation, Minco Plc., and Buchans Resources Limited, has been the operator of the project since 2007.

In 2008, Buchans completed a 53 hole surface diamond drilling program totaling 8,058 m that supported an Inferred Mineral Resource Estimate prepared by Mercator of 20.7 million tonnes averaging 1.68% Zn, 0.72% Pb, 0.38% Cu, 5.92 g/t Ag and 0.07 g/t Au at a 1% Zn cut-off (effective date of November 3, 2008) for the Lundberg and Engine House zones (Webster and Barr, 2008). This Mineral Resource Estimate is now historic in nature and should no longer be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

In 2011, a Preliminary Economic Assessment (PEA) of the Lundberg Deposit was completed by Wardrop Engineering Inc. (a Tetra Tech company) based on a regularized model of the 2008 Mineral Resource Estimate (Coley et al., 2011). The 2011 PEA identified the combined Lundberg and Engine House zones as having potential to support stand-alone 5,000 t per day open pit mining and milling operations, based upon 17.28 million tonnes of Inferred Mineral Resources with an average grade of 1.63% Zn, 0.69% Pb, 0.40% Cu, 5.96 g/t Ag, 0.07 g/t Au and 1.24% Ba, over a 10-year life of mine (LOM). The mining schedule showed that a total of 52.93 million tonnes of waste material would be moved over the 10-year LOM with an overall stripping ratio of 3.06 t/t (waste/resource). This PEA and the associated Mineral Resource Estimate are now historic in nature and should not be relied upon. Buchans is not considering them to be current. The Mineral Resource Estimate described in this Report supersedes all previous estimates.

In 2013, Buchans completed a 58 hole surface diamond drilling program totaling 8,183 m that supported an updated Indicated Mineral Resource prepared by Mercator of 23.44 million tonnes averaging 1.41% Zn, 0.60% Pb, 0.35% Cu, 5.31 g/t Ag and 0.07 g/t Au, as well as Inferred resources of 4.31 million tonnes grading 1.29% Zn, 0.54% Pb, 0.27% Cu, 4.47 g/t Ag and 0.08 g/t Au at a cut-off value of \$15 US/t Net Smelter Return (NSR) (Cullen and Hilchey, 2013). Definition of Mineral Resources was restricted to modelled grade solids that occur within 350 m of the surface elevation but an optimized pit shell was not applied. This Mineral Resource Estimate is also now

historic in nature and should not be relied upon. Buchans is not considering it to be current and the Mineral Resource Estimate described in this Report supersedes all previous estimates.

### 1.3 Geology, Mineralization and Deposit Type

The Lundberg Deposit as defined in this Report is comprised of two mineralized zones, these being the Lundberg zone and the Engine House zone, both of which are hosted by felsic to intermediate volcanic rocks of the Buchans Group and lie within the NE-SW trending Central Mobile Belt (CMB) of Central Newfoundland (Williams, 1979; Kean et al., 1981; Swinden, 1990, Williams 1995). The Buchans Group is a Lower Ordovician volcanic sequence that ranges in composition from basalt to rhyolite and shows relative increase in its felsic component with height in the stratigraphic section (Thurlow and Swanson, 1981). Five main Zn-Pb-Cu-Ag-Au deposits were historically mined at Buchans and all occur in association with the same felsic stratigraphic horizon within the Buchans Group (Thurlow and Swanson, 1981). The Lundberg Deposit surrounds the former Lucky Strike mine site, where ASARCO operated a near-surface underground and glory hole mining operation until mine closure in 1984. The Lundberg Deposit is mainly comprised of stockwork mineralization surrounding and lying below the Lucky Strike orebody but includes some massive sulphide mineralization that was not mined by former operations.

Stockwork mineralization at Buchans consists of a network of sulphide veins and veinlets that cut strongly altered and sulphidized host rocks. The largest known concentration of stockwork and disseminated mineralization at Buchans is the Lundberg zone that underlies the Lucky Strike deposit. The stockwork mineralization has a higher ratio of pyrite to base metal sulphides than the in situ sulphide zones and is typified by presence of fine to coarse grained pyrite with lesser amounts of chalcopyrite, sphalerite, galena and barite (Thurlow and Swanson, 1981). This mineralization occurs within felsic volcanic rocks of the Buchans River Formation below the Lucky Strike deposit and extends into the underlying intermediate to mafic Ski Hill Formation (Jambor, 1987). The Lundberg zone stockwork mineralization comes to surface on the eastern edge of the zone and forms an elongate, wedge-shaped body that is 250 m deep on the western end. The highest concentration of sulphide mineralization lies in close proximity to the previously mined Lucky Strike massive sulphide zone and mineralization is more diffuse away from the zone. A second zone of stockwork mineralization is associated with the Engine House zone, which is located immediately south of the Lucky Strike deposit, and this zone has a higher proportion of chalcopyrite to other base metal sulphides.

## 1.4 Exploration and Diamond Drilling

Exploration prior to 2014 is described in detail in previously disclosed Lundberg Deposit Technical Reports prepared by Mercator and/or Wardrop on behalf of Buchans. This information is not revisited in this Report and the reader is directed to the earlier documents for access to such information.

In 2014, Buchans undertook exploration activities to further assess the Lundberg Deposit and immediate surrounding area. Exploration activities focused on relogging of archived drill core from the Lucky Strike and Engine House orebodies, including more than 9,200 m of core from 87 archived drill holes. Work also included limited sampling and analysis of archived cores (Moore and Butler, 2015). As follow-up to relogging, Buchans undertook a 5-hole (642.6 metres) diamond drilling program to explore for shallow extensions to the high-grade, Lucky Strike deposit and the lower grade Engine House and Lundberg zones (Moore and Butler, 2015; 2016).

In 2015 Buchans undertook a drilling program focused on the area southwest of Lucky Strike (Lundberg) where it drilled 8 holes and extended 4 existing holes, drilling a total of 2,206 m. Buchans continued its core relogging program and at the Report date Buchans had relogged more than 650 holes totalling approximately 123,000 m of drill core, including approximately 420 historic holes within the Lundberg Deposit area.

Work completed in 2018 included diamond drilling (28 holes totaling 5,111 m) and subsequent borehole geophysical surveys. This drilling included 17 holes (2,205 m) drilled at the Lundberg stockwork sulphide deposit as in-fill and step-out holes to support the current Mineral Resource Estimate. Drilling also included 11 holes (2,906 m) drilled to explore for higher-grade VMS deposits within 3.5 km of the Lundberg Deposit.

## 1.5 Quality Control and Data Verification

The Quality Assurance and Quality Control QA/QC program for 2014/2015 and 2018 drill programs carried out by Buchans included the blind insertion, at 1 in 20 frequency, of certified reference materials and coarse blank samples as well as collection and analysis of quarter core duplicate split samples (2018 program only). Eastern Analytical Limited, an independent, fully accredited analytical services firm based in Springdale, NL provided primary analytical services for Buchans drilling programs. ALS Global, an independent, fully accredited analytical services firm with worldwide operations, provided check sample analytical services for the drilling

programs through its Vancouver, BC facilities. Mercator considers the results of the certified reference material, quarter core duplicate, blank sample and check sample programs to be of acceptable quality and to support use of the 2014/2015 and 2018 drilling program data in the current Mineral Resource Estimate. A similar conclusion with respect to core drilling datasets used in previous Lundberg Deposit Mineral Resource Estimates by Mercator, and also applied in the current estimate, appears in their respective Technical Reports. Mercator extends this assessment to use of the earlier dataset in the current Mineral Resource Estimate.

From November 19<sup>th</sup> to November 21<sup>st</sup>, 2018 author Matthew Harrington, P. Geo., visited the Lundberg Deposit accompanied by Buchans staff Paul Moore, P. Geo., Vice President of Exploration, David Butler, P. Geo, Exploration Manager and Derrick Keats, Senior Geological Technician. At that time he visited the Buchans core logging and storage facilities and carried out a review of Buchans' drill program components, including discussion of protocols for sampling of drill core. During the site visit and core review by Mercator, 7 quarter core samples were obtained for purposes of check sample analysis against the 2014/2015 and 2018 analytical results. Efforts were made during the core sampling program to obtain representative samples across the deposit grade ranges. Cu, Pb, Zn, Ag and Au results returned from ALS show acceptable correlation with original sample values reported in the project database, and no issues were identified with respect to the blank sample and certified reference material results. ALS Global provided check sample analytical services for determination of specific gravity, crushing and pulverization and analysis of Zn, Pb, Cu, and Ag by ore grade ME-OG46 protocol and Au by fire assay methods. Mercator subsequently determined that core check sample results show good correlation with corresponding original sampling program values.

Based on observations made during the site visit and further discussions with Buchans staff, Mercator determined that, to the extent reviewed during the visit, evidence of work programs carried out to date on the property is consistent with descriptions reported by Buchans and that procedures employed by Buchans staff are consistent with current industry standards and of good quality.

## **1.6 Metallurgical Testing**

Metallurgical testing on the Lundberg and Engine House deposits was conducted between 2011 and 2017 by SGS - Lakefield, Tomra Sorting Solutions and Thibault & Associates.

The Lundberg mineralogy indicates a stockwork sulphide deposit with good liberation characteristics and no mineralogical factors that should limit the flotation performance.



The Lundberg resource material is amenable to pre-concentration with either dense media separation or sensor-based (i.e. XRT) sorting, and both technologies provided similar grade-recovery results. At 25% rejection of the initial mass, the recovery of copper, lead and zinc to the upgraded material ranged from 95% to 98%.

Two general flowsheets have been considered for flotation of copper, lead and zinc concentrates from the Lundberg/Engine House deposits. One was a bulk Cu/Pb flowsheet where the copper and lead are floated together followed by downstream separation, and zinc is floated last from the Cu/Pb flotation tailings, and the other was a sequential flowsheet where copper, lead, and zinc are floated individually and in that order. The same composite head samples were used to evaluate the two flowsheets.

The most recent flotation test work was conducted by Thibault & Associates in 2017 using the sequential flowsheet. In that study, open-circuit testing was completed on Lundberg Years 1-3 and Years 4-8 samples. Improvements noted compared to earlier testing of the bulk Cu/Pb flowsheet include higher copper concentrate grades with less contamination by zinc, lead and pyrite, and better rejection of pyrite from the zinc concentrate.

Thibault & Associates used a METSIM™ mass balance simulation of the open circuit test results as an initial indication of the closed-circuit performance of the flowsheet, as reported in “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” (Thibault & Associates Inc., 2017) and as shown in Table 1-1. The simulation was conducted for a weighted average of the Lundberg Years 1-3 and Years 4-8 samples to represent the overall Lundberg Deposit. From the test results and the simulation, it was concluded that the Lundberg Deposit is better-suited for processing with the sequential flowsheet compared to the bulk Cu/Pb flowsheet.

Projected metal recoveries with the sequential flowsheet are 83.0% Cu, 13.3% Au, and 7.84% Ag in the copper concentrate, 84.3% Pb, 10.5% Au, and 50.3% Ag in the lead concentrate, and 87.2% Zn, 8.28% Au, and 14.8% Ag in the zinc concentrate. Projected grades in concentrates are 31.1% Cu in the copper concentrate, 67.8% Pb in the lead concentrate and 58.4% Zn in the zinc concentrate.

The preliminary sequential flowsheet recoveries reported in Table 1-1 were therefore used in the net smelter return calculations for this resource estimate.

**Table 1-1: Lundberg Projected Sequential Flotation Grades and Recoveries by METSIM™ Simulation**

Product	Grade (% g/t)						Recovery (%)					
	Cu	Pb	Zn	Fe	Ag	Au	Cu	Pb	Zn	Fe	Ag	Au
Cu Concentrate	<b>31.1</b>	1.63	1.38	29.9	41	1.23	<b>83.0</b>	2.7	0.9	3.5	7.8	13.3
Pb Concentrate	1.08	<b>67.8</b>	4.41	2.87	357	1.31	2.2	<b>84.3</b>	2.3	0.2	50.3	10.5
Zn Concentrate	1.37	1.18	<b>58.4</b>	2.50	36	0.35	8.0	4.3	<b>87.2</b>	0.6	14.8	8.3

## 1.7 Mineral Resource Estimate

The current Mineral Resource Estimate for the Lundberg Deposit is based upon a three-dimensional block model developed by Mercator using Geovia Surpac® Version 6.9 deposit modeling software, and results are presented below in Table 1-3. Mineral Resources are defined in accordance with Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves, Definitions and Guidelines (the CIM Standards, as amended in 2014) and meet disclosure requirements of National Instrument 43-101.

The current Mineral Resource Estimate (Table 1-2) is constrained by an optimized pit shell that incorporates net smelter return (“NSR”) cut-offs reflecting metal price assumptions of \$1.20 US/lb Zn, \$1.00 US/lb Pb, 3.00 US/lb Cu, \$1250 US/oz Au, and \$17 US/oz Ag and costs and recovery parameters determined through continued assessment of the project, comprising multiple past studies, including the positive 2011 PEA completed by Tetra Tech in August of 2011 and the Mineral Resource Estimate completed by Mercator in February 2013, as well as several metallurgical investigations, including bench-scale studies completed by Thibault & Associates Inc. in 2017, and additional definition drilling undertaken by the Company in 2018.

The Mineral Resource Estimate is reported at a cut-off grade of \$20 US/t NSR within the optimized pit shell, measuring 860 metres in length by 650 metres in width and extending to a maximum depth of 240 metres, which results in a strip ratio of 2.9:1 (waste to Mineral Resource) and is considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open-pit mining methods. The pit shell was developed and optimized to Net Present Value by MineTech based on cost, recovery and metal pricing parameters disclosed in Notes 2 through 6 of Table 1-2 below. Projected metal recoveries are based on the 2017 study by Thibault & Associates Inc and a Net Smelter Return (NSR) calculator was prepared by Stantec Consulting.

**Table 1-2: Lundberg Deposit Mineral Resource Estimate – Effective Date: February 28, 2019**

NSR Cut-off (\$US/t)	Category	Rounded Tonnes	Zn %	Pb %	Cu %	Ag g/t	Au g/t	Zn Eq. %	NSR (\$US/t)	Strip Ratio
20	Indicated	16,790,000	1.53	0.64	0.42	5.69	0.07	3.38	54.98	2.9
	Inferred	380,000	2.03	1.01	0.36	22.35	0.31	4.46	72.95	

1. Mineral Resource tonnages have been rounded to the nearest 10,000. Totals may vary due to rounding.
2. Price assumptions used were \$1.20 US/lb Zn, \$1.00 US/lb Pb, \$3.00 US/lb Cu, \$1250 US/oz Au, and \$17 US/oz Ag.
3. Metallurgical recoveries to concentrates are based on the “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” (Thibault & Associates Inc., 2017). Metal recoveries are 83.0% Cu, 13.3% Au, and 7.84% Ag in the copper concentrate, 84.3% Pb, 10.5% Au, and 50.3% Ag in the lead concentrate, and 87.2% Zn, 8.28% Au, and 14.8% Ag in the zinc concentrate.
4. Net Smelter Return (NSR) \$US/t values were determined by calculating the value of each Mineral Resource model block using an NSR calculator prepared by Stantec Consulting Ltd.. The NSR calculator uses the stated metal pricing, metallurgical recoveries to concentrates, concentrate payable factors and current shipping and smelting terms for similar concentrates.
5. Zinc Equivalent metal grade (Zn Eq. %) was calculated as follows using metal pricing, metallurgical recoveries to concentrates, and concentrate payable factors as applied in the NSR calculator:  $Zn\ Eq\ \% = Zn\ \% + ((Cu\ \% \times 22.046 \times 0.8020 \times 3) + (Pb\ \% \times 22.046 \times 0.8010 \times 1) + (Au\ g/t / 31.10348 \times 0.2198 \times 1250) + (Ag\ g/t / 31.10348 \times 0.6514 \times 17)) / (1.20 \times 22.046 \times 0.7412)$ .
6. The Mineral Resource pit shell was developed and optimized by MineTech International Limited. Optimization parameters include: mining at \$3 US per tonne, processing at \$15 US per tonne, and G&A at \$2 US per tonne (total \$20 US per tonne).
7. A cut-off value of \$20 US/t NSR within the optimized pit shell was used to estimate Mineral Resources.
8. Mineral Resources were interpolated using Inverse Distance Squared methods applied to 1.5 metre downhole assay composites.
9. Results of an interpolated Inverse Distance Squared bulk density model ( $g/cm^3$ ) were applied.
10. Mineral Resources are considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open pit mining methods.
11. Mineral Resources do not have demonstrated economic viability.
12. This estimate of Mineral Resources may be materially affected by environmental, permitting, legal title, taxation, socio-political, marketing, or other relevant issues.

## 1.8 Conclusions and Interpretations

Based on the results of the Mineral Resource Estimate summarized in this Report, Mercator has concluded that the current Mineral Resource Estimate represents a substantial upgrade in deposit definition confidence that is exemplified by its large inventory of Indicated category Mineral Resources.

Through completion of a large amount of additional infill core drilling, relogging of archived drill core, database upgrading and detailed deposit model studies in the intervening years, the current Mineral Resource Estimate reflects a ~97.8% conversion of 2011 PEA Ultimate Pit Design Inferred Mineral Resources to Indicated Mineral Resources at comparable grades and a slightly lower strip ratio.

The net effect of the optimized pit shell for the 2019 Mineral Resource Estimate is to define reasonable prospects for economic extraction in the foreseeable future using conventional open-pit mining methods and therefore to not include certain portions of the modelled Lundberg mineral deposit that do not fall within the optimized shell volume. The material falling within the pit shell that meets the \$20 US/t NSR value defines the current Mineral Resource Estimate presented above in Table 1-2. While the optimized pit for the 2019 Mineral Resource Estimate excludes significant volumes of mineralization within the Lundberg Deposit occurring largely beneath the pit shell bottom from classification as current Mineral Resources, pit optimization associated with future economic studies that reflect changes in metal prices or other parameters has the potential to include such mineralization in a future Mineral Resource Estimate.

The current Mineral Resource Estimate upgraded the Lundberg Deposit to a more robust, pit-constrained Mineral Resource. Lundberg's current in-pit Mineral Resources contain more than 1.25 billion pounds zinc equivalent in the Indicated category. As such, Lundberg represents a potential open pit mine development project, optimally situated on a brownfields site, with excellent infrastructure and a low strip ratio.

The Mineral Resource Estimate sensitivity presented in Section 14 demonstrates that a high proportion of the contained metal is retained at the higher cut-off thresholds and indicates that both lower grade - higher tonnage and higher grade - lower tonnage mining scenarios should be assessed in future economic studies. Potential also exists for future enhancement of Mineral Resources through refinement of pit optimization parameters, continued metallurgical studies, and future economic analysis.

Metallurgical studies completed to date found the Lundberg mineralization to be well-liberated at typical grind sizes for recovery by flotation and no potential challenges related to mineralogy were identified. The Lundberg Deposit was shown to be amenable to pre-concentration by either dense media separation or sensor-based sorting.

Two alternative flotation flowsheets and reagent schemes have been tested on the same Lundberg samples for recovery of copper, lead and zinc concentrates: a bulk Cu/Pb flowsheet and a sequential flowsheet. The sequential flotation flowsheet was found to be most suitable for the Lundberg samples. Compared to the bulk Cu/Pb flowsheet, the sequential flowsheet provided improved flotation selectivity with higher grade copper and zinc concentrates, less misplacement of metals and lower pyrite contamination.

The sequential flotation flowsheet has been tested in open-circuit on samples from the Lundberg Deposit; locked cycle testing has not yet been completed. A METSIM™ simulation of the sequential flotation flowsheet has projected recoveries to the respective concentrates of 83.0% copper, 84.3% lead and 87.2% zinc, and these preliminary recoveries have been applied to the resource model in this Study. The preliminary testing of the sequential flowsheet has demonstrated marketable concentrate grades with no deleterious elements.

## 1.9 Recommendations

Based on work carried out for the current Mineral Resource estimation project, Mercator is of the opinion that the Lundberg Deposit has been sufficiently delineated by drilling to support Pre-Feasibility Study (PFS) and Feasibility level studies, and that additional infill resource delineation drilling is not required for this purpose.

The primary recommendation arising from the current Mineral Resource Estimate program is that an updated assessment of the Lundberg Deposit's economic potential be completed as the next phase of project evaluation. This could take the form of a new Preliminary Economic Assessment (PEA) or an internal economic study leading to a decision to proceed directly to a PFS assessment of Lundberg Deposit economics.

A recommended two phase estimated budget for such work is presented below in Table 1-3. PEA level studies are covered in Phase I, and Phase II constitutes a subsequent PFS level assessment. Commitment to Phase II program components is strongly dependent on substantively positive

**Table 1-3: Estimated Budget for Recommended Work Programs**

<b>Phase I – Preliminary Economic Assessment</b>	<b>Estimated Cost (\$CAN)</b>
Recommended Preliminary Economic Assessment metallurgical testing	\$160,000
Completion of Preliminary Economic Assessment	\$125,000
<b>Sub-Total</b>	<b>\$285,000</b>
<b>Phase II – Pre-Feasibility Study</b>	
Recommend Pre-Feasibility metallurgical testing	\$370,000
Environmental, community, and claims management programs	\$250,000
Geotechnical and engineering studies	\$200,000
Completion of Pre-Feasibility Study	\$1,000,000
<b>Sub-Total</b>	<b>\$1,820,000</b>
<b>Completion of Phase I and II Total</b>	<b>\$2,105,000</b>

results being obtained during Phase I programs, however, Buchans may chose to proceed directly to Phase II without full completion of Phase I.

Additional metallurgical testing would be required to support a future Preliminary Economic Assessment or Pre-Feasibility Study Assessment. Continued development of the sequential flotation flowsheet is recommended to confirm the metallurgical performance.

Pre-concentration using dense media separation or ore sorting will improve mill feed grades, reduce the size of the milling facility or reduce mill feed transportation requirements should an off-site milling facility be considered. Future economic studies are therefore recommended to determine any potential savings with pre-concentration versus metal loss from the upgrading process.

With favorable open circuit test results and simulation results, the sequential flotation flowsheet is expected to produce improved results compared to the bulk Cu/Pb flowsheet. Therefore, continued development of the sequential flotation flowsheet for the Lundberg Deposit is recommended to confirm the metallurgical performance. Testing for a Preliminary Economic Assessment should include at minimum one composite sample, with open-circuit tests to better define reagent dosages, grind sizes and regrind sizes, followed by locked cycle flotation testing.

If testing of the sequential flowsheet is conducted for a Pre-Feasibility Study Assessment open circuit and locked cycle flotation testing on up to three composite samples is recommended. Final locked cycle flotation tailings solids should be characterized for acid generation and metals leachability, and liquid effluent should be subjected to a detailed analysis with respect to environmental discharge criteria. Additional concentrate dewatering tests are also recommended.

Phase I includes a budget to complete sequential flowsheet batch flotation testing and locked cycle flotation testing on one composite sample and Phase II includes a budget to complete sequential flowsheet batch flotation testing and locked cycle flotation testing on three distinct composite samples, tailings characterization, and concentrate dewatering tests. The following budgets assume existing metallurgical samples in freezer storage would be used for future testing and therefore costs to acquire additional new drill core samples are not included.

## 2.0 INTRODUCTION

### 2.1 Scope of Reporting

The Lundberg Deposit is 100% controlled by Buchans Minerals Corporation (“BMC”), a wholly-owned subsidiary of Buchans Resources Limited (“BRL”). BMC and its wholly-owned subsidiary, 7980736 Canada Inc., have been the registered property owners of the Buchans property since 2010, prior to which the property, including preceding mineral claims, were registered to Buchans Minerals Corporation’s predecessor company, Buchans River Limited.

Buchans Resources Limited, as well as Buchans Minerals Corporation and its subsidiaries, including 7980736 Canada Inc., as well as predecessor companies Buchans River Limited and Royal Roads Corp., are collectively referred to as “Buchans” in this Report. Buchans Resources Limited’s Canadian corporate office is located at 55 University Avenue, Suite 1805, Toronto, Ontario, M5J 2H7, Canada. Buchans is a reporting issuer in the provinces of Alberta, British Columbia, Newfoundland and Labrador and Nova Scotia. The Common Shares of Buchans were not listed on a recognized stock exchange at the effective date of this Technical Report,

The purpose of this Technical Report (“2019 Technical Report” or the “Report”) is to provide scientific and technical information related to the Lundberg Project. The Report covers the results of an updated Mineral Resource Estimate for the Lundberg Deposit, as described in a Buchans news release dated March 1, 2019 (available on SEDAR under the Company’s profile).

The Report was prepared by: Michael Cullen, P. Geo., Matthew Harrington, P. Geo. and Shaun O’Connor, P. Geo. of Mercator Geological Services Limited (“Mercator”), Timothy McKeen, P. Eng., of Stantec Consulting Ltd. (Stantec), and Douglas Roy, P. Eng., of MineTech International Limited (MineTech), all independent “Qualified Persons” as defined under National Instrument 43-101 (NI 43-101), and Buchans employees Paul Moore, P. Geo., Vice President of Exploration and David Butler, P. Geo, Exploration Manager, who are non-independent “Qualified Persons” as defined under NI 43-101 and as allowed under Section 5.3(3) of the instrument.

The most recent independent inspection of the properties by Mercator was undertaken by Qualified Person M. Harrington between the 19th and 21st of November 2018. Mineral Resources described in this Technical Report are defined in accordance with Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves, Definitions and Guidelines (the CIM Standards, as amended in 2014) and meet disclosure requirements of National Instrument 43-101.



Information and data used in this Technical Report were obtained through compilation of results of exploration and mining activities carried out by the ASARCO (1928 – 1984) and various other operators (1984 – 2007) prior to Buchans as well as all Buchans operated exploration programs, including previously reported programs completed in 2007 and 2012 and recent programs completed in 2014/2015 and 2018. Most aspects of the subject property and previous Mineral Resources were described in a 2008 Mineral Resource Estimate Technical Report completed by Mercator for Buchans (Webster and Barr, 2008), in a Preliminary Economic Assessment (2011 PEA) Technical Report by Coley et al. (2011) completed for Buchans by Wardrop Engineering Inc. (a Tetra Tech company) (Wardrop), and an updated 2013 Mineral Resource Estimate Technical Report completed by Mercator for Buchans (Cullen and Hilchey, 2013).

Unless otherwise stated, the units of measures used in this report conform to the metric system and all dollars are reported in US currency. A list of abbreviations used in this report is presented in Table 2-1.

**Table 2-1: Abbreviations Used in this Technical Report**

Abbreviation	Term	Abbreviation	Term
Abitibi-Price	Abitibi-Price Company	oz	troy ounce (31.04 g)
Acadian	Acadian Mining Corporation	g	gram (0.03215 troy oz)
Acme	Acme Analytical Laboratories	kg	kilogram
AND Company	Anglo-Newfoundland Development Company	lb	pound
ASARCO	American Smelting and Refining Company Limited	t	tonne (1000 kg or 2,204.6 lb)
Billiton	Billiton Resources Canada Incorporated	T	ton (2000 lb or 907.2 kg)
BMC	Buchans Minerals Corporation	Oz/T to g/t	1oz/T = 34.28 g/t
BP	BP Resources Canada Limited	Au	Gold
BRJV	Buchans River Joint Venture	Cu	Copper
BRL	Buchans Resources Limited	Ag	Silver
CBM	CBM Exploration Incorporated	Sb	Antimony
CDN	Canadian	ASL	Above sea level
CIM	Canadian Institute of Mining and Metallurgy	Oxygen	O
CMB	Central Mobile Belt	Zinc	Zn
CSA	Canadian Securities Administrators	Sulphur	S
DCIP	Direct Current Resistivity and Induced Polarization	Lead	Pb
GT	GT Exploration Limited	Iron	Fe
RRO	Royal Roads Corporation	Barium	Ba
IRR	Internal Rate of Return	Manganese	Mn
LOM	Life of Mine	Arsenic	As

Mercator	Mercator Geological Services Limited	Potassium	K
Minco	Minco Plc	Aluminum	Al
MOD	Mineral Occurrence Database	Sodium	Na
MT	Magneto-telluric	Silica	Si
Newminex	Newfoundland Mining & Exploration Limited	mm	millimetre
NI43-101	National Instrument 43-101	cm	centimetre
NLDNR	Newfoundland & Labrador Department of Natural Resources	m	metre
NPV	Net Present Value	km	kilometre
NSR	Net Smelter Returns	ha	hectare
PEA	Preliminary Economic Assessment	C	Celsius
PR	Press Release	UBC	United Bolero Development Corporation
TVB	Tulks Volcanic belt	VMS	Volcanogenic Massive Sulphide
QA/QC	Quality Control and Quality Assurance	Wardrop	Wardrop Engineering Inc., (a Tetra Tech company)
Quantec	Quantec Geoscience Limited		

## 2.2 Responsibility of Authors

Table 2-2 presents details of report section responsibility with respect to the individual Qualified Persons who have co-authored this Technical Report.

**Table 2-2: Qualified Person Report Responsibilities**

Qualified Person	Affiliated Firm	Report Item (Section) Responsibility
Matthew Harrington, P. Geo.	Mercator	12, 14 and parts of Items 1, 25, and 26
Michael Cullen, P. Geo.	Mercator	parts of items 1, 12, 14, 25, and 26
Shaun O'Connor, P. Geo.	Mercator	parts of Items 1, 14, 25, and 26
Tim McKeen, P. Eng.	Stantec	13, and parts of items 1, 14, 25 and 26
Doug Roy, P. Eng.	MineTech	parts of items 1, 14, and 25
Paul Moore, P. Geo.	Buchans	2-11, 15-24, and parts of items of 1 and 12
David Butler, P. Geo.	Buchans	2-11, 15-24, and parts of items of 1 and 12

### **3.0 RELIANCE ON OTHER EXPERTS**

The independent Qualified Persons have relied on information provided by Buchans legal counsel concerning the status of claims that form the Lundberg Project. This information has been relied upon for Report purposes.

#### **3.1 Disclaimer**

This report was prepared by the authors for Buchans and information, conclusions and estimates contained herein are based upon information available to the authors at the time of report preparation. This includes data made available by Buchans, as well as government and public record sources. Information contained in this Report is believed reliable, but the Report is based in part upon information not within the authors' control. The authors have no reason, however, to question the quality or validity of data used in this Report beyond such cautions or comments that may be contained herein.

Comments and conclusions presented in the Report reflect the authors' best judgment at the time of report preparation. The Independent authors are not providing professional opinion with respect to mineral exploration titles, environmental issues, mineral property agreements or surface titles.

## 4.0 PROPERTY DESCRIPTION AND LOCATION

The Lundberg Deposit is located within Mining Lease 222 (M.L. 222) that is centered at 510,000mE 5,407,900mN UTM NAD 83 Zone 21 (Figures 4-1 and 4-2). The deposit and Mining Lease 222 are included within the Company's Buchans property collectively comprised of 150 Mineral Claims, two Mining Leases and two Fee Simple Mining Grants. Referred to herein collectively as the "Buchans Property", these claims, leases and grants assign mineral exploration and/or mineral rights underlying approximately 5,485 hectares to Buchans Minerals Corporation, a wholly-owned subsidiary of Buchans Resources Limited. Details of these holdings are summarized in Table 4-1 below.

The Buchans Property and surrounding area was the subject of extensive historical underground mining and development completed by ASARCO between 1928 and 1984. The history and extent of this and other subsequent work is summarily discussed later in this report.

### 4.1 Underlying Option Agreements, Mining Leases, and Claims

Some of the mineral rights that comprise the greater Buchans Property were acquired by predecessor company, Buchans River Limited, by execution in 2001 of certain option and purchase agreements between Buchans River Limited and a number of previous licence holders (Previous Licence Holders), including GT Exploration Ltd (GT), Newfoundland Mining and Exploration Ltd. ("NME"), Phelps Dodge Corporation of Canada Ltd (PD, now Freeport-McMoRan), Noranda Mining and Exploration Inc. (NOR, now Glencore), and CBM Resources Inc. (CBM). These mineral rights are shown as "Claims at time of transfer / agreement" on Figure 4-3, and include portions of Mining Lease 222 that hosts the Lundberg Deposit, as well as Mining Lease 223 and the Fee Simple Mining Grants.

All mineral licences that comprise the current Buchans Property, excluding the Property's Mining Leases and Fee Simple Grants, were staked by Buchans Minerals Corporation or its associated predecessor companies, and all claims are now registered to Buchans Minerals Corporation. These more recently staked mineral claims cover portions of the original Buchans River 2001 property (shown as greyed shaded areas within Figure 4-3) that lapsed at one time or another since execution of the various underlying option and purchase agreements.

**Figure 4-1: Location Map – Lundberg Project**

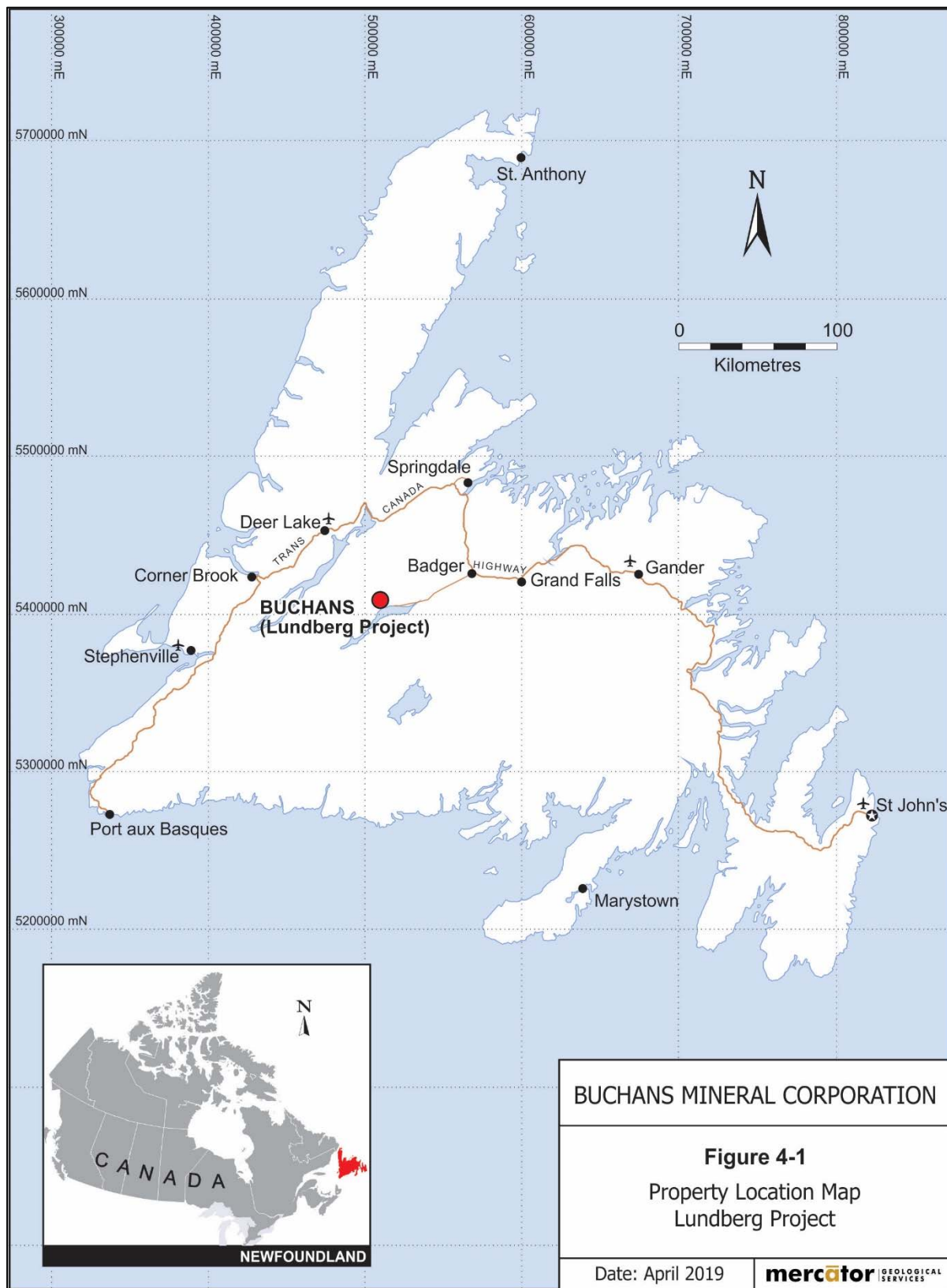
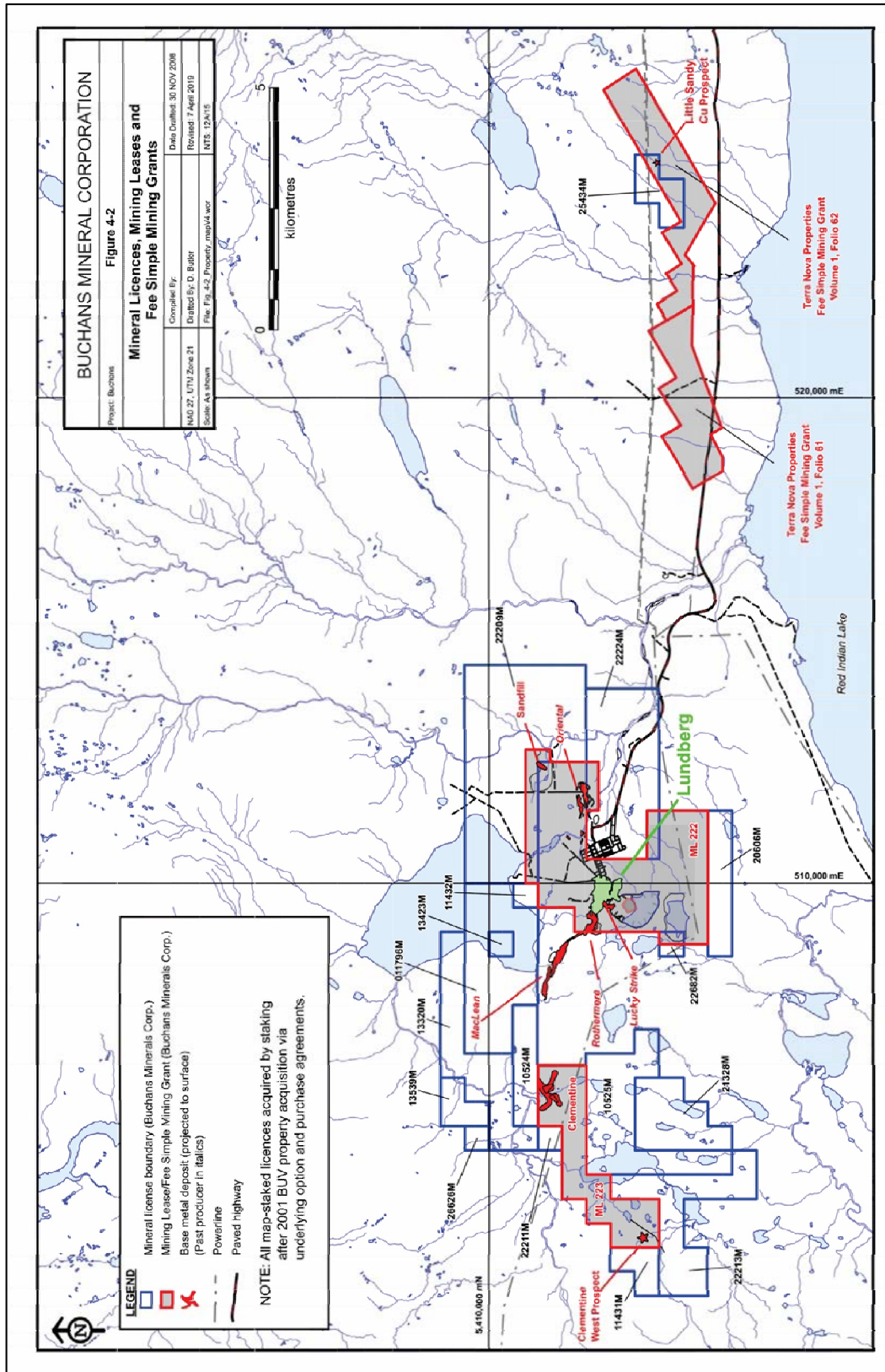


Figure 4-2: Mineral Claim Map – Lundberg Project



**Table 4-1: Summary of Buchans Property Mineral Rights**

<b>Mineral Licences (map-staked claims)</b>					
<b>Date Issued</b>	<b>Expiry Date</b>	<b>Licence No.</b>	<b>Registered Owner*</b>	<b>No. of Claims</b>	<b>No. of Hectares</b>
06-Jan-2005	06-Mar-2020	10524M	Buchans Minerals Corporation	5	125
06-Jan-2005	06-Mar-2020	10525M	Buchans Minerals Corporation	16	400
01-Dec-2005	30-Jan-2025	11431M	Buchans Minerals Corporation	3	75
01-Dec-2005	30-Jan-2020	11432M	Buchans Minerals Corporation	1	25
09-Mar-2006	08-May-2019	11796M	Buchans Minerals Corporation	17	425
09-Apr-2007	10-Jun-2019	13320M	Buchans Minerals Corporation	13	325
30-Apr-2007	01-Jul-2019	13423M	Buchans Minerals Corporation	1	25
25-May-2007	24-Jul-2019	13539M	Buchans Minerals Corporation	3	75
28-Nov-2012	27-Jan-2020	20606M	Buchans Minerals Corporation	6	150
19-Oct-2017	18-Dec-2019	25434M	Buchans Minerals Corporation	4	100
15-Aug-2013	14-Oct-2019	21328M	Buchans Minerals Corporation	9	225
12-Jun-2014	12-Aug-2019	22209M	Buchans Minerals Corporation	35	875
12-Jun-2014	12-Aug-2019	22211M	Buchans Minerals Corporation	1	25
12-Jun-2014	12-Aug-2025	22213M	Buchans Minerals Corporation	13	325
12-Jun-2014	12-Aug-2019	22224M	Buchans Minerals Corporation	21	525
22-Nov-2018	21-Jan-2020	26626M	Buchans Minerals Corporation	1	25
17-Dec-2014	17-Feb-2020	22682M	Buchans Minerals Corporation	1	25
			<b>Total</b>	<b>150</b>	<b>3,750</b>
<b>Fee Simple Mining Grants</b>					
<b>Date Issued</b>		<b>Grant No.</b>	<b>Registered Owner</b>	<b>No. of Claims</b>	<b>No. of Hectares</b>
	31-Dec-2019	Terra Nova Properties Fee Simple Mining Grant Vol. 1, Folio 61	Buchans Minerals Corporation		265.51
	31-Dec-2019	Terra Nova Properties Fee Simple Mining Grant Vol. 1, Folio 62	Buchans Minerals Corporation		367.30
			<b>Total</b>		<b>632.81</b>
<b>Mining Leases</b>					
<b>Date Issued</b>		<b>Grant No.</b>	<b>Registered Owner</b>	<b>No. of Claims</b>	<b>No. of Hectares</b>
22-Aug-2013	22-Aug-2019	Mining Lease 222	Buchans Minerals Corporation		937.50
22-Aug-2013	22-Aug-2019	Mining Lease 223	Buchans Minerals Corporation		350.00
			<b>Total</b>		<b>1287.50</b>
<b>Total All Property</b>					<b>hectares</b>
			<b>Grand Total</b>		<b>5,670.31</b>

\*Buchans Minerals Corporation is a wholly-owned subsidiary of BRL





As a result of the underlying agreements with the Previous Licence Holders, portions of the Buchans Property are subject to Net Smelter Return (NSR) royalties ranging between 1% and 3% (percent), as defined by underlying option and purchase agreement. Some of the agreements pertaining to the underlying royalties have provisions for purchase of one half of the royalty, including properties acquired from Phelps Dodge (PD on Figure 4-3) and CBM resources (CBM on Figure 4-3).

With respect to the Lundberg Deposit and Mining Lease 222 (Figure 4-3), the northeast portion of the deposit, located within historic licence 4823M has a royalty (2% NSR) buyout provision whereby Buchans has the right to purchase up to 1% at net present value as defined subject to a minimum of (CDN)\$1,000,000. The southern portion of the Lundberg Deposit, situated within historic licence 4797, has no underlying royalty assigned. The northwest portion of the deposit, located within historic licence 4867, has a 2% NSR retained by GT Exploration Ltd. with no buyout provision (Figure 4-3).

Mining leases, M.L. 222 and M.L. 223, each have a 25-year term from 2013 and are in their second 5-year term, requiring annual lease rental payments equal to \$120 CDN per hectare (~\$154,500 CDN) to maintain the mining leases.

#### **4.1.1 Review of Agreements by the Independent Authors**

Agreement terms summarized above were provided by Buchans and the Independent authors did not otherwise review, confirm or validate any terms or conditions of the agreements for purposes of this Report. However, at the effective date of this Report the Independent authors had no reason to question agreement information provided by Buchans.

#### **4.1.2 Status of Titles at Effective Date of Report**

All Buchans properties (mineral licences, Mining Leases, Fee Simple Mining Grants) were considered by Buchans to be current and in good standing with the Newfoundland and Labrador Department of Natural Resources (NLDNR) at the effective date of this Report. This includes opinion provided by Buchans with regard to currency, status and ownership of Mining Lease 222 as the mineral title that covers the Lundberg Deposit.

## 4.2 Summary of Exploration Title and Regulatory Information

As licence holder, Buchans, through BMC, has the exclusive right to explore for designated minerals within the boundaries of the mineral claims comprising the Buchans Property but this right does not reflect ownership of corresponding title to surface rights. BMC has, however, secured land access agreements with surface right holders, in this case the Province of Newfoundland and Labrador, by way of a Mining Lease Agreement executed between Buchans and the Province of Newfoundland and Labrador as executed on August 22, 2015. Further land access rights have also been granted to Buchans by way of various exploration and operating permits issued from time to time for the purpose of conducting mineral exploration.

Work requirements of the Newfoundland government for mineral licenses include a work expenditure of \$200 CDN per claim in the first year, rising by \$50 CDN per claim until year 5. The work requirement then rises to \$600 CDN per claim per year from year 6 to year 10, \$900 CDN per claim per year for years 11 to 15, and \$1,200 CDN per claim per year for years 16 to 20. Recent amendments to the Mineral Regulations under the Mineral Act allow a mineral licence to be held for 30 years, with expenditures of \$2,000 CDN per claim per year for years 21 to 25, and \$2,500 CDN per claim per year for years 26 to 30. The type of acceptable work for assessment purposes is defined under the Mineral Regulations 1983 of the Province of Newfoundland, and Labrador and includes most conventional exploration survey methods.

Mining Leases are maintained in good standing through payment of annual lease rental fees equivalent to \$120 CDN per hectare, to the NLDN. Mining Leases have an initial 5-year term and are renewable after five years. If production has not commenced on the leases within 5 years, an extension for another 5-year term may be sought, and is routinely granted, provided the lease holder can demonstrate the extension to be warranted.

## 4.3 Environmental Liability and Other Potential Risks

Environmental liability for past mining in Buchans by entities related to Abitibi Consolidated Inc., including ASARCO, was addressed in a Supreme Court of Canada ruling handed down on December 7<sup>th</sup>, 2012. That decision assigned responsibility to the government of Newfoundland and Labrador for environmental clean-up of impacts associated with past mining activities at Buchans as a result of the expropriation by the Province of various assets of Abitibi Consolidated Inc. Since 2012, the Province has undertaken work to remediate certain impacts associated with past mining operations at Buchans, including to remove lead in soils within the community and to stabilize the historic tailings dam.

Buchans liability at the effective date of this Report is limited to the activities carried out under the exploration permits issued by the NL government. These cover site activities related to core drilling and general site access, but do not include any impacts associated with historic site use. If a decision to pursue mining at Buchans is made by Buchans, the issue of site liabilities will be addressed in the related mining and environmental permitting process.

#### **4.4 Availability of Land for Exploration and Future Development**

To date, Buchans has accessed lands in the Buchans area for the purpose of exploration activities under terms of exploration permits issued by the provincial government. The company has also accessed lands controlled by the municipality of Buchans and is required to advise the municipality of on-going activities of this nature that occur within its boundaries.

Agreements have not been established to access any lands for the purposes of future mine development and establishment of associated infrastructure.

Buchans is of the opinion that sufficient lands exist in the deposit area to potentially accommodate future open pit mine development and establishment of required milling infrastructure plus tailings impoundment and waste rock storage areas.

## 5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

### 5.1 Accessibility

The Lundberg Deposit is situated adjacent to the community of Buchans in Central Newfoundland. The community is located approximately 530 km by highway west of the provincial capital city of St. John's, and is accessible via paved Route 370 from its junction with the Trans-Canada Highway at the town of Badger, approximately 70 km north of Buchans. The nearest major airports are Gander International Airport and Deer Lake Regional Airport, which are located 128 km east and 181 km west of the town of Badger, respectively. The community of Buchans is located approximately 4 km north of Red Indian Lake, which measures approximately 60 km in maximum length and 5.5 km in maximum width. The Lundberg Deposit is situated within lands associated with the past-producing Lucky Strike mine.

Access to the deposit area is excellent, with most of the area required for drilling assessment having been cleared for historical mining operations. Winter access typically necessitates use of snowmobiles, since road networks surrounding the deposit are not actively used and not typically cleared of snow.

### 5.2 Climate

The climate in central Newfoundland is characterised by relatively cool, northern Atlantic temperate conditions with a short summer season from July through early September and a long winter period from November through late March or early April. Environment Canada records show the daily mean temperature during the winter months to be  $-5^{\circ}\text{C}$ , ranging from  $0^{\circ}\text{C}$  to  $-10^{\circ}\text{C}$ , and daily mean temperature from May to October is  $10^{\circ}\text{C}$ , range from  $5^{\circ}\text{C}$  to  $15^{\circ}\text{C}$ . Daily winter minimums can exceed  $-30^{\circ}\text{C}$  and summer daily maximum values in the  $25^{\circ}\text{C} +$  also occur. Average annual precipitation ranges from 200 cm to 300 cm with much of this occurring as snow.

Exploration activities can be carried out in all seasons in this area, assuming that appropriate allowances are made for heavy snow conditions during winter months and thawing ground during Spring break-up.

### 5.3 Physiography

The Buchans area is generally flat to gently rolling with elevation ranging from 155 m to 165 m above sea level at Red Indian Lake to approximately 350 m above sea level inland. There are numerous bogs and small brooks in the area that drain into Red Indian Lake with spruce and fir growing on the slopes and in upland areas. The northern portion of the greater Buchans property

area is poorly drained and covered by areas of shallow bogs and extensive muskeg in flat areas. The depth of till is typically less than 5 metres and the area is generally considered to have less than 5% outcrop exposure.

The area hosting the Lundberg Deposit is for the most part relatively flat with minimal low vegetation, including low bushes and grass as well as area of uncovered gravel (e.g. Figure 10-1). The main topographic feature near the deposit is a water-filled pit over the central portion of the deposit that is known as the Lucky Strike “glory hole”. This feature extends to a depth of approximately 65 m and represents an excavated area established by past underground mining operations at the former Lucky Strike mine site that extended to surface. The glory hole connects to other flooded and backfilled underground workings and access tunnels that connect to the other historic mining sites at Buchans.

Historic mining infrastructure in the form of various buildings and roads also exist within the Lundberg Deposit resource area.

#### **5.4 Local Resources and Infrastructure**

The town of Buchans has a population of approximately 700 and is supported by services such as a medical clinic, hotel, gravel air strip, as well as grocery, gas and hardware retailers. Field supplies, fuel and logistical support are available in Buchans and contract geotechnical personnel including drill companies and analytical laboratories, are typically available in either Grand Falls or Springdale. Other supplies and heavy equipment can be brought to Buchans by highway from Deer Lake, Corner Brook, or St. John’s.

The closest deep-water ports are located approximately 140 km to the east-northeast at Botwood, which was formerly used as the concentrate loading terminus for the past-producing Buchans Mine; or approximately 130 km to the northeast at Goodyears Cove, an active concentrate storage and shipping facility operated by Rambler Metals and Mining.

The main power line from Grand Falls to Corner Brook passes through Buchans and the town has full industrial electrical services. Two main arteries of the provincial power grid cross the property, these being a 230 kV transmission line that extends approximately 40 km southwest of Buchans to an 18.4 MW hydroelectric plant at Star Lake, and an east-west, 230 kV line that runs between Grand Falls and Corner Brook.

Water, both industrial and potable, is in ample supply and is drawn from Buchans Lake and Red Indian Lake, as well as several nearby ponds.

The Duck Pond copper-zinc mine, formerly operated by Teck Resources Ltd. until its closure in 2015, is located approximately 60 km east of the Lundberg Deposit. At the Report date, the Duck Pond mill/concentrator and mine site are still maintained in care and maintenance while Teck continues to execute its closure and remediation plans. The Duck Pond site is vehicle accessible from Buchans by approximately 38 km of public paved roads to Millertown followed by an additional 30 km of secondary gravel roads that extend to the mine site.

A core storage and logging facility operated by the Newfoundland and Labrador government is available for use at Buchans. This facility is used by government, industry and academic interests and much of the core from historic drilling on the Buchans area properties is stored at this location. Viewing and re-sampling of core can be arranged under government supervision.

Historic mine buildings and two large tailing ponds remain on the property from past mining by ASARCO. The tailings ponds are located south of the Lundberg Deposit and are not currently permitted for additional use, though one of the ponds is partially covered by a Mining Lease that is exclusive to barite in the tailings. These barite rights are leased by the Province to a local private company that has in the past operated seasonally to produce barite for sale to the local offshore oil industry.

The community of Buchans is very small and could not be expected to provide a substantial proportion of any mining and industrial work force associated with a future development of the Lundberg Deposit. However, central and western Newfoundland have a diverse workforce that currently supports underground and open pit mining operations as well as other industrial and natural resource based activities such as the forestry industry. This workforce, augmented by workers from other regions could contribute to a future mining operation at Buchan

## 6.0 HISTORY

### 6.1 Introduction

The earliest report of lead-zinc mineralization in the Buchans area was in 1905, when local prospector Matty Mitchell discovered high grade base metal mineralization in the banks of Buchans River, east of the current main Buchans mine site at Lucky Strike. The Anglo-Newfoundland Development Company (AND Company) owned mineral rights at that time in Central Newfoundland, including the Buchans area, and formed a joint venture ASARCO in 1926 to pursue evaluation of the area.

This resulted in exploration and development of mining operations at Buchans that continuously operated continuously from 1928 until mine reserves were depleted in 1984 (Neary, 1981). In total, the Buchans ore deposits are reported to have produced 16,196,876 tonnes of ore from the five major orebodies. The average grade of total production is reported to be 14.51% zinc, 7.65% lead, 1.33% copper, 126 g/t silver, and 1.37 g/t gold (Kirkham, 1987).

The following chronological summary of exploration history in the Buchans area was substantially excerpted or summarized from the 2008 Mercator NI 43-101 Mineral Resource Estimate technical report (Webster and Barr, 2008), the 2013 Mercator NI 43-101 Mineral Resource Estimate technical report (Cullen and Hilchey, 2013), and the 2019 JEA Submission Report (Moore and Butler, 2019), unless otherwise indicated. A complete history of the discovery and early exploration and development of the Buchans Mine can be found in Neary (1981) and Thurlow (2010).

### 6.2 Exploration History

#### 6.2.1 Early Work (1905-1926)

In 1905, Matty Mitchell employed as a prospector to explore lands held by the AND Company for sulphur or other minerals of economic interest and travelling up a tributary to Red Indian Lake, now known as Buchans River, discovered outcropping base metal-bearing sulphides in the banks of the river that would ultimately lead to discovery of the original Old Buchans orebody (Neary, 1981). After further investigations, a small-scale failed attempt at mining, and visits by several groups in 1911, a report was commissioned by the New York firm Weed and Probert to assess the economic value of the Buchans sulphide deposit (now known as Old Buchans) and to make recommendations for further exploration. In 1925, a geological examination was conducted as

part of an economic Feasibility assessment completed by consulting engineer, J.G. Baragwanath, for the ASARCO, (Thurlow, 1991), and concluded the area held great potential for finding further ore. In 1926 ASARCO entered into a formal agreement with the AND Company's subsidiary, Terra Nova Properties, granting ASARCO certain rights to the property. At this time, ASARCO contracted a Swedish-American prospecting company, led by Mr. Hans Lundberg, while the orebody was being prepared for mining, to conduct a geophysical survey known as the equipotential line method. This survey detected two anomalies in the area over the Oriental and Lucky Strike deposits. Trenching and a small amount of diamond drilling were subsequently conducted over these areas in 1926 leading to the discovery of the Lucky Strike and Oriental orebodies in 1926. Dr. W. H. Newhouse was commissioned to create a geological map of the area surrounding the mine in 1927. Small scale spot drilling programs were also carried out in the region to the south and southwest of the Lucky Strike and Oriental orebodies (Thurlow, 1991).

### 6.2.2 1928–1984 ASARCO

ASARCO initiated mining operation at Buchans in 1928. Between 1930 and 1984, extensive drilling programs and a variety of exploration activities including geological, geochemical and geophysical surveys were undertaken. This work included completion of more than 3,500 surface and underground holes, totalling 375,000 m of drilling that lead to the discovery of most of the known mineralized zones and orebodies. Almost all surface drilling was vertical, with core sizes varying from 22 mm (EX core) to 47.6mm (NQ core), and typically testing to depths of 200 m or less, and a maximum depth of approximately 1,100 m. As ASARCO was focused on high-grade mineralization comparable to the Lucky Strike and Oriental massive sulphide orebodies, much of the intersected mineralization was defined as sub-economic, and as such, limited drill core assay data is available from this period. Early ASARCO drill programs were closely spaced and concentrated primarily on near surface equipotential anomalies outlined by Hans Lundberg. Later expansion of exploration consisted of systematic outward extension of drilling and led to discovery of the Rothermere (1947), Maclean (1950), Oriental No. 2 (1953), Clementine (1960), and Maclean Extension (1979) orebodies (Swanson, 1981, Calhoun and Hutchinson, 1981; Thurlow, 2010).

The Lundberg Deposit is located immediately below the Lucky Strike orebody, the largest and highest grade of the Buchans orebodies. At Lucky Strike, ASARCO mined 5.6 million tonnes of high-grade massive sulphide ore with an average head grade of 18.4% Zn, 8.6% Pb, 1.6% Cu, 112 g/t Ag & 1.7 g/t Au (Thurlow and Swanson, 1981). Discovery and mining of the Lucky Strike orebody underpinned subsequent exploration and development of additional ore deposits at Buchans, as ASARCO established it's main infrastructure, including support buildings, and mill at



this site. Historic mining at Lucky Strike, particularly within that portion of the orebody mined from the Lucky Strike glory hole, ultimately exposed a significant portion of the Lundberg Deposit's mineralization that now extends to the top of the current bedrock surface.

In 1976, imposition of the Mineral Holdings Impost Act ended the concession mineral rights system and much of the Buchans mine property was converted to ground staked claims. At this time, a Co-tenancy agreement was negotiated with Abitibi-Price (51%) (successor to AND Company), the mineral rights holder, as exploration manager and ASARCO, (49%) as mine operator.

### **6.2.3 1985–1991 BP Resources Canada Inc.**

BP Resources Canada Inc. (BP) optioned all or most of Abitibi-Price's mineral properties throughout central Newfoundland, including the Abitibi-Price-ASARCO Co-tenancy Buchans mine property in 1985. In 1991, BP returned the Buchans property to the Co-tenants.

BP commenced work on the Buchans property in 1986 and completed an Input Airborne EM survey over the area, plus a variety of other work that included borehole TDEM surveys, ground geophysical surveys (including, IP, gravity, TDEM, Mag-VLF, HLEM and SAMT) and diamond drilling of at least 22 holes totalling 3,627.43 m, including deepening of several historic holes (Thurlow and Barbour, 1986; Thurlow et al., 1987; Barbour et al., 1988; and Barbour et al., 1989). This work also included limited Vibroseis seismic and limited supplementary seismic surveying over the current Buchans Property, including immediately north of the Lundberg Deposit (Thurlow et al., 1992).

It was during this period that thrust belt tectonic models emerged for the Buchans Camp, resulting in a simplified stratigraphic interpretation of the camp's geology; but a significantly more complex structural interpretation that recognized duplex structures, antiformal stacks, multiple thrusts and related features (Thurlow and Swanson, 1987). This recognition of complex faulting and shuffling of the camp's geology was a turning point in the camp's exploration and came after the mines had closed, leaving ASARCO's successors to explore the camp with a geological understanding that was absent during the camp's productive lifetime.

### **6.2.4 1995-2001 Buchans River Joint Venture - Billiton/GT/Newminex/BLR**

In August 1995 GT Exploration Ltd. (GT)/ Newfoundland Mining & Exploration Ltd. (Newminex)/ Buchans River Ltd., acquired a large land position by staking, including portions of the current

property covering the Lundberg Deposit (see Section 4, Figure 4-3). In addition, other portions of the current property were optioned from competing junior and senior mining companies (e.g. CBM Resources, Phelps Dodge Canada, and Noranda Mining and Exploration (Figure 4-3)).

Between 1995 and 1998, exploration consisted of various geophysical and geochemical surveys largely consisting of soil and whole rock geochemistry, gravity, IP, surface and borehole TDEM geophysical surveys, and limited diamond drilling. Aside from limited relogging and whole-rock sampling of archived drill cores, the bulk of this work was conducted outside of the Lundberg Deposit area.

In 1997, a core relogging program dedicated to re-interpreting results of past drilling programs was initiated. This program was initiated in an attempt to better appreciate the effects of thrusting on the stratigraphy in and around the former mine sites, including the Lundberg Deposit area. During this period between 1997 to 2000, a majority of the surface drill holes drilled within the current Buchans Property were relogged, however, the Lundberg Deposit area received only cursory attention, as the operators were focused on less explored areas with perceived greater potential for discovery of new high-grade orebodies.

In September of 1998, Billiton Resources Canada Inc. (Billiton), Buchans River Limited, Newminex, and GT formed the Buchans River Joint Venture (BRJV). This agreement granted Billiton an option to earn 51% interest in all the claims held by the joint venture partners in the Buchans area, including the Lundberg Deposit area, by spending \$3.5 million CDN on exploration over 4 years, with a further option to earn an additional 19% by spending an additional \$4 million CDN on exploration and paying Buchans River Limited \$1 million CDN.

Work undertaken by the joint venture included a variety of geophysical and geochemical surveys, including airborne EM surveys, as well as ground IP, gravity and TDEM surveys, and diamond drilling. The bulk of this work was undertaken outside the immediate Lundberg Deposit area and failed to discover new high-grade Buchans-style ore deposits. Upon Billiton leaving the joint venture in 2001, Buchans River Limited amalgamated the properties explored by the joint venture through a series of option and purchase agreements that issued shares and warrants of Buchans River Limited to various vendors for 100% interests in the properties, subject to various underlying royalties (see Section 4).

During the Billiton joint venture, ERA-Maptec Ltd. of Dublin, Ireland, was contracted by Billiton to conduct a structural reinterpretation of the Buchans mines. The study utilized 3D modeling in an attempt to map and predict the location of ore horizon rocks at depth (Millar, 2001).

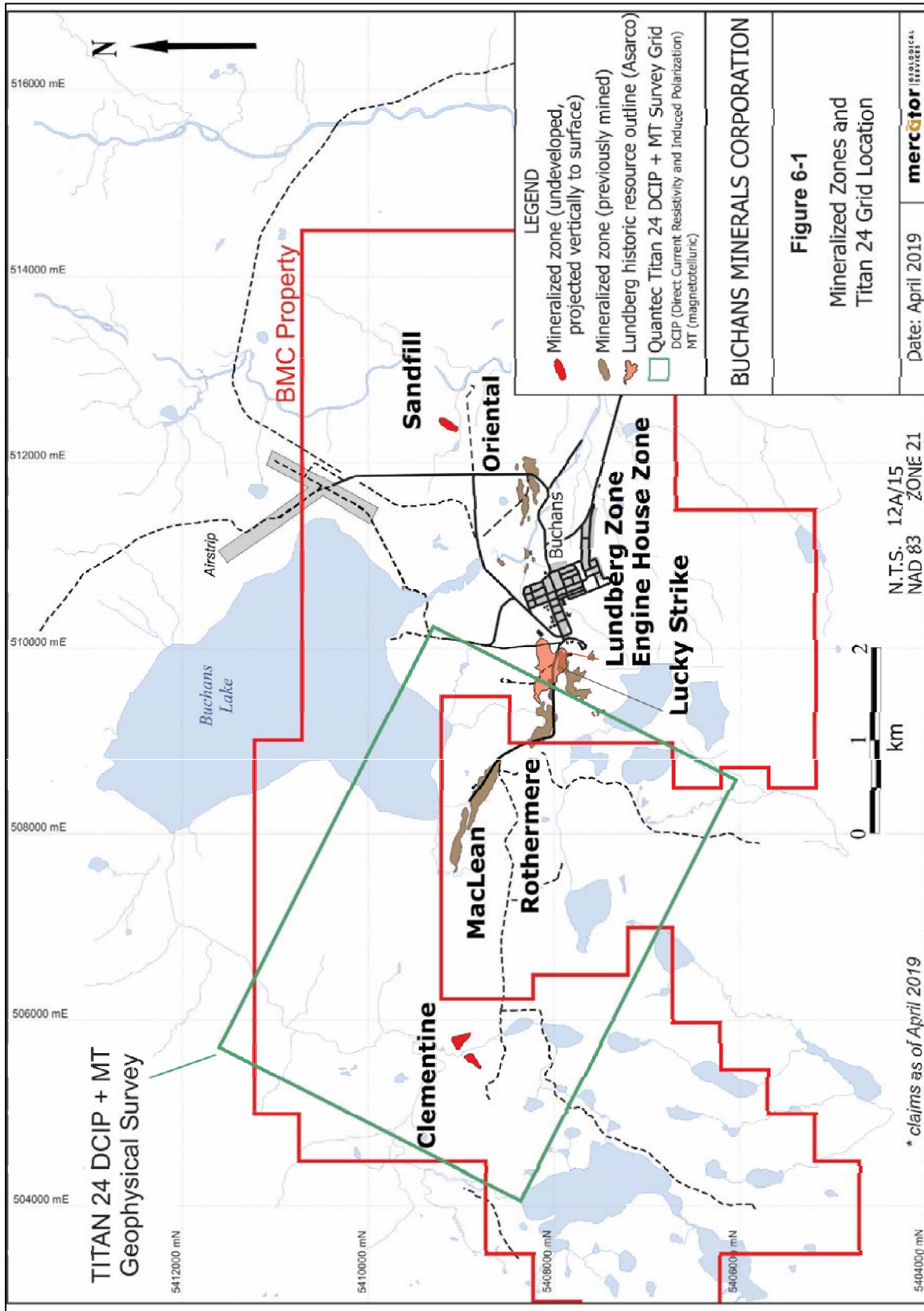
Prior to entering into the joint venture with Billiton, Newminex initiated a lithogeochemical sampling study in 1997 that continued throughout the joint venture before concluding in 2001. Researchers at Memorial University of Newfoundland conducted the work that collected and analyzed 468 rock samples by XRF or ICP/MS. Results of this study suggested hanging wall and footwall rocks from the Lucky Strike deposit area can be differentiated on the basis of their major and trace element signatures.

The joint venture was terminated in September 2001 without Billiton retaining interests in the property (Halpin, 2001). Billiton spent \$2.4 million CDN in exploration on the property and authored a final report in 2001 that presented a list of 126 targets totalling 46,020 m of proposed drilling for high-grade massive sulphide deposits similar in size and grade to the former Lucky Strike mine. These targets were not located within the immediate Lundberg Deposit area, which had not been tested by the joint venture.

#### **6.2.5 2007–2008 Buchans River Limited**

In 2007, Buchans contracted Quantec Geoscience Limited (Quantec) to complete a Titan 24 Direct Current Resistivity and Induced Polarization (DCIP) & Magnetotelluric (MT) survey to assess a 3.6 x 5.1 km portion of the Buchans area extending over the past producing Lucky Strike, Rothermere and MacLean deposits, as well as the undeveloped Clementine deposit (Figure 6-1). This area included coverage over the Lundberg Deposit and extended over several deposits that account for a large proportion of Buchans historical mine production. The survey was undertaken to explore down plunge and adjacent to several of the previously mined orebodies and undeveloped Clementine prospect. As historical geophysical surveys at Buchans were considered to have only tested to depths down to 250 m, the Titan 24 DCIP & MT surveys were selected to explore for sulphide rich zones at depths between 500 m and 750 m using the DCIP component of the surveys and potentially to depths to 1,500 m depth using the MT survey component.

**Figure 6-1: Buchans Deposits Projected to Surface and 2007-2008 Titan 24 Survey Areas**



Also in 2007, Buchans retained Mercator to undertake an extensive compilation of available geoscientific information from the Buchans area, including the Lundberg Deposit area. This program was designed to convert historic hard copy files into a comprehensive digital record and assist with identification of new targets on the property. This program included review and compilation of government assessment reports, government and industry technical reports, digital government data, published maps and diamond drill logs. All reviewed information was compiled and cross-checked with original survey files. The compilation also focused on compiling and digitizing historical diamond drilling information, including logs for over 3,000 historical drill holes dating back to 1928. Hard copy drill logs were acquired from a number of sources including company files, Department of Natural Resources assessment files and website resources and historic government archives. Using this information, a digital drill hole database was established for the project that included collar co-ordinates, , down hole survey files, assays and lithological data.

In addition to the historical drill hole compilation, information pertaining to previous exploration work on the Buchans property, including the Lundberg Deposit area, was compiled in a MapInfo GIS database. These data included results of past ground and airborne surveys using information obtained from previous assessment reports, the online Newfoundland and Labrador Department of Natural Resources (NLDNR) Mineral Occurrence Database (MOD) and various internal company documents.

## 6.2.6 2008-2010 Royal Roads Corporation

In July 2008, Royal Roads Corp. (RRO), and Buchans River Limited, both predecessor companies to BMC, combined their assets and operations in central Newfoundland and Labrador's Victoria Lake and Buchans mining camps. These properties included the historic Buchans mine area held by Buchans River Limited and the Daniels Pond Zn-Pb-Cu deposit held by RRO.

### 6.2.6.1 Regional Exploration

In July of 2008, results of the Titan 24 survey were received. The survey covered a portion of the Lundberg Deposit area as well as the former Lucky Strike, Rothermere and MacLean mines, and the undeveloped Clementine prospect (Moore and Butler, 2010). This survey identified 130 targets as mostly defined as chargeability highs that were subsequently determined to often coincide with hematitic mafic volcanic and intrusive rocks. Additionally, it was observed that underground rails and wiring associated with underground access levels for the mines had essentially rendered the survey blind near the former orebodies, as initial processing of the Titan data overwhelmed weaker responses throughout the remainder of the survey area that may be associated with accumulations of base metal sulphide mineralization.

Quantec subsequently recollected Titan MT data in select areas, including within the immediate Lundberg Deposit area, using the Spartan Tensor Magnetotelluric Survey system and issued a logistics report along with revised dataset.

### 6.2.6.2 Lundberg Deposit

In September 2007, Buchans' review of historic files located data outlining an uncategorized mineral resource estimate for a zone of stockwork style base metal mineralization peripheral to the former Lucky Strike mine. This historic, uncategorized estimate reported approximately 13.1 million short tons (11.9 million tonnes) with an average grade of 1.83% zinc, 0.67% lead, 0.38% copper, 0.16 ounces per ton silver (5.5 g/t) and trace amounts of gold (ASARCO, 1974; Buchans River Limited PR #14-07). This mineral resource estimate is historical in nature and was not prepared in accordance with National Instrument 43-101 and CIM Standards. ASARCO documents from 1974 included plans and sections that referred to this mineralization as the "Lucky Strike Low Grade" mineralization. In 2007, Buchans renamed this deposit the "Lundberg Zone".

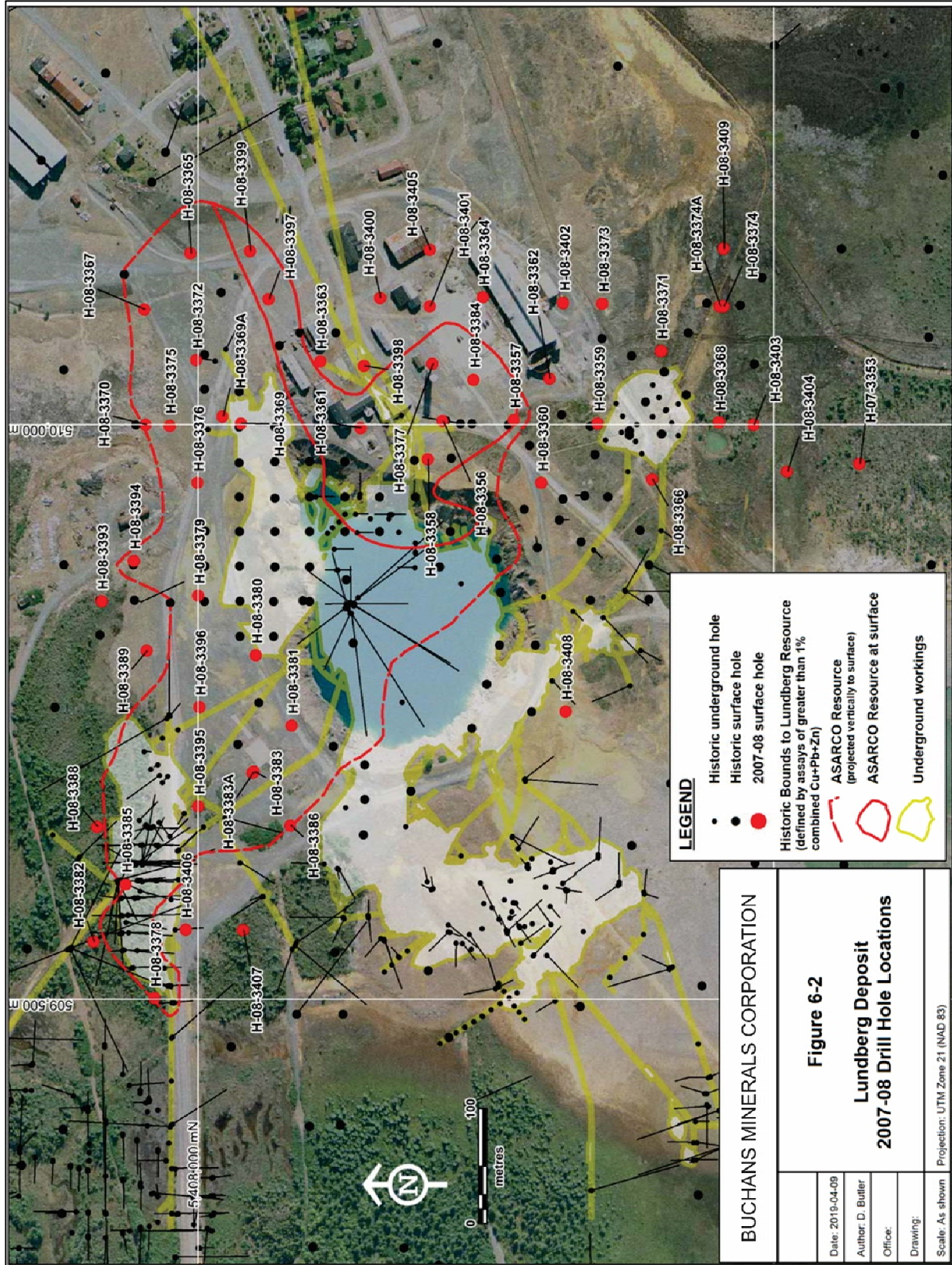
The Lundberg Zone's stockwork mineralization had previously been described by Thurlow and Swanson (1981) as a network of sulphide veins cutting strongly altered and sulphide-impregnated host rocks occurring beneath the Lucky Strike deposit. They described a wedge-shaped zone of mineralization up to 360 m wide, extending 600 m down dip with thicknesses up to 100 m. Thurlow and Swanson (1981) also noted this mineralization subcrops under shallow (<1.5m depth) surface material at the east end of the Lucky Strike glory hole, where it contains sulphide-rich mineralization intercepted in historic drill holes completed by ASARCO.

Mercator was retained by Buchans in 2007 and 2008 to help plan, manage and carry out a diamond drilling program to support Mineral Resource Estimate on the Lundberg and Engine House stockwork zones. Over this period, 53 surface drill holes comprising 8,058 m of NQ core drilling were completed on the Lundberg zone and adjacent and similar Engine House zones (H-08-3356 to H-08-3409; Figure 6-2). Mercator compiled analytical data for zinc, lead, copper, silver, gold and barite from this drilling, in addition to historical assay results from previous drilling in this area.

Results of this work resulted in an Inferred Mineral Resource Estimate of 20.7 million tonnes averaging 1.68% Zn, 0.72% Pb, 0.38% Cu, 5.92 g/t Ag and 0.07 g/t Au at a 1% Zn cut-off (effective date of November 3, 2008) that was prepared in accordance with NI 43-101 and CIM Standards (Webster and Barr, 2008). This Mineral Resource Estimate is now historic in nature and should no longer be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

The 2008 Mineral Resource Estimate was based on derived from a three-dimensional deposit block model developed by Mercator using Surpac© Version 6.0.3 deposit modelling software. Analytical results for 178 diamond drill holes were used in the estimate, of which 42 drill holes were from 2007-2008 drilling and 136 drill holes from validated historic data. The model utilized 1 metre down-hole assay composites individually calculated for Zn (%), Pb (%), Cu (%), Ag (g/t), Au (g/t) and BaSO<sub>4</sub> % database values.

Figure 6-2: Lundberg Deposit 2007-2008 Drill Holes





### 6.2.7 2010-2012 Buchans Mineral Corporation

Royal Roads Corporation (RRO) changed its name to Buchans Minerals Corporation (BMC) in July 2010 (BMC PR #16-10 Jul 2, 2010). In August 2010, BMC engaged Wardrop Engineering Inc. (a Tetra Tech company) (Wardrop) to complete a Preliminary Economic Assessment (PEA) of the Lundberg and Engine House Zones, based on the Mineral Resource Estimate prepared by Mercator in 2008 [Technical Report dated August 11, 2011 and entitled “Preliminary Economic Assessment on the Lundberg and Engine House Deposits, Newfoundland, Canada” by Daniel Coley, P.Eng., Daniel Gagnon, P.Eng., Mike McLaughlin, P.Eng., Peter C. Webster, P.Geo., and Doug Ramsey, R.P. Bio of Tetra Tech Wardrop (with Peter C. Webster of Mercator Geological Services Limited)].

To accommodate pit design and optimization by Wardrop, Mercator modified their original 2008, sub-blocked resource model by re-blocking at a constant 5 m x 5 m x 5 m block size. The modified block model contained an Inferred Mineral Resource of 22.21 million tonnes with average grades of 1.62% Zn, 0.69% Pb, 0.38% Cu, and 5.81 g/t Ag at a combined Zn-Pb-Cu cut off grade of 1%. This Mineral Resource Estimate is now historic in nature and should not be relied upon and is superseded by the current Resource Estimate (effective date February 28, 2019).

Both the Lundberg and Engine House zones are located close to surface and, after evaluation, Wardrop determined that underground mining options would not be viable on the resources as then defined. As a result, assessment was restricted to open pit scenarios. The open pit design process was optimized using the Lerchs-Grossman pit optimization method, which included design of catch berms and in-pit ramps. Once open pit mine development and production schedules were developed, mine equipment items were selected, and capital and operating costs were estimated. SGS Canada Inc. completed a two-phase metallurgical test work program to support the PEA project and results of this work are presented in Section 13.0 of this Report.

The 2011 PEA identified the combined Lundberg and Engine House deposits as having potential to support stand-alone 5,000 t per day open pit mining and milling operations over a 10-year life of mine (LOM). The overall stripping ratio of 3.06 t/t (waste/resource) would feed a flotation mill to produce separate zinc, copper and lead concentrates with silver credits in both the lead concentrate, and to a lesser degree, the copper concentrate. The mining schedule showed that a total of 52.93 Mt of waste material would be moved over the 10-year LOM.

The 2011 PEA assumed an ultimate pit design for the base case pit containing 17.28 Mt of inferred Mineral Resources (pit-constrained) with an average grade over a 10-year mine life of 1.63% Zn,

0.69% Pb, 0.40% Cu, 5.96 g/t Ag, 0.07 g/t Au and 1.24% Ba as presented in Table 6-1. Both the 2011 PEA and the associated Mineral Resource estimate are considered historic in nature and should not be relied upon. Buchans is not considering these to be current.

The 2011 PEA was based on Inferred Mineral Resources only that do not have demonstrated economic viability. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves, and there is no certainty that the conclusions of the PEA would have been realized.

**Table 6-1 Ultimate Pit Design Results (from historic 2011 PEA, Table 16.6, p. 16-20)**

Item	Tonnes (millions)	Zn %	Pb %	Cu %	Ag g/t	Au g/t	Ba %	
Inferred Resource	17,280,000	1.63	0.69	0.40	5.96	0.07	1.24	
Waste Rock	52,930,000							
Stripping Ratio	3.06							

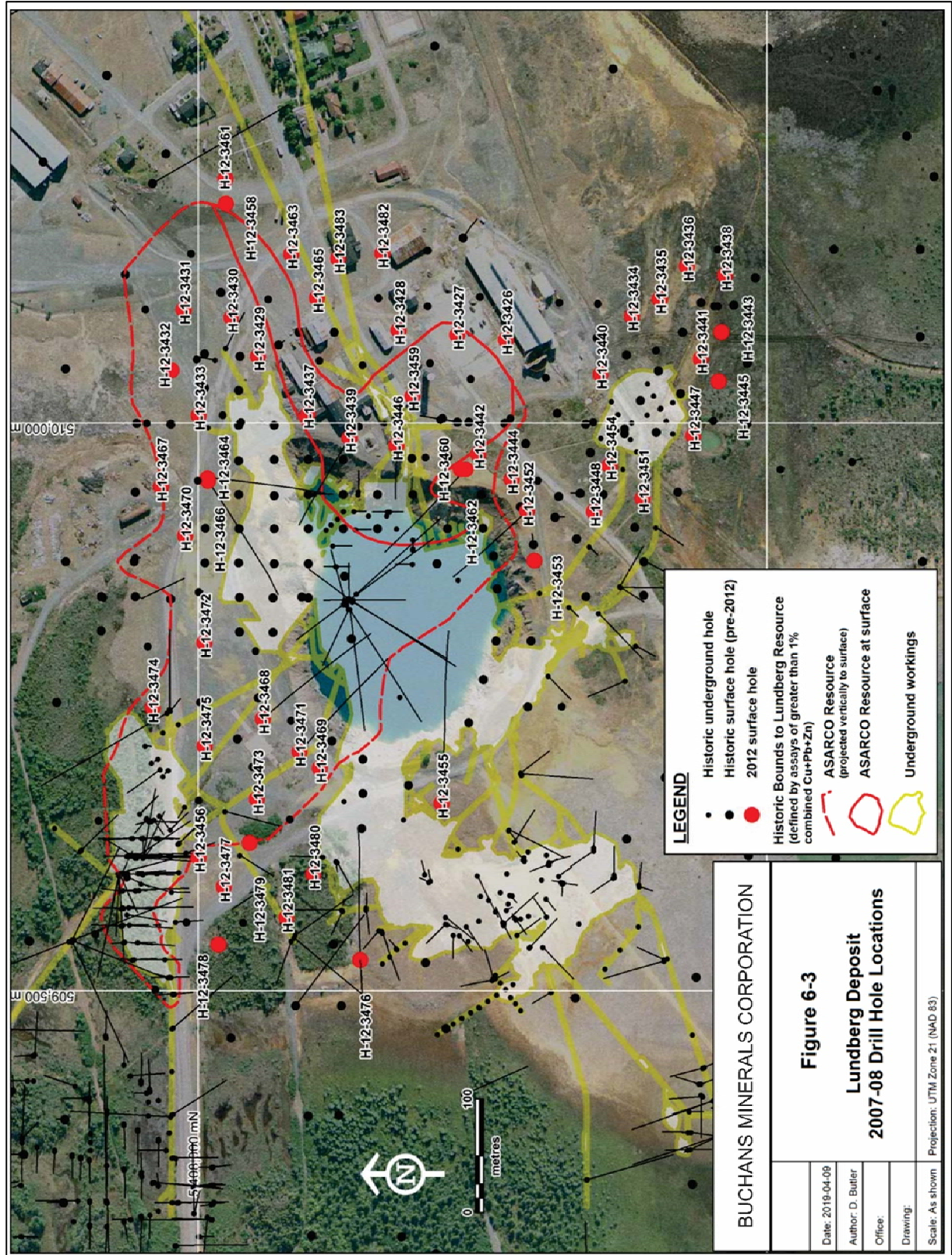
2011 PEA metal price and currency exchange assumptions: 3.62 \$US/lb Cu, 1.10 \$US/lb Pb, 1.22 \$US/lb Zn, 22.74 \$US/oz Ag, value CDN dollar in \$US 0.988.

### 6.2.8 2012-2013 Minco Plc./Buchans Mineral Corporation

Minco Plc (Minco) became a joint venture partner to BMC for the Buchans project and nearby VMS properties at Tulks North and Tulks Hill in April of 2012. Upon forming the BRJV, BMC completed a 58-hole, 8,183 metre, NQ core drilling program to upgrade Inferred Mineral Resources used in the 2011 PEA (Figure 6-3) (Moore and Butler 2013a).

The Lundberg Mineral Resource was subsequently updated to include an Indicated Mineral Resource of 23.44 million tonnes averaging 1.41% Zn, 0.60% Pb, 0.35% Cu, 5.31 g/t Ag and 0.07 g/t Au, as well as Inferred resources of 4.31 million tonnes grading 1.29% Zn, 0.54% Pb, 0.27% Cu, 4.47 g/t Ag and 0.08 g/t Au at a NSR cut-off value of \$15 US/t (Cullen and Hilchey, 2013). The 2013 Mineral Resource Estimate did not include pit optimization for definition of Mineral Resources and was spatially constrained by an NSR cut-off, grade solid modelling and a 250 m depth extent below the surface elevation. This Mineral Resource Estimate is now historic in nature and should no longer be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

Figure 6-3: Lundberg Deposit 2012 Drill Holes



Highlights from 2012 Lundberg drilling included several higher-grade intersections returned from holes along the southern margin of the Lundberg Deposit, including an intercept of 4.0 m grading 2.06% Cu, 5.94% Pb, 11.62% Zn, 119.0 g/t Ag and 0.72% Au in drill hole H-12-3453. These higher-grade intercepts were interpreted to represent remnants of the high-grade Lucky Strike ore presumably left behind by past mining either because of their narrow widths, location relative to infrastructure, or because they were not known to exist at the time of mining.

In 2012, BMC entered into an option and joint venture agreement with Minco Plc giving Minco the option to earn a 51% interest in the Buchans property, and in July of 2013, Minco acquired BMC by way of a plan of arrangement.

In August of 2017, Dalradian Resources Inc. acquired all of Minco Plc's issued and outstanding shares via a scheme of arrangement. BMC remains a wholly-owned subsidiary of Buchans Resources Limited and the registered property owner of the current Buchans Property, including Mining Lease 222 that hosts the Lundberg Deposit.

## 7.0 GEOLOGICAL SETTING AND MINERALIZATION

The following descriptions of geological setting and mineralization were substantially excerpted from Webster et al. (2008a), Webster et al. (2008b) and Cullen and Hilchey (2013) unless otherwise indicated.

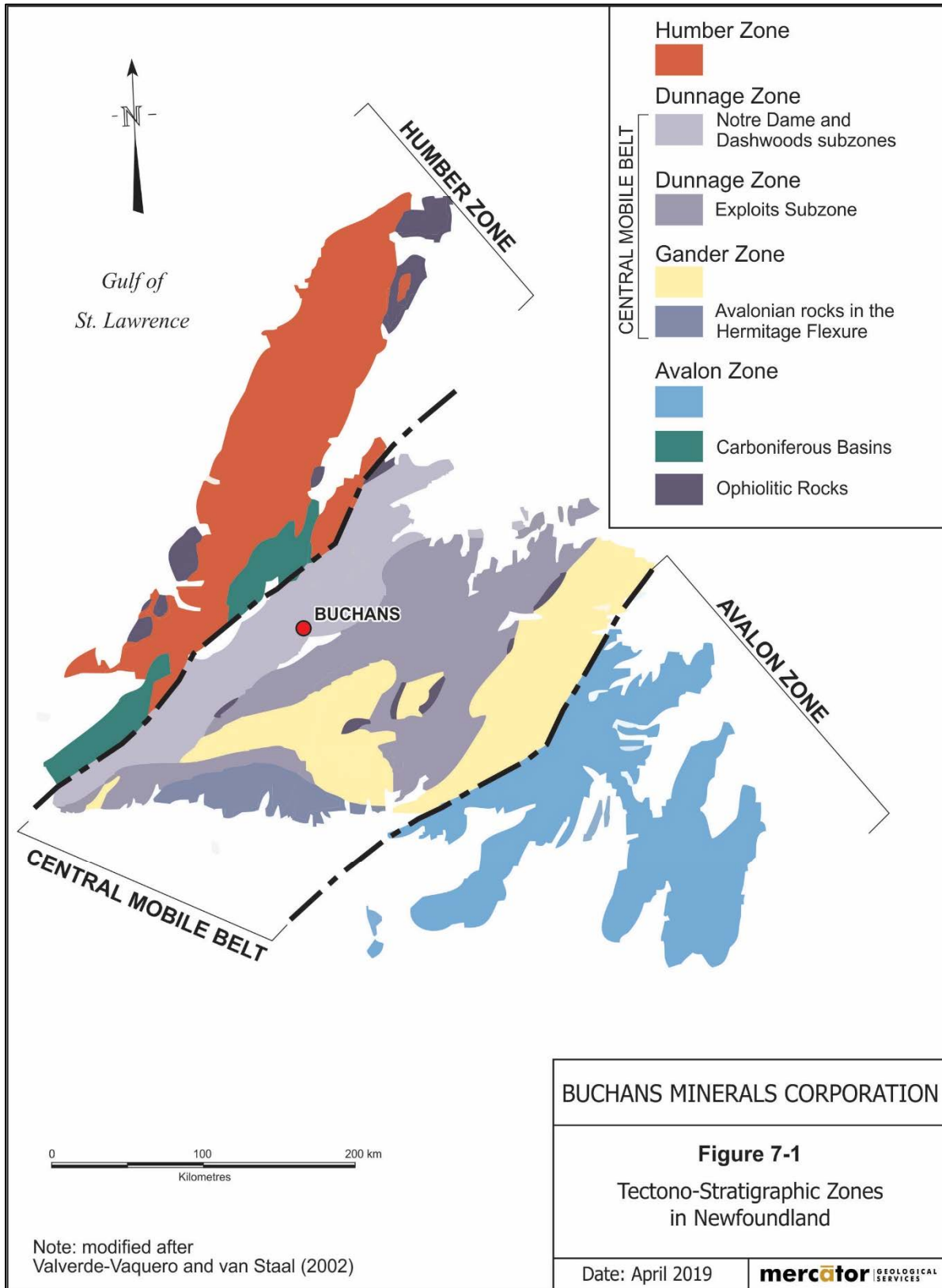
### 7.1 Regional Geology

Newfoundland is comprised of several tectono-stratigraphic zones which include from north to south, the Humber Zone, Dunnage and Gander zones of the NE-SW trending Central Mobile Belt (CMB), and the Avalon Zone (Figure 7-1). The current Buchans property holdings described in this report all lie within the Dunnage Zone.

The Dunnage Zone represents volcanic vestiges of Cambro-Ordovician continental and intra-oceanic crust, back-arc basins, and ophiolites that formed in the Iapetus Ocean (Williams, 1979; Kean et al., 1981; Swinden, 1990, Williams 1995). The zone is divided by an extensive fault system (the Red Indian Line) into a western peri-Laurentian segment (Notre Dame and Dashwoods subzones), and an eastern peri-Gondwanan segment (Exploits Subzone) (Figure 7-1). In the immediate property area, the Red Indian Line separates the Notre Dame Subzone (Buchans Group), which formed on the Laurentian or North American side of the Iapetus Ocean, from the Exploits Subzone (Victoria Lake Supergroup), which formed on the Gondwanan side of Iapetus.

Deformation associated with the final closure of Iapetus culminated during the Late Silurian, at which time thrusting and folding juxtaposed these initially geographically distinct geologic Groups and their associated volcanic belts (Colman-Sadd et al., 1992). The two main subzones of the Dunnage Zone (i.e., Notre Dame and Exploits subzones) have been conclusively differentiated based on stratigraphic, structural, faunal, and isotopic characteristics (Williams et al., 1988).

Figure 7-1: Tectonostratigraphic Zones, Newfoundland



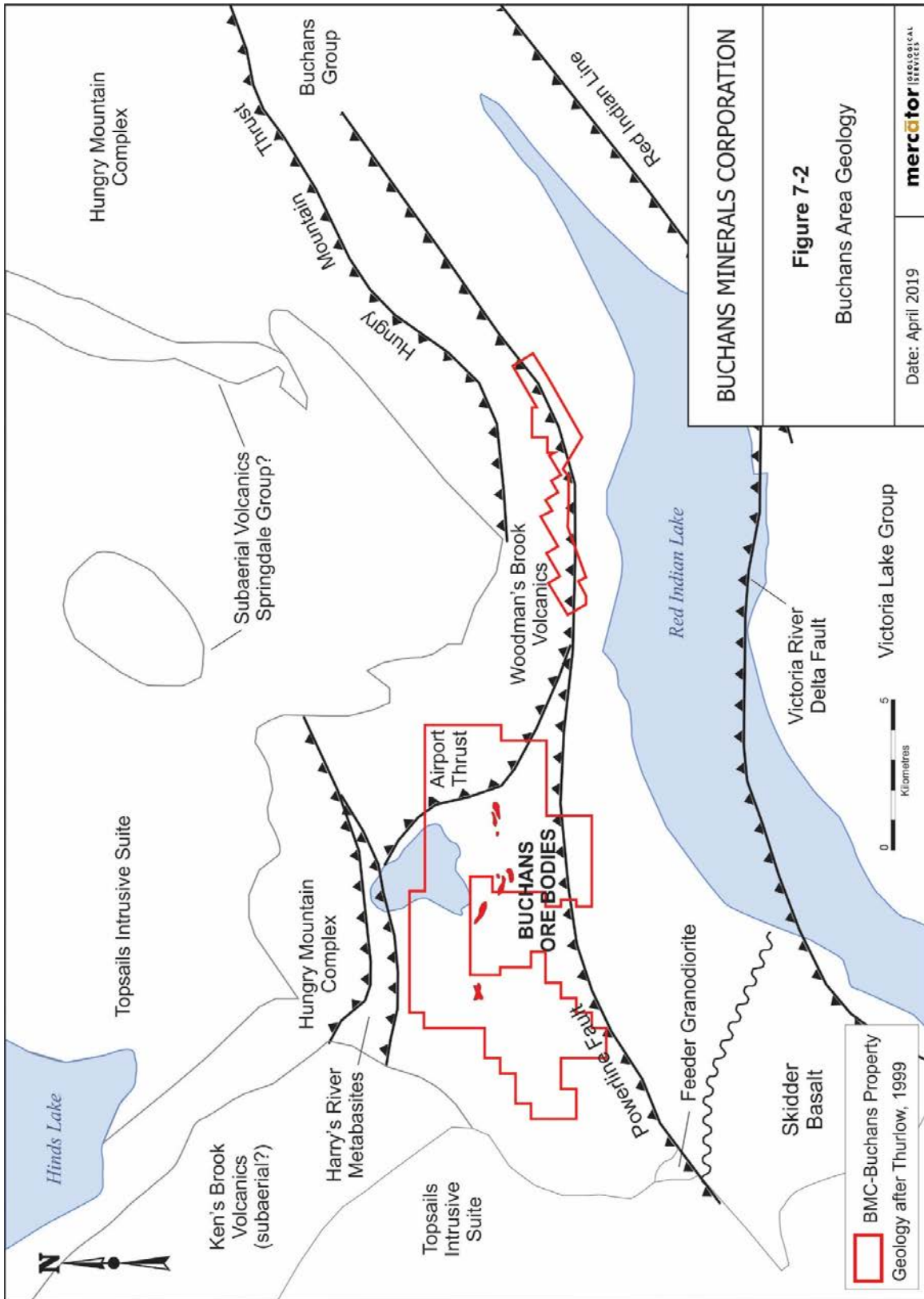
## 7.2 Property Geology

The property is primarily underlain by subaqueous volcanic and volcano-sedimentary rocks of the Buchans Group of the Norte Dame subzone and may be correlative with the Roberts Arm Group of Notre Dame Bay area to the north (Thurlow and Swanson, 1981). Volcanic rocks within this Group range in composition from basalt to rhyolite with a generally increasing proportion of felsic rocks with stratigraphic height (Thurlow and Swanson, 1981). This variation from mafic to felsic volcanism is repeated several times within the Buchans Group and repetition was originally interpreted as repeating volcanic cycles (e.g. Thurlow et al., 1975). A revised and more generally accepted geological interpretation explains this repetition as being largely attributable to thrusting (Thurlow and Swanson, 1981).

The five main ore bodies historically mined at Buchans are thought to occur within a single felsic stratigraphic horizon within the Buchans Group. The Buchans Group lies structurally above the ophiolitic Skidder Basalt in the southwest, and the Victoria Lake Supergroup of Cambro-Ordovician origin to the southeast (Thurlow and Swanson, 1981) (Figure 7-2). The Feeder Granodiorite is an intrusive body interpreted to represent part of the subvolcanic magma chamber which fed the Buchans Group in some areas (Thurlow and Swanson, 1987). Geochemical evidence suggests the Feeder Granodiorite is the source of granitic boulders found within the breccia-conglomerate deposits within the transported ores at the Buchans deposit (Thurlow and Swanson, 1981).

Poly-deformed intrusive rocks of the Cambro-Ordovician Hungry Mountain complex are thrust over the Buchans Group in the north and are intruded by the Devonian Topsails Granite in the northeast. In the northwest, Silurian subaerial volcanics unconformably overlie the Buchans Group and carboniferous red beds overlie the Buchans Group in the Red Indian Lake basin. The Ken's Brook Volcanics are also thought to overlie the Buchans Group, but this relationship is not clearly understood (Thurlow and Swanson, 1987 and Thurlow, 1999). Rocks of the Harry's River Metabasites have recently been reinterpreted as ophiolitic rocks of the more widespread Lloyds River ophiolite complex (Zagorevski et al., 2007) and have no stratigraphic linkage with the Buchans Group (Zagorevski et al., 2015). The rocks in the Buchans area are metamorphosed to low-grade prehnite-pumpellyite facies and were originally determined to have an age of 473 +/- 2Ma derived from U-Pb zircon age dating of Buchans Group rhyolite (Dunning et al., 1987). Subsequent age dating by the Geological Survey of Canada now suggests the Buchans rocks have ages closer to 462±3 Ma and 465±3 Ma (Zagorevski and Rogers, 2008; Zagorevski et al., 2007; Whalen et al., 2013; Zagorevski et al., 2015) based on U-PB zircon dating conducted on rhyolites near the former Oriental Mine.

**Figure 7-2: Buchans Area Geology**





### 7.3 Stratigraphy and Rock Types

As mentioned above, the five main ore bodies historically mined at Buchans are thought to occur within a single felsic stratigraphic horizon within the Buchan Group, but recognition of this stratigraphy on a regional basis is difficult. Thurlow et al. (1975) noted that the mafic to felsic volcanism was repeated several times within the Buchans Group and initially explained this as cyclical re-occurrence.

Subsequent studies completed following the closure of mining operations in 1984 resulted in recognition of regional thrusting and structural repetition of geology, resulting in re-interpretation of Buchans Group stratigraphy (Thurlow and Swanson, 1987). The stratigraphic re-interpretation of the Buchans Group was largely based on the relationship of fault bound mineralized blocks and led to the establishment of four sub-units or formations within the Buchan Group. These are felsic and mafic volcanic sequences identified as the Lundberg Hill, Ski Hill, Buchans River, and Sandy Lake formations, in addition to the Feeder Granodiorite, as well as an unresolved unit named the Woodman's Brook Volcanics (Thurlow, 1999) (Figure 7-3).

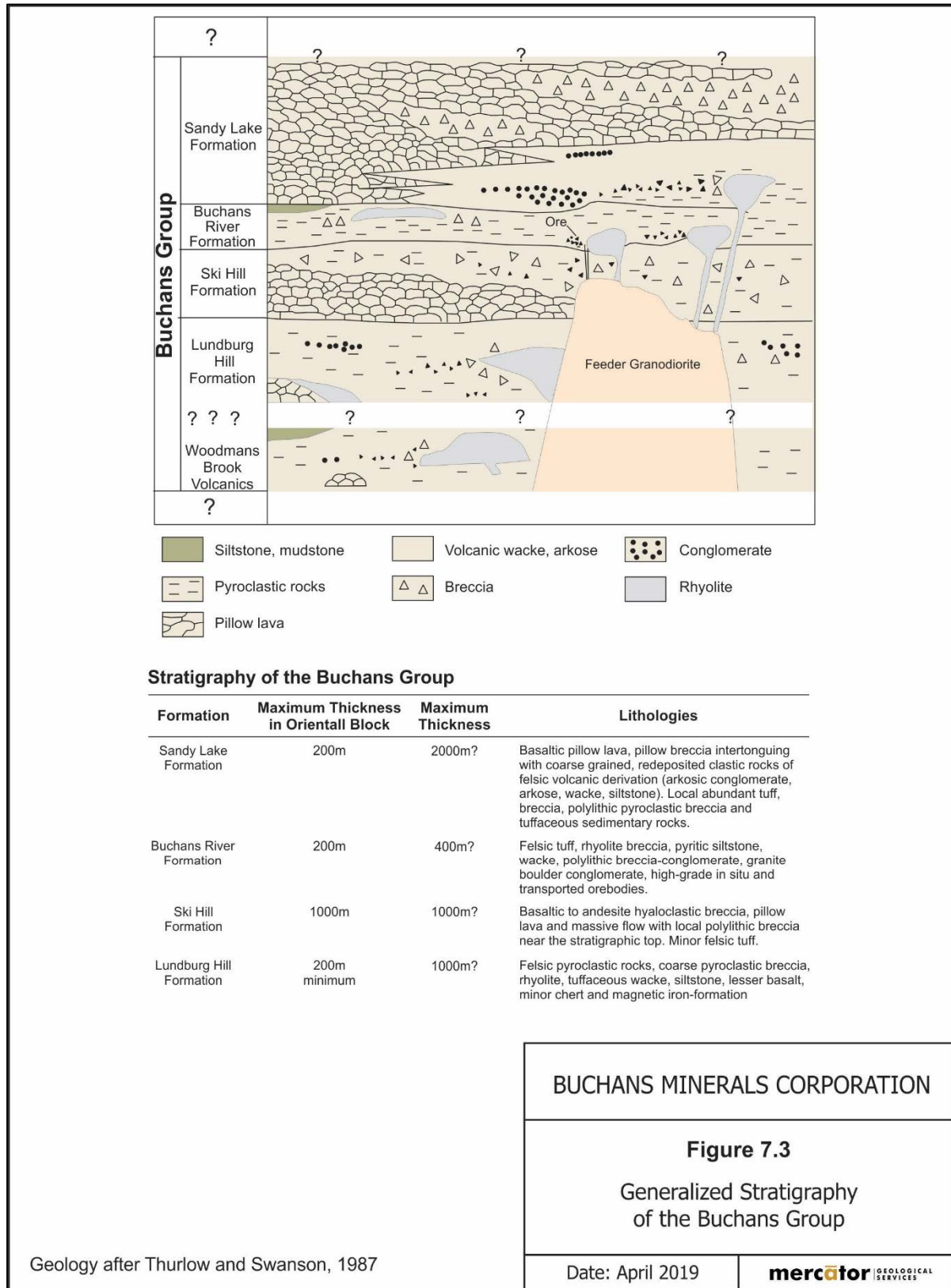
More recent geological interpretations for the Buchans Camp rocks have attempted to re-assign the geology in and around Buchans within a revised tectono-stratigraphic framework based on trace element geochemical and age-dating studies (e.g., Zagorevski et al., 2015). While potentially significant with respect to regional correlation of mineralized host stratigraphy of the Buchans Group within the current property, this re-interpretation has limited bearing on the current property where more detailed work has assigned the geology of the property to the Buchans Group and its formations as proposed by Thurlow et al., (1987), particularly the Lundberg Hill, Ski Hill, Buchans River and Sandy Lake formations, as well as the still poorly constrained Woodman's Brook Volcanics that have been tentatively assigned by Zagorevski et al., 2015, to the slightly younger (ca 461 Ma $\pm$  4 Ma) proposed Mary March Brook Group. The latter interpretation being largely based upon these rocks possessing predominantly tholeiitic chemistries compared to the predominantly calc-alkalic compositions observed within the Buchans Group.

The lowermost unit of the Buchans Group is the Lundberg Hill Formation, which is characterized by felsic pyroclastic rocks, coarse pyroclastic breccia, rhyolite, tuffaceous wacke, siltstone, and lesser basalt with minor chert and magnetic iron-formations. The Lundberg Hill Formation has a maximum thickness which ranges from 200 to 1000 m (Thurlow and Swanson, 1987). The Lundberg Hill Formation is conformably overlain by the Ski Hill Formation which is dominantly

composed of dark green mafic pillow lavas, breccias and pyroclastic rocks (Thurlow and Swanson, 1987).

The Buchans River Formation hosts the historic ore deposits mined at the Lucky Strike, Engine House, Oriental, Rothermere and MacLean mines and is comprised of felsic tuff, rhyolite breccia, pyritic siltstone, wacke, poly lithic breccia-conglomerate and granite boulder conglomerate, plus both in situ and transported sulphide zones. This formation ranges from 200-400 m in thickness in the mines area and smaller amounts of the formation are found locally throughout the Buchans area (Thurlow and Swanson, 1987) (Figure 7-3).

**Figure 7-3: Stratigraphic Column for Buchans Group**



## 7.4 Structural Geology and Metamorphism

The Buchans Group has been subjected to two major periods of deformation. The first was a Silurian episode of south-easterly-directed thrusting during which the Hungry Mountain Complex, which consists largely of pre-deformed granitoid rocks, was emplaced upon the Buchans Group. In addition, this period of thrusting caused repetition of units within the Buchans Group, including the possible repetition of an originally continuous sulphide bearing sequence that hosts the past-producing ore deposits. The second deformational event resulted in development of broad open folds during the Devonian, which show associated weak, northeast-trending axial planar cleavage in all rock types. A large northeast-trending syncline in the Buchans Group is related to this event (Thurlow, 1981).

## 7.5 Mineralization

### 7.5.1 Buchans Area

Mineralization in the Buchans area is associated with the three main genetically related mineral deposit types: 1) massive in situ sulphide; 2) transported sulphide clasts; and 3) stockwork and stringer sulphides.

The Lucky Strike and Oriental #1 deposits are the best-known examples of the in situ sulphide style of mineralization, contain the highest metal grades mined in the Buchans area and occur on the current Buchans property (Thurlow and Swanson, 1981). Massive in situ sulphides exhibit various textures, but massive, fine-grained, streaky texture is most common and occurs in aggregates of sphalerite, galena, barite and lesser chalcopryrite. Thurlow et al. (1975) reported presence of trace amounts of enargite, native silver and argentite, ruby silver and gold tellurides, in addition to native silver and gold in this style of mineralization. Minor sulphides also include tetrahedrite-tenantite, chalcocite and bornite. Pyrite forms a relatively minor part of the massive sulphide assemblage but is more common in association with stockwork sulphides (Thurlow and Swanson, 1981). The paragenetic sequence of mineral deposition is complex and includes resorption, fracturing and re-deposition. Pyrite appears to be the first mineral deposited and sphalerite, chalcopryrite and galena are thought to be deposited at the same time. However, chalcopryrite is also seen as blebs, lamellae and veins (Strong, 1981).

Transported mineralization occurs as elongate, tabular accumulations of discrete fragments of high-grade sulphides (Thurlow and Swanson, 1981). These deposits reflect transport by density flows that were controlled by paleo-topographic lows that extended down slope from in situ

sulphide zones. The MacLean, Rothermere, Clementine and Oriental #2 deposits are examples of transported sulphide styles of mineralization. Together with the massive style, they represent 98% of the production from Buchans deposits. The transported mineralization occurs as mechanically transported sulphide breccia lenses composed of sulphide bearing fragments derived from in situ sulphide zones (Thurlow and Swanson, 1981). These deposits demonstrate transport of as much as 2 km from source areas. Sulphide fragments range from angular to sub-rounded and display streaky textures, with sphalerite, galena, chalcopryrite and barite being the main minerals. Unlike the in situ sulphide ore deposits, these deposits have no associated stockwork zone. Stockwork mineralization is typically associated spatially with in situ sulphide zones and the best example on the Buchans property is the Lundberg zone.

Mineralization is also found in association with high-grade clasts noted from drilling within the Buchans area and their source is not clearly understood. Clasts range in size from grains and pebbles to 30 cm boulders of high-grade sulphide mineralization. The clasts contain galena, sphalerite, pyrite, chalcopryrite and gold and silver and are similar in metal grades to the in situ Buchans ores. They occur in poly lithic conglomerates within the same stratigraphic horizon as the in situ ore but also at distances of up to 6.7 km away from any known in situ ore body (Thurlow and Swanson, 1981).

#### **7.5.1.1 Lundberg and Engine House Zones**

The Lundberg zone sits below the historic Lucky Strike orebody and consists of sulphide veins and veinlets plus disseminated sulphide mineralization hosted by strongly altered felsic to intermediate volcanics. The stockwork mineralization comes to surface on the eastern edge of the zone and forms an elongate, wedge-shaped body that is 250 m deep on the western end. The highest concentration of sulphide mineralization lies in close proximity to the Lucky Strike massive sulphide zone and mineralization is more diffuse away from the zone. Unlike the in situ sulphides, fine- to coarse-grained euhedral pyrite is the dominate sulphide and occurs with varying amounts of chalcopryrite, sphalerite, galena and barite (Thurlow and Swanson, 1981).

A second zone of stockwork mineralization is associated with the Engine House zone, which is located immediately south of the Lucky Strike deposit, and this zone has a higher proportion of chalcopryrite.

## 8.0 DEPOSIT TYPES

The following descriptions regarding deposit types found on the Buchans property are excerpted with modification from the previous Technical Reports prepared by Mercator for Buchans predecessors, Buchans River Limited (Webster and Barr, 2008) and Buchans Minerals Corporation (Cullen and Hilchey, 2013).

The Buchans area deposits and showings are classified as being of volcanogenic massive sulphide (VMS) association, primarily comprised of base-metal sulphides and barite and show strong similarities to the Kuroko style deposits of Japan (Thurlow, 1981).

The Buchans deposits include three distinct but genetically related deposit types, and occur as in situ sulphides, mechanically transported sulphides, and stockwork sulphides (Thurlow and Swanson, 1981). The high-grade in situ and transported styles were the focus of historic mining in the area and the stockwork style, associated with lower grade sulphide mineralization at the Lundberg Deposit, has been the focus of recent exploration programs by Buchans.

The zoned massive sulphides of the in situ deposits are interpreted to have formed in close proximity to volcanic discharge zones. They consist of thick lenses of high-grade sulphide and form the largest deposits in the Buchans area. The in situ sulphides are overlain by a cap of massive barite that is characteristic of the historically mined Buchans deposits and may provide an important lithogeochemical exploration tool. The felsic volcanics also host lower grade, base metal enriched sulphide systems of hydrothermal alteration that manifest as stockwork mineralization (Thurlow et al., 1975).

The largest known concentration of stockwork and disseminated mineralization is the Lundberg zone that underlies the Lucky Strike deposit. Stockwork mineralization consists of a network of sulphide veins and veinlets that cut strongly altered and sulphide-impregnated hosts rocks. The stockwork mineralization has a higher ratio of pyrite to base metal sulphides than the in situ sulphide zones and is typified by presence of fine- to coarse-grained pyrite with lesser amounts of chalcopyrite, sphalerite, galena and barite. This mineralization occurs within felsic volcanic rocks of the Buchans River Formation below the Lucky Strike deposit and extends well into the underlying Ski Hill Formation, where sulphide-bearing stockwork mineralization occurs at tens to hundreds of metres below the deposit (Jambor, 1987). In that instance, mineralization thins and feathers out into lower grade, semi-conformable zones of alteration (Moore, pers. com., 2013).

Transported sulphide deposits are coarser grained and are interpreted to be debris flows originating from the in situ deposits that have accumulated in paleo-channels and other downslope regions. The transported sulphide deposits at Buchans are elongate, tabular accumulations of high-grade massive sulphide fragments and lithic fragments that most commonly occur within paleo-topographic channels. Six of these channels, containing at least seven economic and sub-economic sulphide deposits have been recognized in the Buchans area including the former Two-Level/North Orebody (Lucky Strike), Rothermere, Oriental #2, MacLean-MacLean Extension orebodies, as well as the undeveloped Clementine, and Sandfill prospects.

Transported sulphide deposits are characterized by massive sulphide and lithic fragments in a matrix of finer grained material that is compositionally similar to the fragments. Clasts include various volcanic, sedimentary and plutonic lithologies, all of which are interpreted to have been locally derived. Granitoid fragments show an anomalous composition and a higher degree of rounding than other fragments and are interpreted based upon age dating as well as geochemical and isotopic evidence to represent exhumed and eroded felsic plutonic rocks related to the felsic volcanic host rocks to the Buchans deposits (Stewart, 1987; Whalen et al., 2013). Massive sulphides and barite occur both as clasts and matrix material (Thurlow, 2001).

## 9.0 EXPLORATION

Exploration prior to 2014 is summarized in report Section 6.0 and detailed in earlier Technical reports by Mercator and/or Wardrop. Only recent exploration not previously disclosed in a Technical Report is included in the current Report, with this applying specifically to the 2014 through 2018 period that is addressed below.

### 9.1 2014 to 2017 Buchans Mineral Corporation

Exploration prior to 2014 is summarized in report section 6.0 and detailed in earlier Technical reports by Mercator.

In 2014, Buchans undertook additional work to further advance the Lundberg project towards Pre-feasibility, including additional metallurgical test work by SGS (Roman and Imeson, 2011; Legault, 2013; & Patsias and Imeson, 2014) and pre-concentration test work using Optical Ore sorting technology by Tomra (2014) as previously described in Moore and Butler, 2015. Environmental studies were also undertaken, contracted to Sikumiut Environmental Management Limited (Ledrew, 2012 and Sikumiut, 2013) that included collection and analyses of water from the Lucky Strike glory hole (Moore and Butler, 2014).

Also in 2014 (Moore and Butler, 2015), Buchans undertook exploration activities to further assess the Lundberg Deposit and immediate surrounding area. These exploration activities included relogging of archived drill core from the Lucky Strike and Engine House orebodies, including more than 9,200 metres of core from 87 archived drill holes. Work also included limited assay sampling of archived cores to provide confirmation assays within a portion of the 2013 Inferred Mineral Resource located beneath the glory hole that was inaccessible to drilling (Cullen and Hilchey, 2013; Moore and Butler, 2013).

As follow-up to relogging, Buchans undertook a 5-hole (642.6 metres) diamond drilling program to explore for shallow extensions to the high-grade Lucky Strike ore-body and the lower grade Engine House and Lundberg zones (Moore and Butler, 2015; 2016). This drilling confirmed extensions to both the Lucky Strike massive sulphide horizon with 2 drill hole intersections and the deeper Engine House Horizon with 3 drill holes intersections.

In 2015, Buchans undertook a drilling program focused on the area southwest of Lucky Strike (Lundberg) where it drilled 8 holes and extended 4 existing holes, drilling a total of 2,206 m. The program met with success with respect to expanding the Lucky Strike and Engine House deposits;



however, results indicate the Engine House zone appears to be closed off to the west, where the zone thins and decreases in grade. Also in 2015, Buchans continued its ongoing relogging program by relogging archived drill cores stored at the Newfoundland and Labrador government's core library facility in Buchans.

In 2016-17, Buchans continued its core relogging program to further assess exploration potential within the Buchans property. Initial relogging of historic drill holes focused on the immediate Lundberg Deposit area, and then stepped out to several of the historic orebodies and undeveloped prospects. The latter areas were assessed in this way as potential target areas where additional exploration may discover additional mineralization that might complement Lundberg's development, or perhaps be developed as additional stand-alone deposits of high-grade, Buchans-style mineralization. As of the date of this report, Buchans has relogged more than 650 holes totalling more than 123,000 metres of drill core as part of this initiative, including approximately 420 historic holes within the Lundberg Deposit area. Significant portions of this work have been entered into a digital drilling database for Buchans. Hardcopy interpreted paper sections have been compiled in each of the areas and used to refine the current geological interpretation (map) for the property. Mercator has adapted scanned sections for the Lundberg Deposit area for incorporation into the current Mineral Resource Estimate.

## **9.2 2018 Buchans Resources Limited**

Work completed in 2018 included diamond drilling (28 holes totaling 5,111 metres) and subsequent borehole geophysical surveys. Drilling included 17 holes (2,205 m) drilled at the Lundberg stockwork sulphide deposit as in-fill and step-out holes to support the current Mineral Resource Estimate and 11 holes (2,906 m) drilled to explore for higher-grade VMS deposits within 3.5 km of the Lundberg Deposit.

## 10.0 DRILLING

### 10.1 Introduction

Diamond drilling completed on the Buchans property, including the Lundberg Deposit area prior to 2014 is summarized in Section 6.0 of this Report, and is addressed more extensively in previous Technical Reports by Webster and Barr (2008) and Cullen and Hilchey (2013). Buchans has since completed two drilling programs, including a 2014-15 exploration drilling program south of Lundberg (Lucky Strike South area), and Lundberg Deposit drilling in 2018. Both of these programs are summarily described in Section 9 of this Report. As the latter two programs have influence within the Lundberg Deposit area, they are described in more detail here as their results support the 2019 Mineral Resource Estimate (Figure 10-1).

The 2014-2015 Lucky Strike South drilling program totaled 16 holes (3,255 m of drilling) including 5 holes (totaling 642.9 m) drilled in 2014; as well as drilling completed in 2015 consisting of 12 new holes plus several extensions of earlier Buchans holes (totaling 2,686 m).

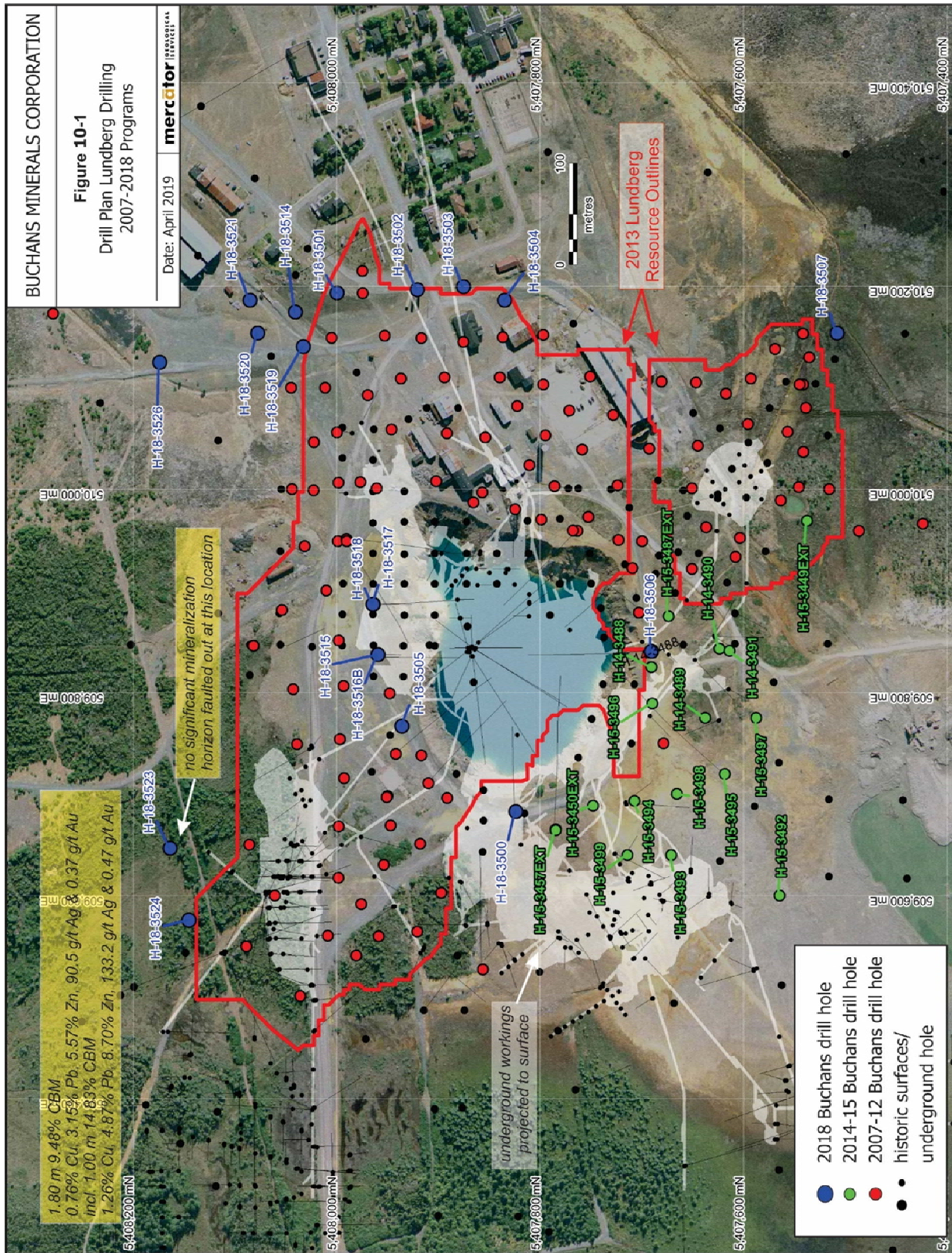
The 2018 Lundberg area drilling included in-fill and step-out drilling of the Lundberg Deposit comprised of 17 new drill holes (totalling 2,205 m), the majority of which were drilled based on recommendations of Mercator for the purpose of up-grading and further delineating the deposit in advance of the 2019 Mineral Resource Estimate.

Descriptions of these programs are presented below, and collar coordinates plus azimuth, inclination and depth data specific to all Lundberg Deposit area holes drilled since the 2013 report are tabulated in Tables 10-1, 10-2, and 10-3, and a collar plan for the Lundberg Deposit area holes appears in Figure 10-1.

### 10.2 2014 to 2015 Buchans Mineral Corporation

In 2014, Buchans undertook a 5-hole (642.6 metres) diamond drilling program to explore for shallow extensions to the high-grade, Lucky Strike ore-body and the lower grade Engine House and Lundberg zones (Moore and Butler, 2015). All five holes (H-14-3487, -3488, -3489, -3490, -3491) were drilled south of the glory hole on the margins of an optimized open pit (2013, internal pit model) proposed for development of the Lundberg Mineral Resource. Summary details for the 2014 Lucky Strike South (Lundberg area) drill holes are provided in Table 10-1.

Figure 10-1: Drill Plan of Lundberg Deposit 2007-2018 Drill Programs



**Table 10-1: Summary of Drill Holes Completed in the Lucky Strike South Area in 2014**

Hole	UTM m E	UTM mN	Elev.(m	Length (m)	Dip °
<b>H-14-3487</b>	509875	5407675	287.2	199	-90
<b>H-14-3488</b>	509830	5407690	291.3	200	-90
<b>H-14-3489</b>	509775	5407639	288.7	191	-90
<b>H-14-3490*</b>	509843	5407625	288	86.6	-90
*hole abandoned in underground workings, moved and re-drilled as H-14-3491					
<b>H-14-3491</b>	509841	5407615	288	152	-90

\* NAD83, Zone 21 UTM coordinates. Elevations relative to mean sea-level.

Drilling was undertaken over the period of September to October 2014, with drilling contracted to Springdale Forest Resources of Springdale, NL. NQ core was drilled using a Duralite 500 drill rig, and the program was managed by Buchans staff. Hole orientation tests were collected by Springdale Forest Resources at a nominal spacing of 50 metres using a Flexit test system. All holes were surveyed using differential GPS by Red Indian Surveys of Grand Falls-Windsor (NL) to determine accurate, sub metre) collar locations and elevations. All cores were logged and sampled by Buchans geological and technical staff with core descriptively logged on site, aligned, marked for sampling and split longitudinally using a diamond saw. Samples consisted of halved NQ-size diamond core (47.6 mm diameter core) with the remaining half of the core is preserved in core boxes for future reference. All sampling and assaying was completed in keeping with Buchans' 2014-2015 QA/QC protocols as described further in Section 11 of this Report.

The 2014 drilling confirmed extensions to the Lucky Strike massive sulphide horizon, with 2 holes intersecting high-grade mineralization at the Lucky Strike horizon, while 3 holes intersected the deeper Engine House horizon, approximately 40 to 50 m below the Lucky Strike horizon. Hole H-14-3488 intersected significant mineralization at the top of the Engine House zone, including an intercept of 7.80 m (core length) averaging 3.43% Zn, 1.85% Cu, 1.30% Pb, 22.9 g/t Ag, that included 1.45 m (core length) of massive sulphides assaying 17.00% Zn, 2.51% Cu, 6.54% Pb, 92.5 g/t Ag and 0.14 g/t Au.

In addition to positive results obtained from the Lucky Strike and Engine House horizons, hole H-14-3489 tested a lesser known, deeper horizon referred to as the Ore Clast horizon (historically referred to as the "HAG" horizon) where it cut a 1 metre (core length) intercept assaying 2.31 % Zn, 0.08% Cu, 1.49% Pb, 24.6 g/t Ag and 0.47 g/t Au. While little was known about the Ore Clast horizon, results from limited and widely spaced historic drilling were reviewed and noted to host potentially significant mineralization (below Lundberg and Engine House mineralization).

Given the positive results returned from the 2014 Lucky Strike South drill program, it was recommended that Buchans undertake additional relogging and diamond drilling in 2015 to explore for additional extensions to high-grade massive sulphides occurring on the Lucky Strike and Engine House horizons, as well as explore the deeper Ore Clast horizon southwest of the Lucky Strike glory hole (Moore and Butler, 2016).

In 2015 Buchans undertook a drilling program southwest of Lucky Strike (Lundberg) where it drilled 8 holes and extended 4 existing holes for a total of 2,206 m of core drilling. The program was managed by Buchans staff with drilling undertaken over the period from April to May 2015. Drilling was completed under contract to CABO Drilling Corp (“CABO”) of Springdale, NL, who cored NQ core using an Atlas Copco B320 drill rig supported by a Cat D-5 bulldozer and Cat 315 excavator. Hole orientation tests were collected by CABO at a nominal spacing of 50 metres using a Flexit test system. All core was handled exclusively by CABO and Buchans personnel with chain of custody maintained throughout the program, including delivery of core samples to Eastern Analytical’s (“Eastern”) assay Laboratory in Springdale, NL. Summary details for the 2015 Lucky Strike South (Lundberg area) drill holes are provided in Table 10-2. Eastern is an independent, accredited analytical services firm registered to ISO standards.

All cores were logged and sampled by Buchans geological and technical staff with core descriptively logged on site and sampled intervals aligned, marked for sampling and split longitudinally using a diamond saw. All cores were photographed prior to sampling and archived in Buchans’ digital records. All sampling and assaying was completed using the same parameters as the 2014 QA/QC protocols as further described in Section 11 of this Report.

**Table 10-2: Summary of Drill Holes Completed in the Lucky Strike South Area in 2015**

Hole	UTM m E	UTM m N	Elev.(m)	Dip°	Azim.°	Length (m)
H-15-3457EXT	509664.2	5407785.9	291.8	-88.4	315	317.6
H-15-3449EXT	509968.8	5407539.0	286.4	-89.7	327	175.0
H-15-3450EXT	509688.5	5407749.1	291.1	-90.0		242.0
H-15-3487EXT	509875.0	5407675.0	287.2	-90.0		164.0
H-15-3492	509600.0	5407566.0	291.1	-90.0		250.0
H-15-3493	509634.0	5407672.0	287.3	-89.7	53	246.0
H-15-3494	509690.0	5407710.0	288.0	-90.0		228.0
H-15-3498	509700.0	5407666.9	287.5	-90.0		239.0
H-15-3495	509766.5	5407667.5	287.7	-51.0	45	249.5
H-15-3497	509775.0	5407589.0	286.2	-90.0		200.0
H-15-3496	509789.0	5407691.0	289.0	-65.0	45	125.0
H-15-3499	509639.8	5407715.5	287.7	-90.0		252.0

\* NAD83, Zone 21 UTM coordinates. Elevations relative to mean sea-level.

Two holes (H-15-3495 & 3496) drilled west and northwest of high-grade massive sulphides previously intersected at Engine House in 2014 (hole H-14-3488), intersected only weak mineralization at the Engine House horizon.

Holes drilled south of the Lucky Strike deposit met with success as H-15-3496 intersected mineralization immediately south of former mine workings cutting 5.05 m averaging 5.98% combined base metals as 0.20% Cu, 2.15% Pb, 3.63% Zn, 8.9 g/t Ag, and 0.05 g/t Au, including 2.70 m averaging 7.41% combined base metals as 0.23% Cu, 2.74% Pb, 4.44% Zn, 10.1 g/t Ag, 0.06 g/t Au. Further south, holes testing the southernmost lobe of the Lucky Strike deposit intersected 0.94 m assaying 12.04% combined base metals as 0.44% Cu, 3.80% Pb, 7.80% Zn, 88.4 g/t Ag, and 1.62 g/t Au in hole H-15-3495; and 0.5 m averaging 8.23% combined base metals as 0.20% Cu, 3.60% Pb, 4.43% Zn, 32.2 g/t Ag, and 0.29 g/t Au in hole H-15-3497.

Among encouraging result returned from the 2015 program was the consistent intersection of the Ore Clast horizon; the deepest of the three horizons tested and located 75 to 50 metres below the Lucky Strike and Engine House horizons. All 10 holes designed to test the Ore Clast horizon intersected mineralization containing mineralized ore clasts composed of high-grade massive sulphides to heavily mineralized and altered felsic volcanic clasts up to 15 cm in diameter. Highlights include a drilled intercept of 0.5 m averaging 13.32% combined base metals in hole H-15-3493 as 1.80% Cu, 5.20% Pb, 6.32% Zn, 53.3 g/t Ag, and 0.18 g/t Au; as well as hole H-15-3497 that intersected a 1.0 m section averaging 6.16% combined base metals as 0.35% Cu, 1.72% Pb,

4.10% Zn, 63.4 g/t Ag, and 0.27 g/t Au. The Ore Clast horizon appears to be thickening to the west where it may hold potential for discovery of new orebodies composed of breccia or “transported ores” similar to those previously mined in Buchans. Transported ores are reported to have accounted for approximately 52% of the camp’s historic production and to have had an average grade of 1.04% Cu, 7.12% Pb, 12.20% Zn, 124.9 g/t Ag and 1.04 g/t Au.

### 10.3 2018 Buchans Minerals Corporation

Drilling was undertaken at Buchans (including Lundberg) over the period of June to December 2018 and included drilling 28 new holes (5,111 m), as well as cleaning out several holes for borehole geophysical surveys. The program was completed under contract to ICM Petro Drilling Ltd. (“Petro”) of Springdale, NL, who cored NQ core using up to 3 drill rigs and support equipment including Atlas Copco B20, Atlas Copco S2, and Duralite T800 drill rigs supported by a 315c Cat excavator and a D5 Cat bulldozer. The program was managed by Buchans staff with support from professional consultant geologist, James Harris, P.Geol., and further supported by locally hired technicians. All hole collars, except H-18-3526, were surveyed using DGPS by Red Indian Surveys who recorded collar locations in NAD 83 coordinates, as well as collar elevations relative to mean sea-level. Hole H-18-3526, being the last hole of the program, and located outside of the perceived Lundberg Resource, had its collar location established using hand-held GPS (+/- 8 m accuracy) and will be surveyed by DGPS in the future. Down-hole orientation tests were recorded by Petro at a nominal spacing of 50 metres using a Flexit test system. All core was handled exclusively by Petro and Buchans personnel and contractors, with chain of custody maintained throughout the program, including delivery of assay samples to Eastern assay Laboratory in Springdale, NL.

All core handling, sampling and sample handling procedures were undertaken in line with Buchans’ 2014 and 2015 QA/QC protocols; however the QA/QC protocols were modified and enhanced as field duplicates were added to the QA/QC procedure (one sawed quarter core sample every 20 samples), while Ore Grade check assays were also completed by ALS on a select number of samples so as to include a representative and broad range of assaying values as further described in Section 11 of this Report.

Drilling included 17 holes (2,205 m) drilled at the Lundberg stockwork sulphide deposit as in-fill and step-out holes in preparation for the current Mineral Resource Estimate, as well as two holes (822 m) drilled immediately north of the Lundberg Deposit to explore for extensions to the Lucky Strike orebody within the Lucky Strike North (Two Level) target area (holes H-18-3523 & -3524). Hole H-18-3526 (300 m), another hole drilled in the Lucky Strike North target area, is also shown

on Figure 10-1 and is also included in Table 10-3, as it is located within the general Lundberg Deposit area. Summary details for the 2018 Lundberg area drill holes (including Lucky Strike North Target holes H-18-3523, -3524, & -3526) are provided in Table 10-3.

**Table 10-3: Summary of Drill Holes Completed in the Lundberg Area in 2018**

Hole	UTM m E	UTM m N	Elev.(m)	Dip°	Azim.°	Length (m)
H-18-3500	509682.673	5407824.873	291.2	-58	90	152
H-18-3501	510193.296	5408000.695	286.8	-90		149
H-18-3502	510196.391	5407921.898	286.1	-90		75
H-18-3503	510199.351	5407876.475	286.3	-90		52
H-18-3504	510185.892	5407835.811	285.5	-90		53
H-18-3505	509766.81	5407936.745	292.6	-90		248
H-18-3506	509840.353	5407691.548	291.1	-45		182
H-18-3507	510153.835	5407509.254	281.7	-90		50
H-18-3514	510174.358	5408041.495	287.0	-90		173
H-18-3515	509837.037	5407960.316	292.1	-84	180	251
H-18-3516B	509834.756	5407959.718	292.2	-45	180	114.9
H-18-3517	509886.57	5407965.078	291.1	-45	180	55
H-18-3518	509886.555	5407965.52	291.4	-48	180	134
H-18-3519	510140.453	5408033.671	287.5	-90		176
H-18-3520	510153.809	5408078.57	287.2	-90		143
H-18-3521	510186.016	5408086.184	286.4	-90		192.8
H-18-3523	509646.507	5408164.796	292.1	-90		430
H-18-3524	509575.857	5408146.203	289.4	-90		392
H-18-3526**	510125	5408175	285	-90		300

\* NAD83, Zone 21 UTM coordinates, elevations relative to mean sea-level (\*\* hole not surveyed by DGPS).

Results from the 2018 Lundberg drilling further support the Mineral Resource and its extents. This drilling also identified additional higher-grade mineralization located immediately above the stockwork zone as remnant high-grade mineralization left behind by historical mining of the former Lucky Strike massive sulphide orebody. Intersections of remnant Lucky Strike mineralization included hole H-18-3515 that intersected the North Orebody zone as high-grade massive sulphides, including an intercept of 8.0 m averaging 0.69% Cu, 6.81% Pb, 12.88% Zn, 159.94 g/t Ag and 1.254 g/t Au; as well as hole H-18-3516b that intersected 4.80 m of 0.50% Cu, 5.01% Pb, 9.98% Zn, 149.06 g/t Ag and 0.686 g/t Au. Other highlight intersections of remnant high-grade massive sulphides of the Lucky Strike Orebody include 1.0 m of 0.59% Cu, 7.90% Pb,



13.50% Zn, 109.9 g/t Ag & 1.93 g/t Au and 1.8 m of 4.29% Cu, 11.62% Pb, 16.30% Zn, 85.4 g/t Ag & 1.39 g/t Au in hole H-18-3500.

Drilling on the northeast margin of the Lundberg Resource extended stockwork mineralization to the northeast, including intersections of 28.0 m of 0.34% Cu, 0.83% Pb, 1.47% Zn, 3.0 g/t Ag & 0.05 g/t Au in hole H-18-3501, and 29.0 m of 0.14% Cu, 0.57% Pb, 1.15% Zn, 2.12 g/t Ag & 0.043 g/t Au hole H-18-3519. Drilling within the north-central part of the Lundberg Deposit also returned positive results, as hole H-18-3505 intersected 152 m of stockwork mineralization averaging 0.27% Cu, 0.71% Pb, 1.50% Zn, 4.20 g/t Ag & 0.05 g/t Au. Other positive confirmatory results from the central portion of the Lundberg stockwork zone include hole H-18-3518 that intersected 35.7 m of 0.53% Cu, 0.71% Pb, 1.34% Zn, 11.54 g/t Ag, and 0.065 g/t Au.

In addition to the 2018 Lundberg holes, exploration drill holes H-18-3523 and -3524, drilled within the Lucky Strike North target area (Two Level area) returned favorable results as hole H-18-3524 intersected 1.8 m of 0.76% Cu, 3.15% Pb, 5.57% Zn, 90.5 g/t Ag and 0.37 g/t Au, including 1.0 m assaying 1.26% Cu, 4.87% Pb, 8.70% Zn, 133.2 g/t Ag and 0.47 g/t Au. This hole, drilled near the end of the 2018 program, extends mineralization 70 m north of historic underground workings at the Two Level deposit and suggests the deposit extends northwards where potential remains to identify additional higher-grade mineralization.

## 11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

### 11.1 Introduction

Sample preparation, analysis and security aspects of historic and Buchans programs prior to 2014 drilling were presented in previous Mineral Resource Estimate Technical Reports prepared by Mercator (Webster and Barr, 2008 and Cullen and Hilchey, 2013). That discussion showed various levels of documentation were available for the various programs, with the most detailed information with respect to sample preparation, analysis and security being found in reporting prepared by Buchans and related predecessors. After consideration of all factors, it was concluded that the major drilling programs reflected in the current Mineral Resource Estimate drilling database had been carried out under protocols assumed to be consistent with industry standards of the respective times. This assertion is accepted for current Report purposes with respect to pre-2014 drilling programs, details of which appear in the respective previously disclosed Technical Reports. Post - 2013 program details are presented below.

### 11.2 Sampling Method and Approach

#### 11.2.1 Buchans 2014 - 2015

Core logging, sampling and quality assurance and quality control (QA/QC) programs were carried out by Buchans Minerals Corporation personnel during the 2014/2015 exploration drilling programs under direction of Vice President of Exploration Paul Moore, P. Geo., and Exploration Manager, David Butler, P. Geo. All logging, sampling and sample shipment preparation activities were carried out under secure conditions at Buchans, core logging and storage facility in Buchans.

After mark-up by Buchans geologists, core was sawn by Buchans staff technicians to create half core samples, that were then given a unique sample number and recorded in the digital logging database. Samples consisted of halved NQ-size core (47.6 mm diameter core) with the remaining half of the core preserved in core boxes for future reference. In keeping with previous Buchans QA/QC protocols, samples were bagged, tagged, sealed and delivered directly to Eastern Analytical Limited's ("Eastern") laboratory in Springdale, Newfoundland, by Buchans personnel. Samples were typically selected to be one metre in length, except where specific geologic parameters required a different interval be sampled. In addition to regular samples, blank samples (one per 20 samples) and certified standards (one per 20 samples) were also submitted for sample preparation and assay. Unlike previous (i.e., 2008 and 2012) and subsequent (2018)

Lundberg resource drilling programs, no field duplicates were collected or submitted for sample preparation and assay during the 2014 and 2015 drilling programs.

### **11.2.2 Buchans - 2018**

Core logging, sampling and quality assurance and quality control (QA/QC) programs were carried out by Buchans personnel during the 2018 exploration drilling program under direction of Vice President of Exploration Paul Moore, P. Geo., Exploration Manager, David Butler, P. Geo., and consulting geologist James Harris, P. Geo., a member of Buchans exploration staff. All logging, sampling and sample shipment preparation activities were carried out under secure conditions at Buchans' core logging and storage facility in Buchans.

After mark-up by Buchans geologists, core was sawn by Buchans staff technicians to create half core samples, that were then given a unique sample number and recorded in the digital logging database. Samples consisted of halved NQ-size core (47.6 mm diameter core) with the remaining half of the core preserved in core boxes for future reference.

In keeping with previous Buchans QA/QC protocols applied to Buchans' 2008 and 2012 Lundberg Mineral Resource drilling programs, samples were bagged, tagged, sealed and delivered directly to Eastern's laboratory in Springdale, Newfoundland, by Buchans personnel. Samples were typically selected to be one metre in length, except where specific geologic parameters required a different interval be sampled. In addition to regular samples, blank samples (one per 20 samples) and certified reference materials (one per 20 samples) were also submitted for sample preparation and assay. Field duplicates, consisting of quartered core were also collected once for every 20 samples and submitted for sample preparation and assay. Check sample splits for third party laboratory analysis were selected later, after receipt of initial analytical results.

### **11.2.3 Mercator Check Sample Program (2018)**

After a careful review of the drill hole database, two drill holes from the recent Buchans drill programs were selected for re-sampling by Mercator geologists in order to obtain representative samples of the various lithologies and grades found within the deposit areas (H-14-3488 and H-18-3516B). Samples were collected at the BMC core logging and storage facility in Buchans in November of 2018. Seven quarter core samples of previously half-core sampled core were collected from these holes, ensuring a quarter of the core remained for archival purposes. Drill core cutting was carried out under supervision of Mercator Senior Resource Geologist, Matthew

Harrington, P. Geo. Samples were identified using tags from a three tag sample book system and placed in plastic bags and sealed.

### **11.3 Sample Security**

#### **11.3.1 Buchans 2014 - 2018**

All logging, sampling and sample shipment preparation activities were carried out under secure conditions at the BMC core logging and storage facility in Buchans. Drill core was under custody of BMC personnel from the time it was delivered from the drill site by the drilling contractor to the time associated samples were delivered to the primary laboratory for preparation and analysis.

#### **11.3.2 Mercator Check Sample Program (2018)**

Core samples collected during the site visit were transported by Mercator staff to Mercator's Dartmouth office, where a single blind standard and blank were inserted before shipment to ALS for analysis. Preparation of sample shipment documentation, checking, and packing of samples were carried out by Mercator staff prior to shipment by commercial courier to ALS Canada in Sudbury, ON. Samples remained in the secure possession of M. Harrington, P. Geo., of Mercator prior to shipment to the laboratory.

### **11.4 Sample Preparation & Analysis**

#### **11.4.1 Buchans 2014 - 2018**

Sample preparation was completed by Eastern with each sample crushed to approximately -10 mesh and split using a riffle splitter to approximately 300 g. Each sample split was pulverized using a ring mill to approximately 98% -150 mesh. All assays were completed by Eastern by the inductively coupled plasma method (ICP-34 Multi-Acid package) for base metals (Cu, Pb, Zn), and by Ore Grade Assay (atomic absorption) for Cu, Pb and Zn, if upper detection limits by ICP were exceeded for either element (upper detection limits; Cu 10,000 ppm, Pb 2,200 ppm, Zn 2,200 ppm). ICP analyses were completed using a 0.50 g sample digested in four acids (nitric and hydrochloric acid and analyzed by ICPOES (Inductively Coupled Plasma Optical Emission Spectroscopy). Base metal Ore Grade Assays (Cu, Pb, Zn) were completed using a 0.200 g to 2.0 g sample digested in nitric and hydrochloric acid and analyzed by the atomic absorption (AA) method. Silver assays were completed using a 1,000 mg sample digested in hydrochloric and

nitric acid and analyzed by AA (Atomic Absorption spectroscopy). Gold assays were completed by standard ½ assay ton fire assay using the AA method. All samples analyzed by the Ore Grade Assay method were also re-assayed as by ALS Canada Limited (ALS) at the firm's Vancouver, BC facility for Specific Gravity (SG) determinations (OA-GRA08b; Specific Gravity on pulps using pycnometer) by the as well as Barium by Fusion XRF (XRF10 and or Ba-GRA81 for Ba>45%). A subset of these samples were also analysed as check assays for QA/QC purposes (ME-OG46 for Ag, Cu, Pb, Zn; assay-grade Aqua regia digestion, multi-element ICP; and gold by fire assay and AAS using a 30 g nominal sample weight). Eastern and ALS also implemented independent QA/QC protocols that included insertion of blanks and certified reference materials as part their routine analyses.

Both Eastern and ALS are independent, fully accredited, analytical services firms registered to the ISO 17025 standard.

#### **11.4.2 Mercator Check Sample Program (2018)**

Sample preparation was completed by ALS Canada with each sample crushed to approximately 70% < 2 mm and split using a riffle splitter. Each sample split was pulverized to approximately 85% < 75 µm. Ag, Cu, Pb, and Zn were assayed by ore grade ME-OG46 protocol, which employs Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-ES) analysis after digestion in 75% aqua regia for 120 minutes. This protocol may default to gravimetric or titration techniques if very high metal levels (> 15-20 %) are present. Au was assayed by Au-GRA21 protocol whereby samples are analyzed fire assay fusion using Atomic Absorption Spectroscopy from a 30 g nominal sample weight. Specific Gravity determinations (OA-GRA08b; determinations on pulps using pycnometer) were completed as well as Ba analysis by Fusion XRF protocol (XRF10, and or Ba-GRA81 for Ba > 45 %). ALS also implemented independent QA/QC protocols that included insertion of blanks and certified CanMet standards as part their routine analyses. As noted above, ALS is an independent, fully accredited, analytical services firm registered to the ISO 17025 standard.

## 12.0 DATA VERIFICATION

### 12.1 Introduction

The purpose of a quality assurance and quality control program (QA/QC) is to monitor accuracy and precision of results and to detect instances of potential sample contamination. The QA/QC program carried out during the 2014/2015 and 2018 Buchans exploration programs included blind insertion of blank and certified reference material samples and quarter core field duplicates in 2018 only. As noted previously in report Section 11.0, Eastern Analytical Limited's ("Eastern") provided primary analytical services for Zn, Pb, Cu, Ag and Au and ALS provided independent, third party, check analysis services for these metals plus and primary analytical services for Ba and specific gravity determinations. Duplicates, blanks, certified reference materials and in-house standard samples were also analyzed by both laboratories for internal QA/QC purposes.

QA/QC aspects of Buchans operated programs prior to 2014 drilling were presented in prior Mineral Resource Estimate Technical Reports prepared by Mercator (Webster and Barr, 2008 and Cullen and Hilchey, 2013). That discussion showed that Mercator is of the opinion that sample preparation, analysis and security methodologies employed for prior Buchans drilling programs were consistent with current industry standards and Mercator considered the Buchans drilling dataset prior to 2014 to be of acceptable quality for use in Mineral Resource Estimation programs. Mercator continues to be of this opinion with respect to pre-2014 drilling programs and detailed results of the 2014/2015 and 2018 drilling programs are discussed below. The reader is directed to the previous Mercator Technical Reports for more detailed information pertaining to the earlier programs.

### 12.2 Quality Control Data

The QA/QC sample program for both the 2014/2015 and 2018 drill programs carried out by Buchans was designed to include the following sampling components and nominal insertion or testing intervals:

- Certified reference materials inserted in sample stream at 1 in 20 frequency
- Blank samples inserted in sample stream at 1 in 20 frequency
- Field duplicate quarter core sample prepared at 1 in 20 frequency, implemented exclusively for the 2018 drill program
- Re-analysis of selected sample pulps by an independent, third party laboratory (ALS)

Results of each program component are addressed separately below.

### 12.2.1 2014/2015 and 2018 Certified Reference Material Program

Canadian Resource Laboratories of Delta, BC provided certified reference material (CRM) samples for use in the 2014/2015 and 2018 drilling programs and these were selected by Buchans on the basis of mineral composition and grade range. Materials CDN-HL-HZ, CDN-HZ-HZ-2, CDN-FCM-4, CDN-FCM-6, CDM-FCM-7, CDN-SE-01, CDN-ME-1402, CDN-MP-1b, were used and certified values for these appear in Table 12-1.

**Table 12-1: Certified Reference Materials for 2014/2015 and 2018 Programs**

Certified Material	Certified Mean Value $\pm$ 2 Standard Deviations				
	Au g/t	Ag g/t	Cu %	Pb %	Zn %
CDN-FCM-4	0.97 $\pm$ 0.08	54.9 $\pm$ 6.4	0.702 $\pm$ 0.042	0.34 $\pm$ 0.028	1.28 $\pm$ 0.08
CDN-FCM-6	2.15 $\pm$ 0.16	156.8 $\pm$ 7.9	1.251 $\pm$ 0.064	1.52 $\pm$ 0.06	9.27 $\pm$ 0.44
CDN-FCM-7	0.896 $\pm$ 0.084	64.7 $\pm$ 4.1	0.526 $\pm$ 0.026	0.629 $\pm$ 0.042	3.85 $\pm$ 0.19
CDN-HL-HZ	1.31 $\pm$ 0.16	101.2 $\pm$ 10.8	0.76 $\pm$ 0.097	0.815 $\pm$ 0.06	7.66 $\pm$ 0.36
CDN-HZ-HZ-2	0.124 $\pm$ 0.024	61.1 $\pm$ 4.1	1.36 $\pm$ 0.06	1.62 $\pm$ 0.11	7.2 $\pm$ 0.35
CDN-SE-01	0.480 $\pm$ 0.034	712 $\pm$ 57	0.097 $\pm$ 0.005	1.92 $\pm$ 0.09	2.65 $\pm$ 0.20
CDN-ME-1402	13.9 $\pm$ 0.8	131 $\pm$ 7	2.9 $\pm$ 0.16	2.48 $\pm$ 0.11	15.23 $\pm$ 0.67
CDN-MP-1b	NA	47 $\pm$ 7	3.069 $\pm$ 0.178	2.091 $\pm$ 0.144	16.67 $\pm$ 0.44

CRM samples were inserted blindly in the analytical core sample stream at every even 20<sup>th</sup> sample number and marked accordingly in the sample record book. Results returned for each were checked by Buchans staff during the program to monitor trends on an on-going basis. Figures 12-1 through 12-5 present results for 101 samples submitted to Eastern for the 2014/2015 and 2018 drill programs. Results were aggregated for each metal, chronologically ordered, and then normalized by standard deviation and graphed for review purposes.

Project control limits considered for review of data were set as the certified mean value, plus or minus 1, 2 and 3 standard deviations for each metal. Results returned for Zn, Pb, and Au consistently fall within the 2 standard deviation control limits with the exception of a series of samples from the 2015 program that fall below the 3 standard deviations control limit. These are clearly visible in Figures 12-1 through 12-5. Follow-up showed that these results are associated with certified materials HL-HZ and FCM-4. Results for Cu show greater range than those for the other metals and values exceeding the +3 standard deviations control limit typically assign to CRM SE-01 that was used in the 2014/2015 drill program. Zn, Pb and Cu results define a slight

low bias trend that increases through the 2014/2015 and 2018 period. Ag and Au results consistently fall within the 2 standard deviations control limits for all programs but also show a slight, consistent low bias trend.

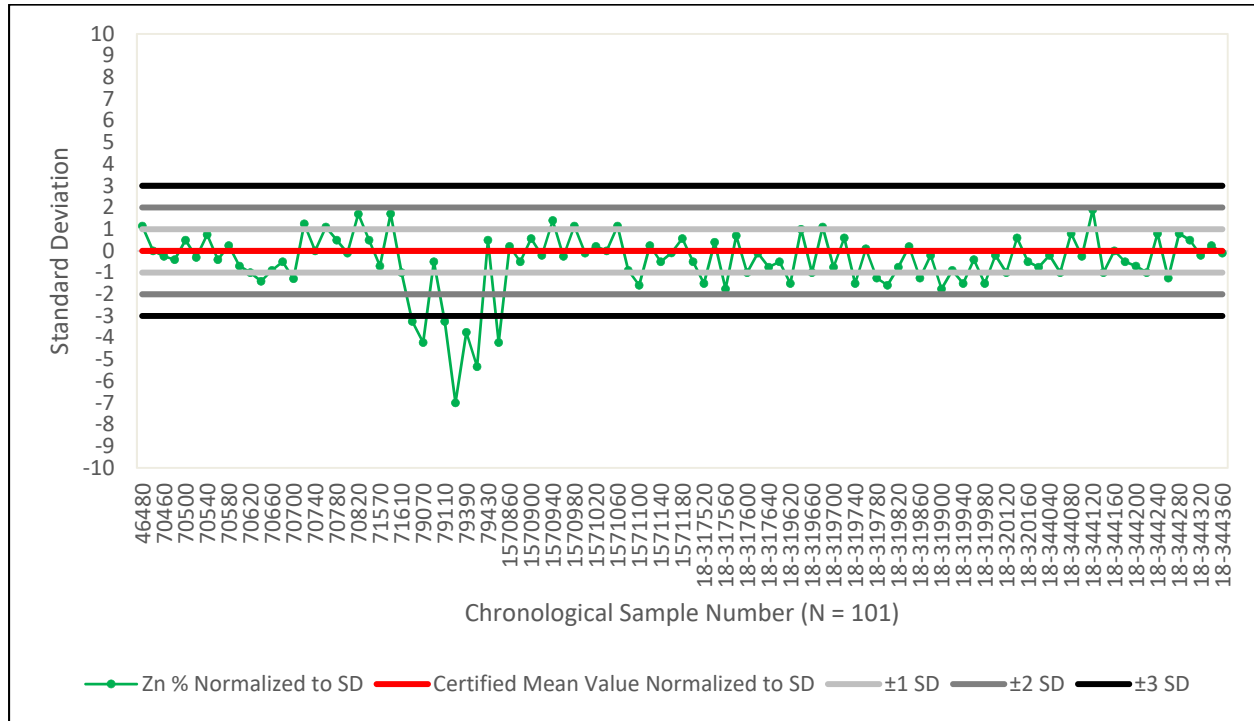
During the 2014/2015 drilling program, Buchans requested Eastern to re-analyze sample batches that included 3 Cu and 2 Zn results near or above the 3 standard deviations control limit for certified materials and re-issued results returned values within the 2 standard deviations control limits. The project drilling database was updated to include the revised analytical results. Cu results above the 3 standard deviations control limit for certified material SE-01 also returned acceptable results for the other metals. This suggests that subsamples of the reference material may have become inhomogeneous with respect to distribution of some constituent metals.

An explanation for the long-term, slightly increasing low bias trend in CRM analytical results for Zn, Pb and Cu and the slight but consistent low bias trend for CRM Au and Ag results is not readily apparent. Both trends are primarily defined within the range of the 2 standard deviations CRM control limits and corresponding laboratory QA/QC results do not define similar trends. Mercator recommends that an evaluation of possible contributing factors to these trends be undertaken by Buchans, with this to include assessment of CRM age, storage conditions, sub-sampling methodology and potential for progressive oxidation of materials.

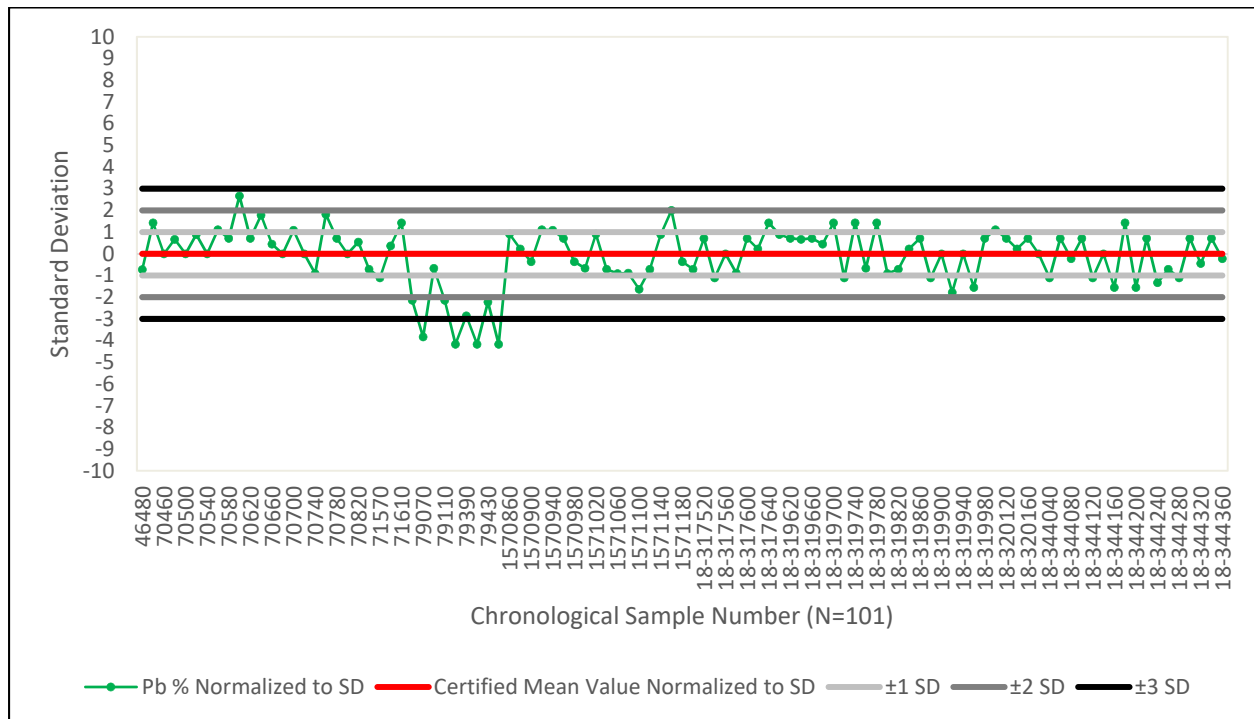
Based upon review of all 2014/2015 and 2018 drilling program CRM results, inclusive of the slight low bias trends noted above, Mercator is of the opinion that associated core sample analytical results are of sufficient quality for use in the current Mineral Resource Estimate.



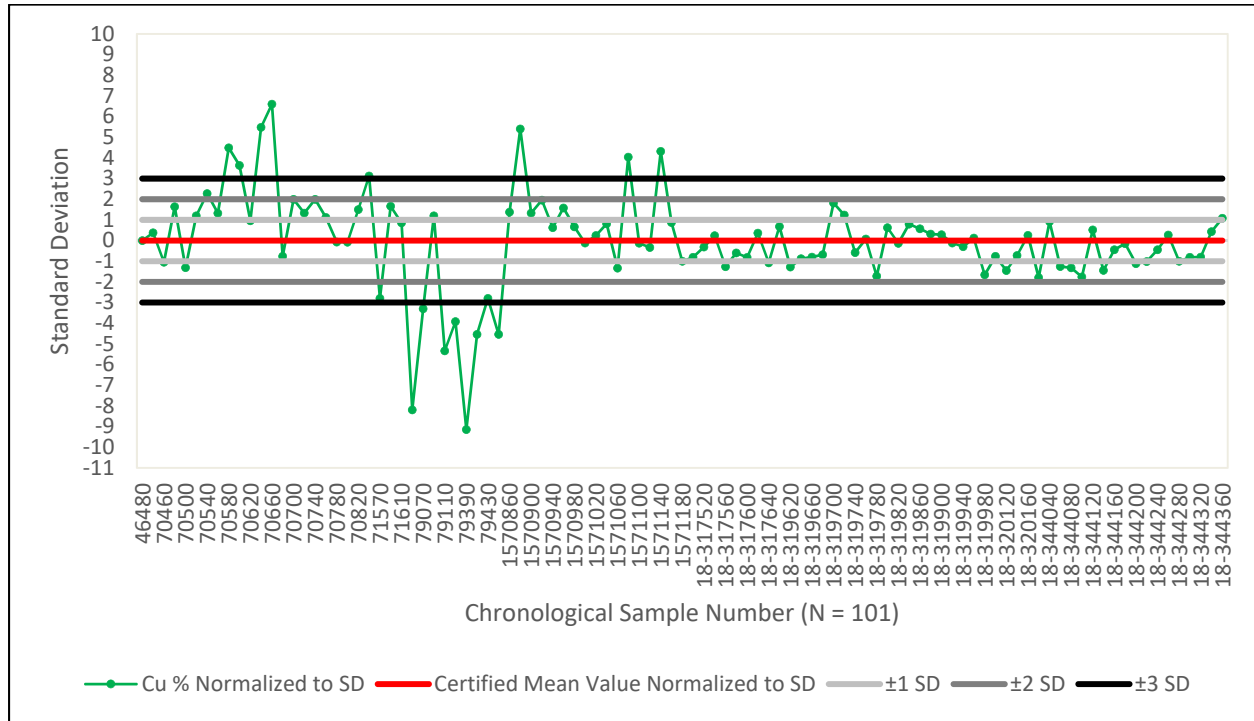
**Figure 12-1: Certified Reference Materials - Zn % Normalized to Standard Deviation**



**Figure 12-2: Certified Reference Materials - Pb % Normalized to Standard Deviation**



**Figure 12-3: Certified Reference Materials - Cu % Normalized to Standard Deviation**



**Figure 12-4: Certified Reference Materials – Ag g/t Normalized to Standard Deviation**

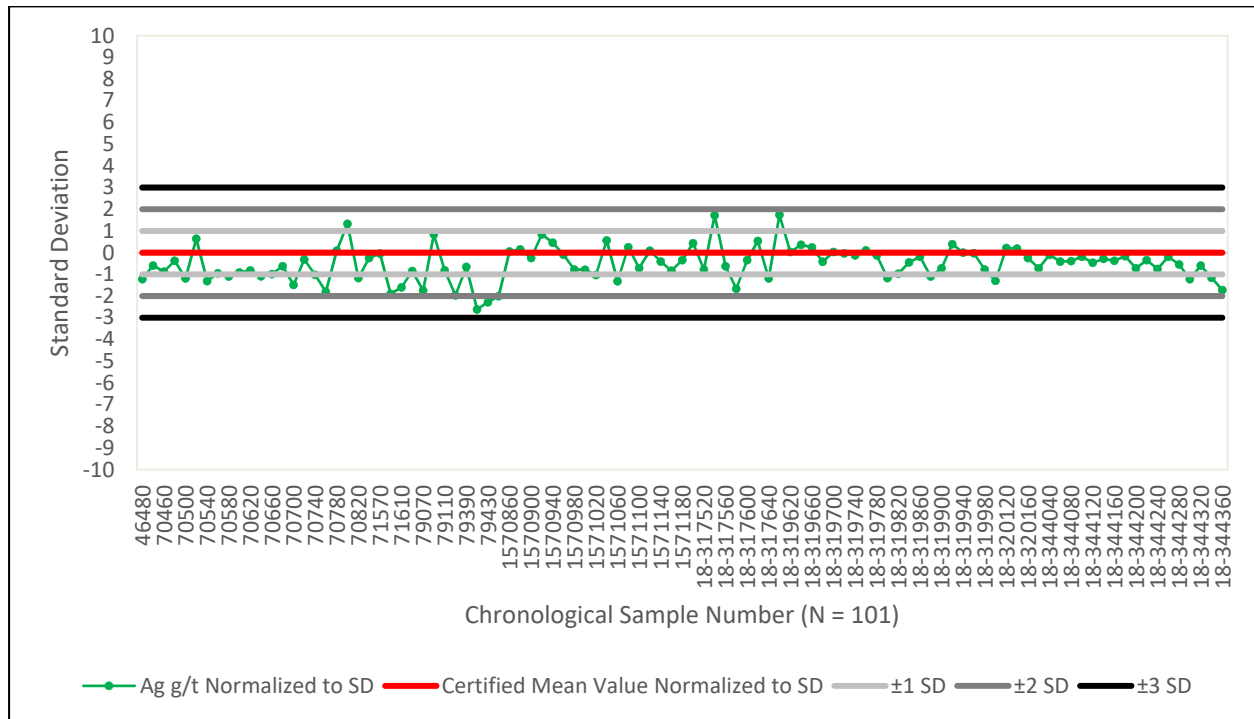
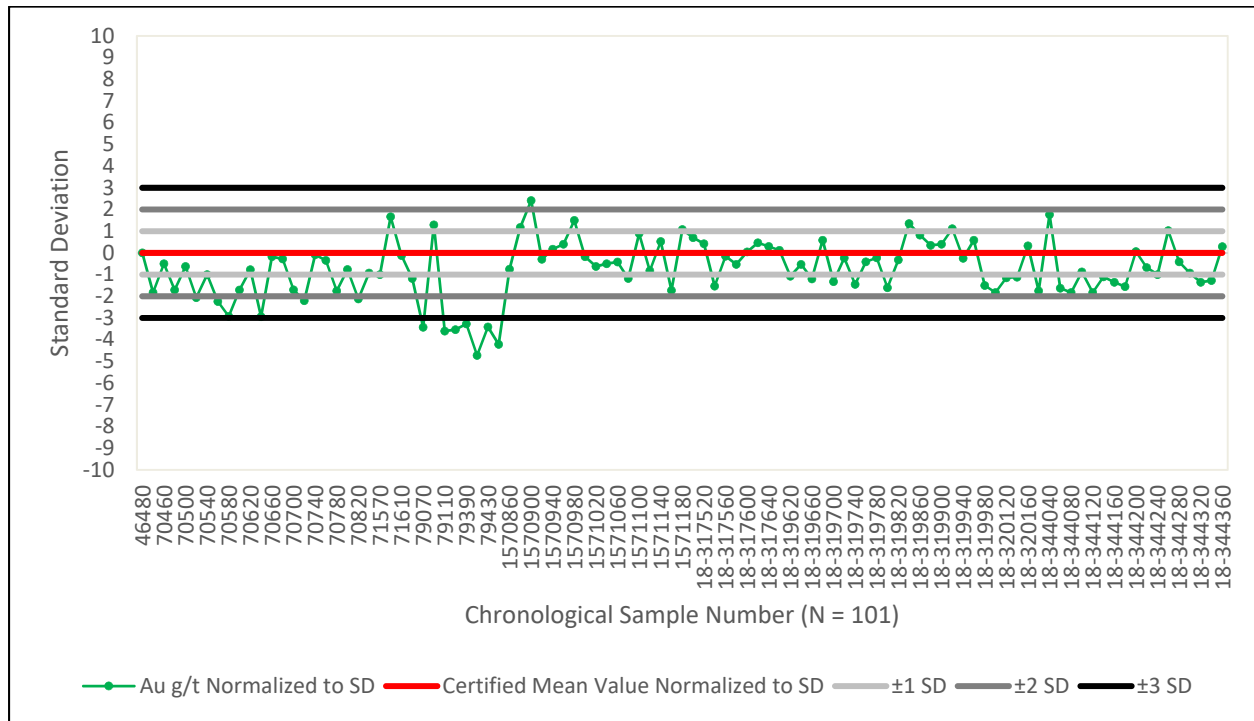


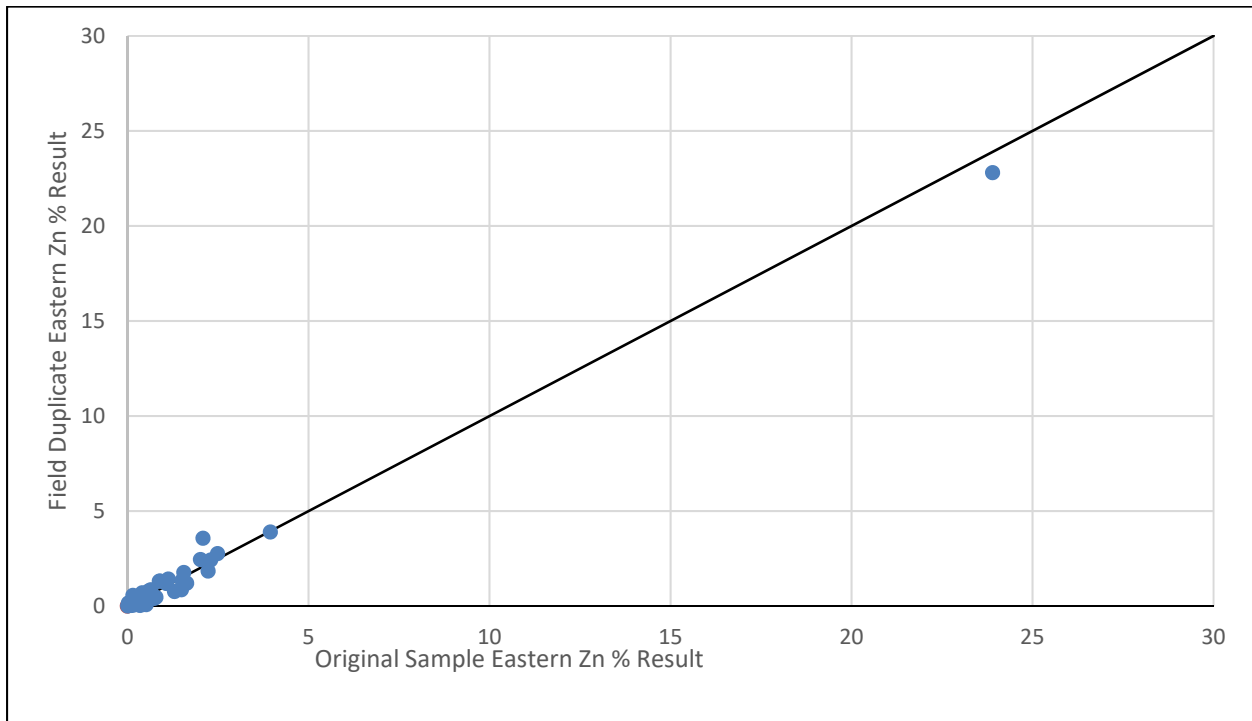
Figure 12-5: Certified Reference Materials – Au g/t Normalized to Standard Deviation



### 12.2.2 2018 Quarter Core Duplicate Sample Program

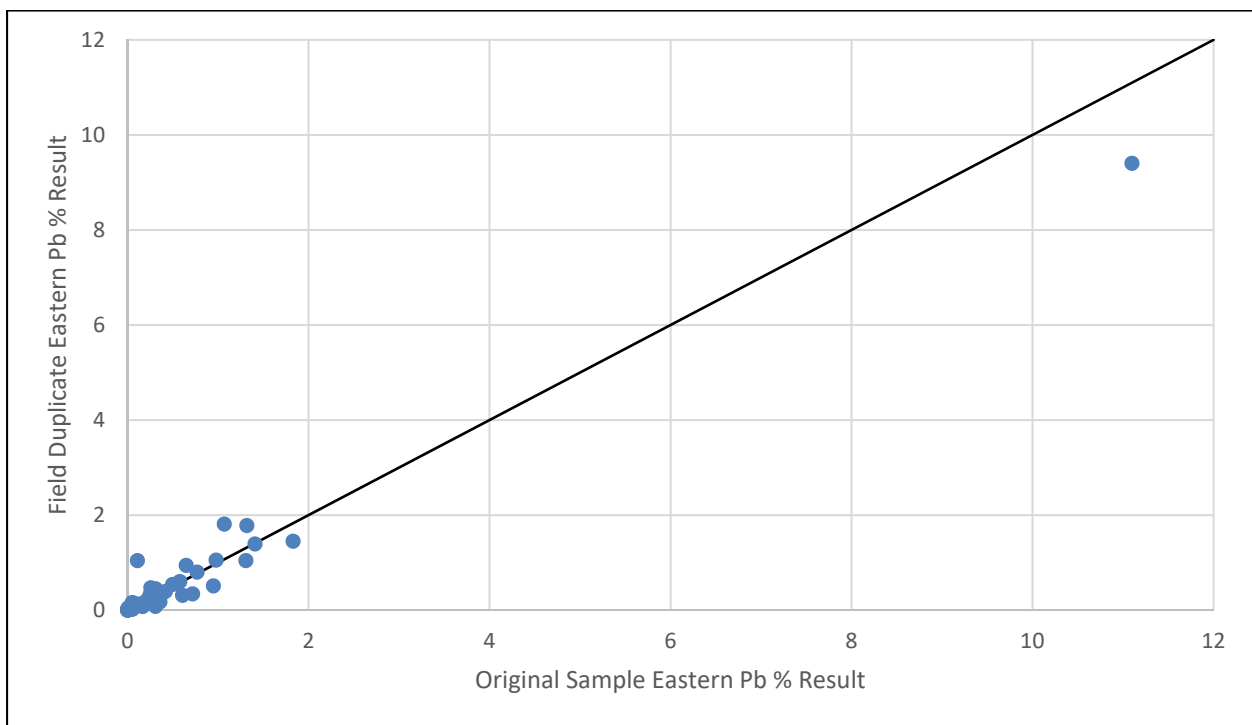
A quarter core field duplicate was prepared by Buchans for every 20th sample during the 2018 drill program. Results for the 2018 duplicate pairs for Zn, Pb, Cu, Ag and Au are presented below in Figures 12-6 through 12-10. Duplicate split pairs for all metals correlate well along a 1:1 trend. This is interpreted as indicating that grade distributions at the core scale are relatively homogenous and that associated analyses reflect acceptable precision.

**Figure 12-6: 2018 Quarter Core Duplicate Results – Zn % (N = 61)**



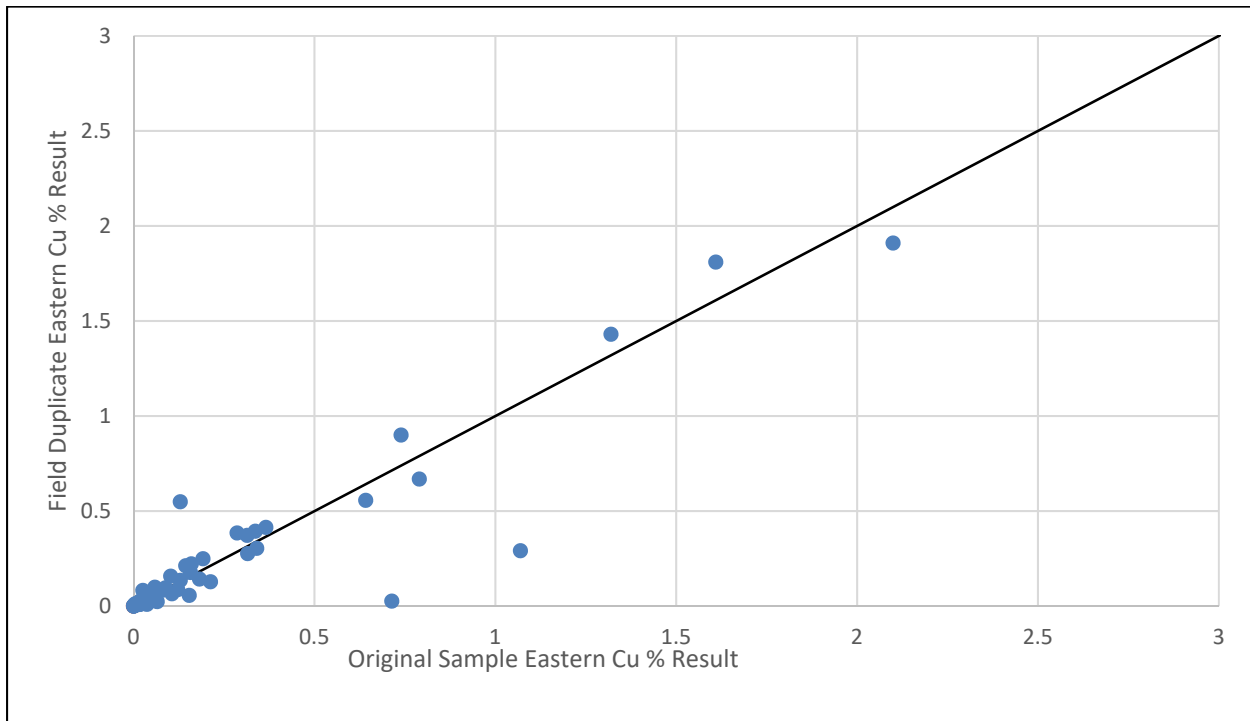
**Black line denotes 1:1 correlation**

**Figure 12-7: 2018 Quarter Core Duplicate Results – Pb % (N = 61)**



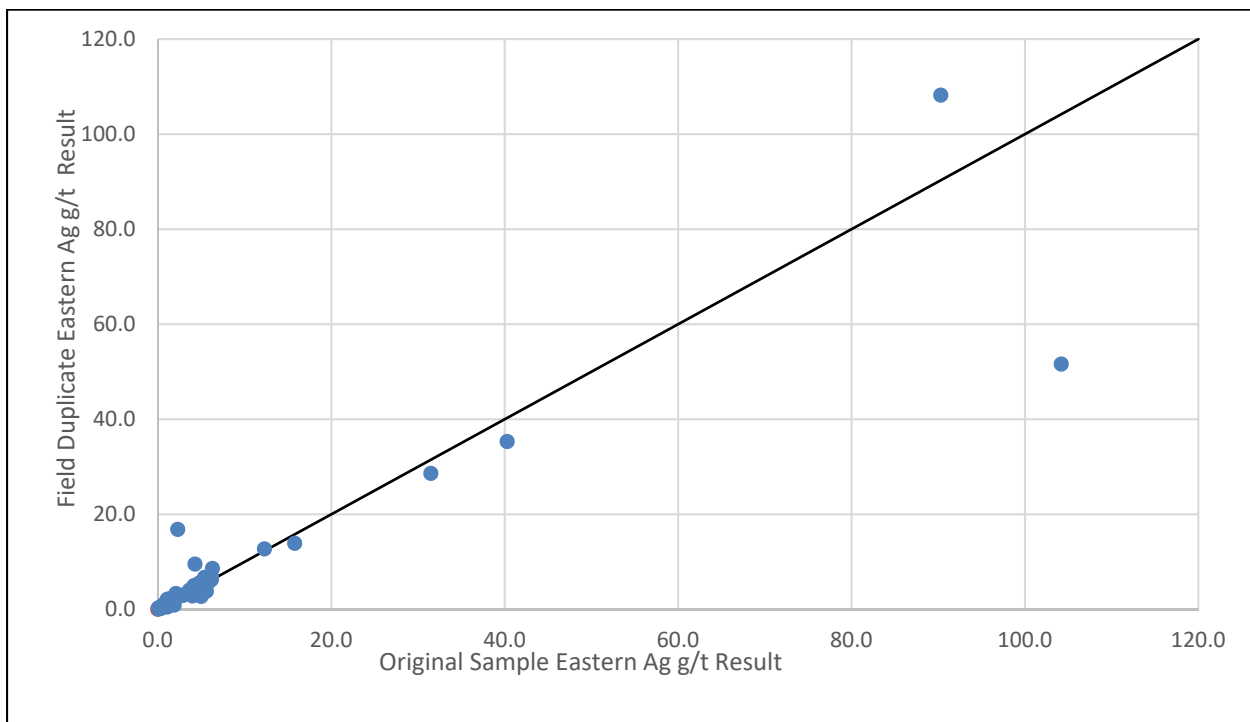
**Black line denotes 1:1 correlation**

**Figure 12-8: 2018 Quarter Core Duplicate Results – Cu % (N = 61)**

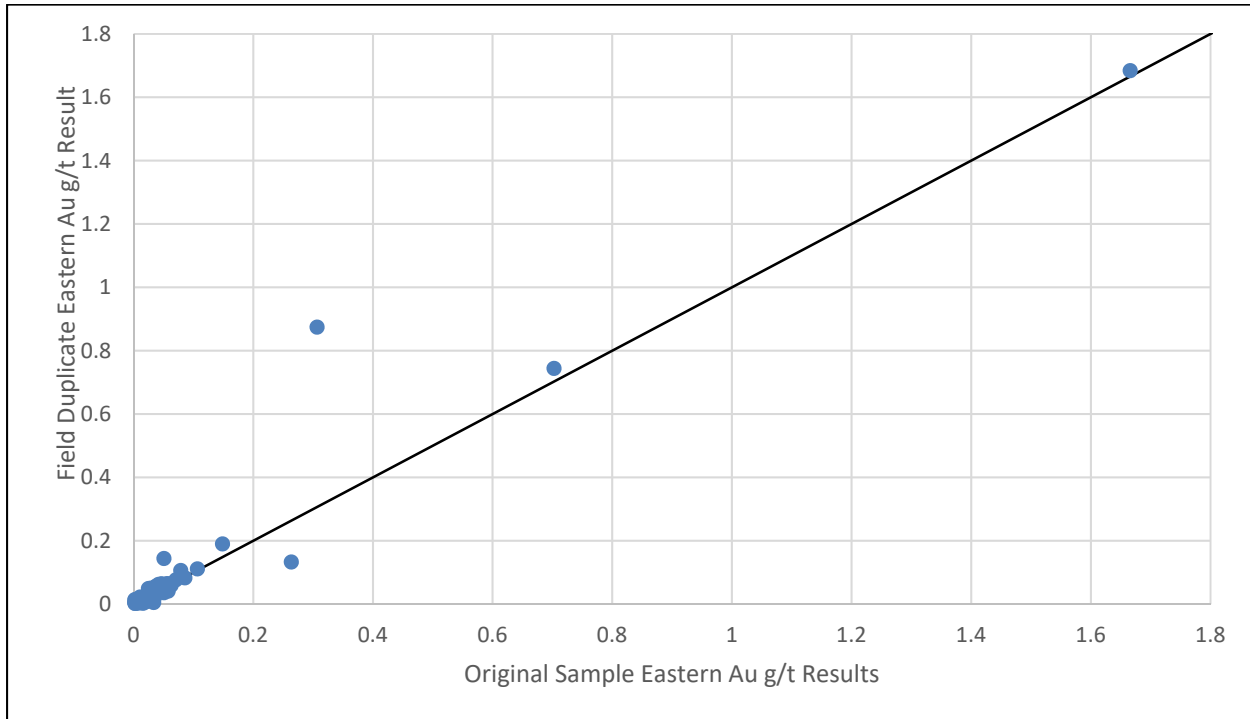


**Black line denotes 1:1 correlation**

**Figure 12-9: 2018 Quarter Core Duplicate Results – Ag g/t (N = 61)**



**Black line denotes 1:1 correlation**

**Figure 12-10: 2018 Quarter Core Duplicate Results – Au g/t (N = 61)**

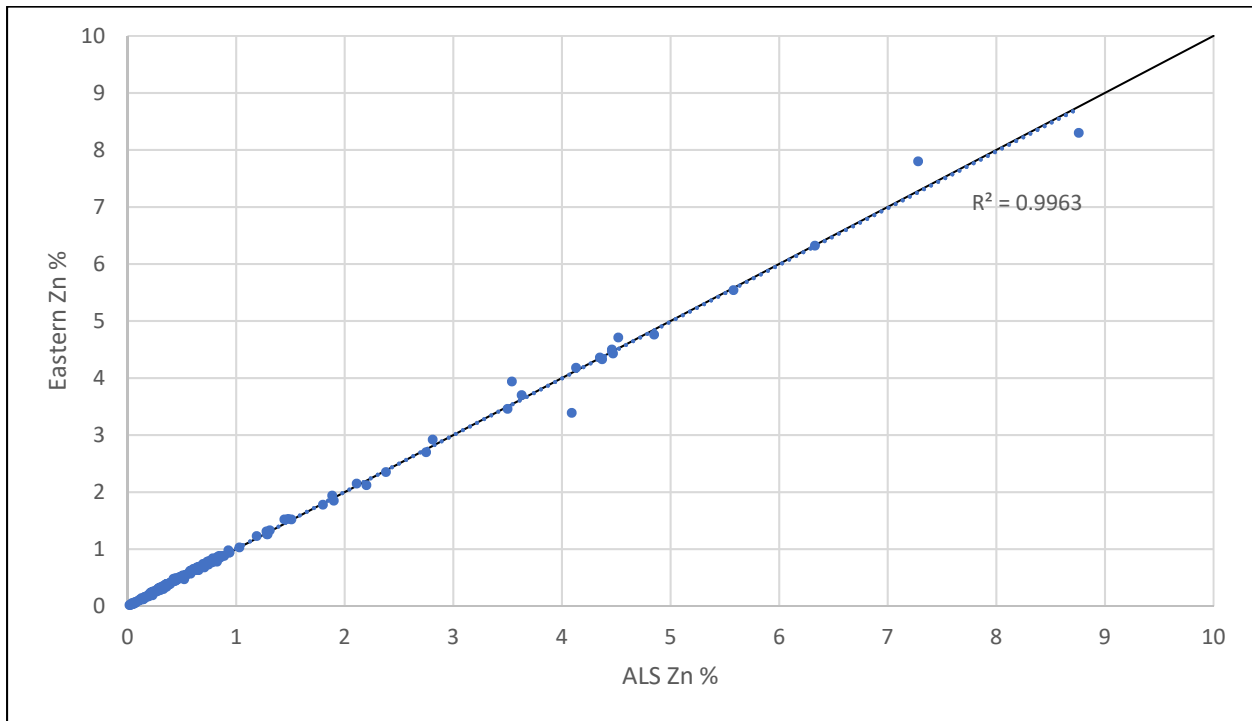
**Black line denotes 1:1 correlation**

### 12.3 2014/2015 and 2018 Check Sample Program

Buchans instituted an independent laboratory check sample program for both the 2014/2015 and 2018 drilling campaigns. The program consisted of analysis at ALS of selected core sample pulps that were initially prepared and analyzed at Eastern. Samples were selected on the basis of their elevated metal levels as determined in the initial analysis at Eastern. As a result, a sampling bias toward higher base metal grade levels characterizes the data set. Analytical procedures applied at both laboratories were the same. A total of 165 pulp splits for the 2014/2015 program were submitted for analysis, as well as 32 from the 2018 program.

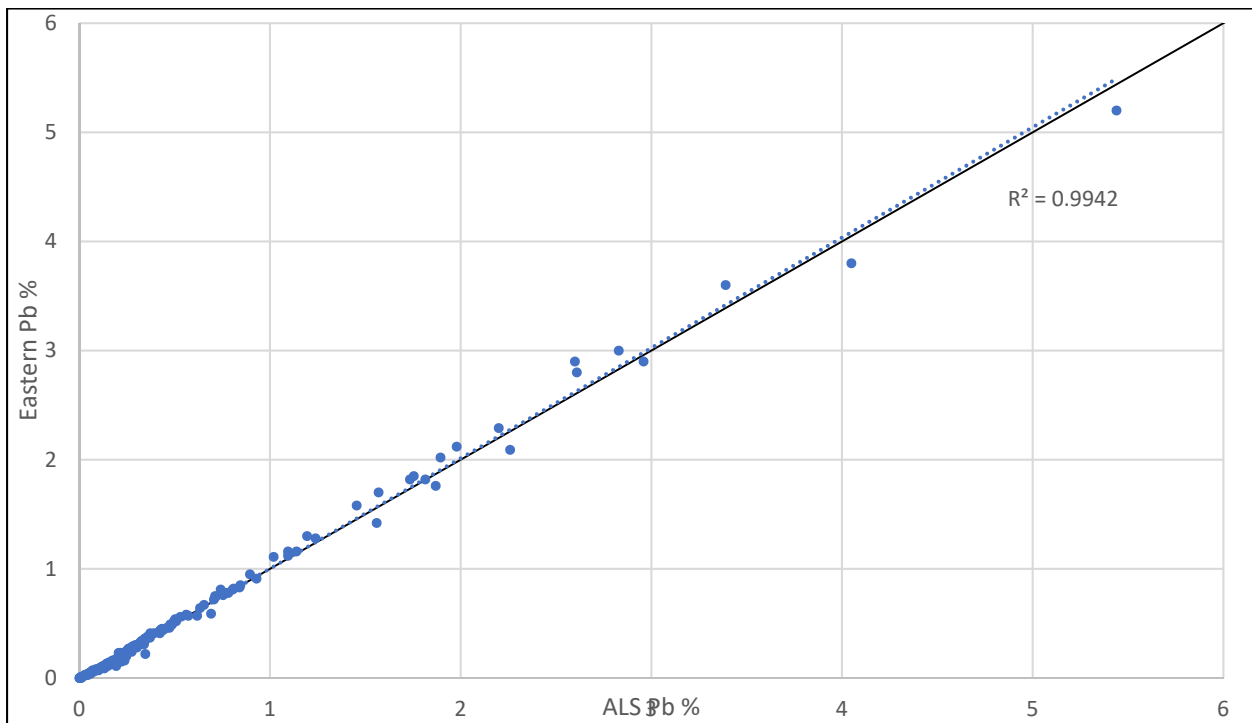
Figures 12-11 through 12-15 present combined check sample program results for Cu, Pb, Zn, Au and Ag, respectively. In all cases, good correlation exists between the two data sets, as exemplified by close grouping of data along the 1:1 correlation trend line included in each plot. The Figure 12-13 Cu plot shows a slight positive bias for Eastern Cu values relative to ALS results but this is not considered significant.  $R^2$  values for each data set are displayed on respective plots. The Figure 12-17 gold plot excludes a single outlier value of 12.3 g/t Au that was repeated at 8.3 g/t Au at ALS.

**Figure 12-11: Third Party Duplicate Results – Zn % (N = 196)**



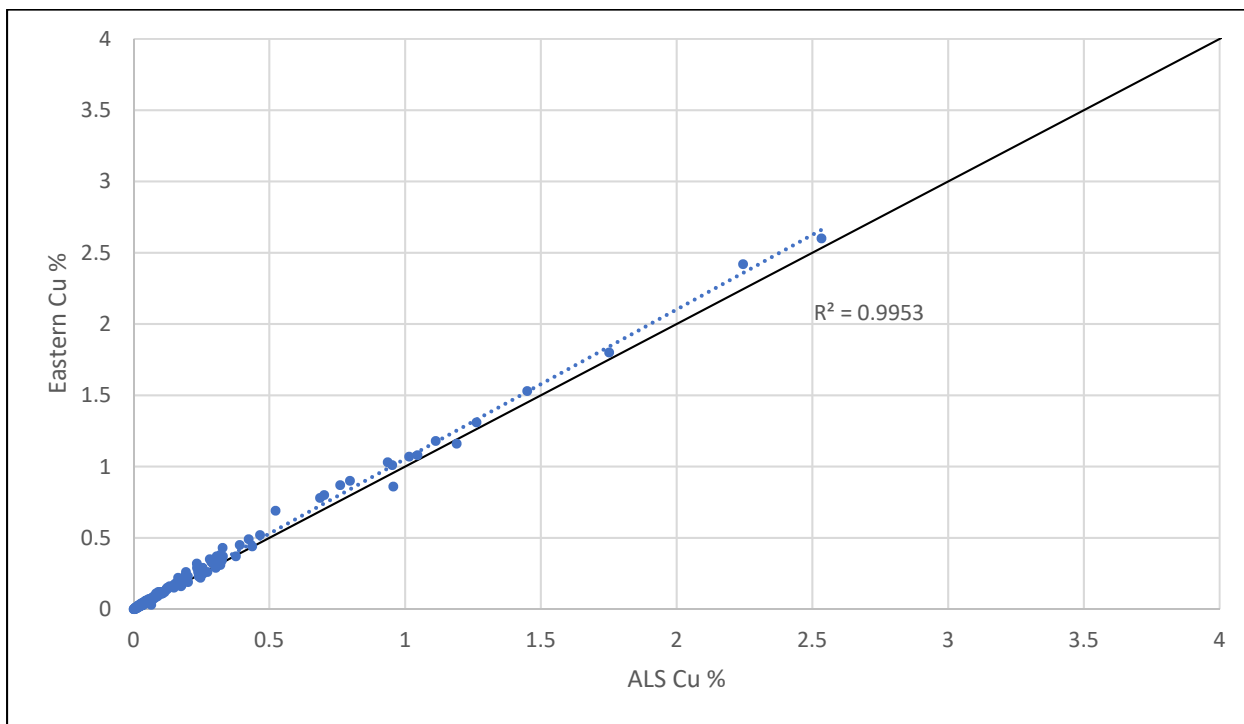
*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-12: Third Party Duplicate Results – Pb % (N = 196)**



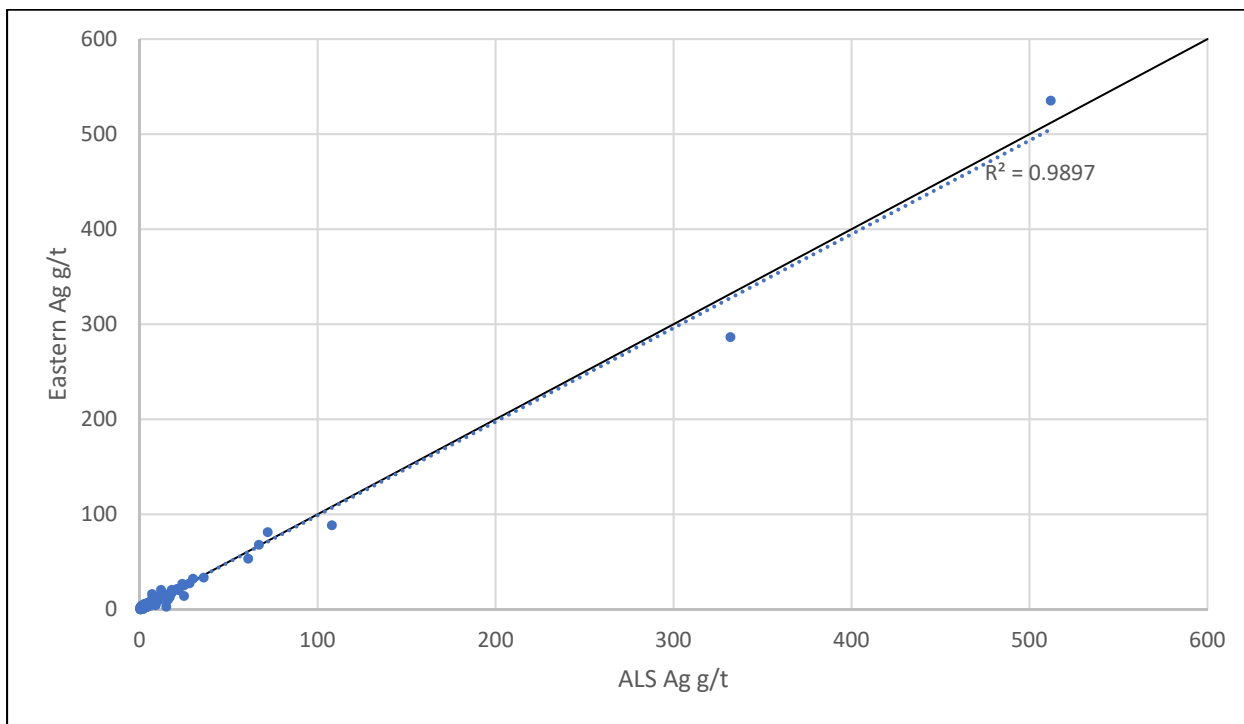
*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-13: Third Party Duplicate Results – Cu % (N = 196)**



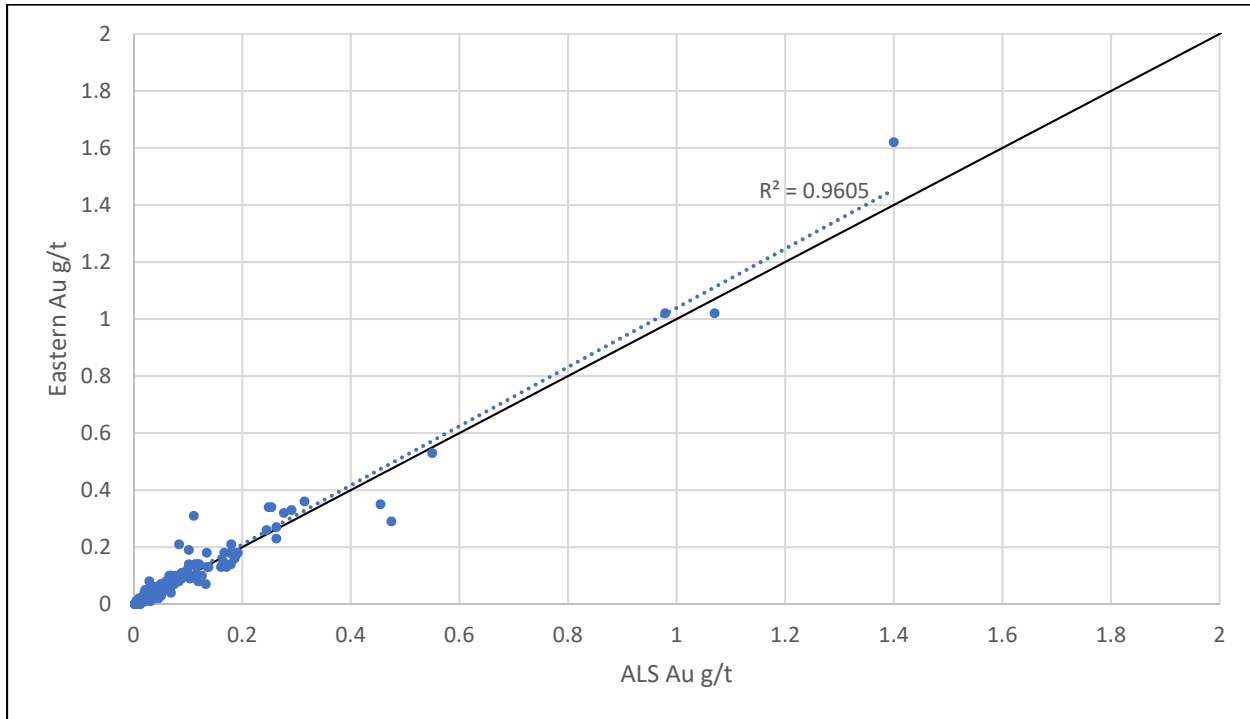
**Black line denotes 1:1 correlation; Blue dashed - data linear regression**

**Figure 12-14: Third Party Duplicate Results – Ag g/t (N = 196)**



**Black line denotes 1:1 correlation; Blue dashed - data linear regression**



**Figure 12-15: Third Party Duplicate Results – Au g/t (N = 196)**

**Black line denotes 1:1 correlation; Blue dashed - data linear regression**

Mercator is of the opinion that results of the Buchans check sample program for both 2014/2015 and 2018 programs show that the primary laboratory (Eastern) performed consistently well with respect to the check laboratory (ALS). There is no indication of significant systematic or irregular discrepancy between the laboratories that would be of concern with respect to application of data in the current Mineral Resource Estimate.

### 12.3.1 2014/2015 and 2018 Blank Sample Program

Blank samples were blindly inserted in chronological succession, at an interval of every 20th sample, for both the 2014/2015 and 2018 program. Blank sample status was noted in the project sample record books and the material consisted of non-mineralized, siliceous sandstone collected from a roadside outcrop on the southern side of Red Indian Lake. This material was used previously by Buchans and Mercator for analytical blank purposes in 2008 and 2012 programs. Blank samples for the recent programs were analyzed by Eastern along with the associated core sample stream.

Results for the 2018 program samples appear in Figures 12-16 (Zn, Pb, and Cu) and Figure 12-17 (Au and Ag). Cu and Pb results define trends at values less than 20 ppm that are close to

Figure 12-16: 2014/2015 and 2018 Blank Results – Zn, Pb and Cu % (N = 92)

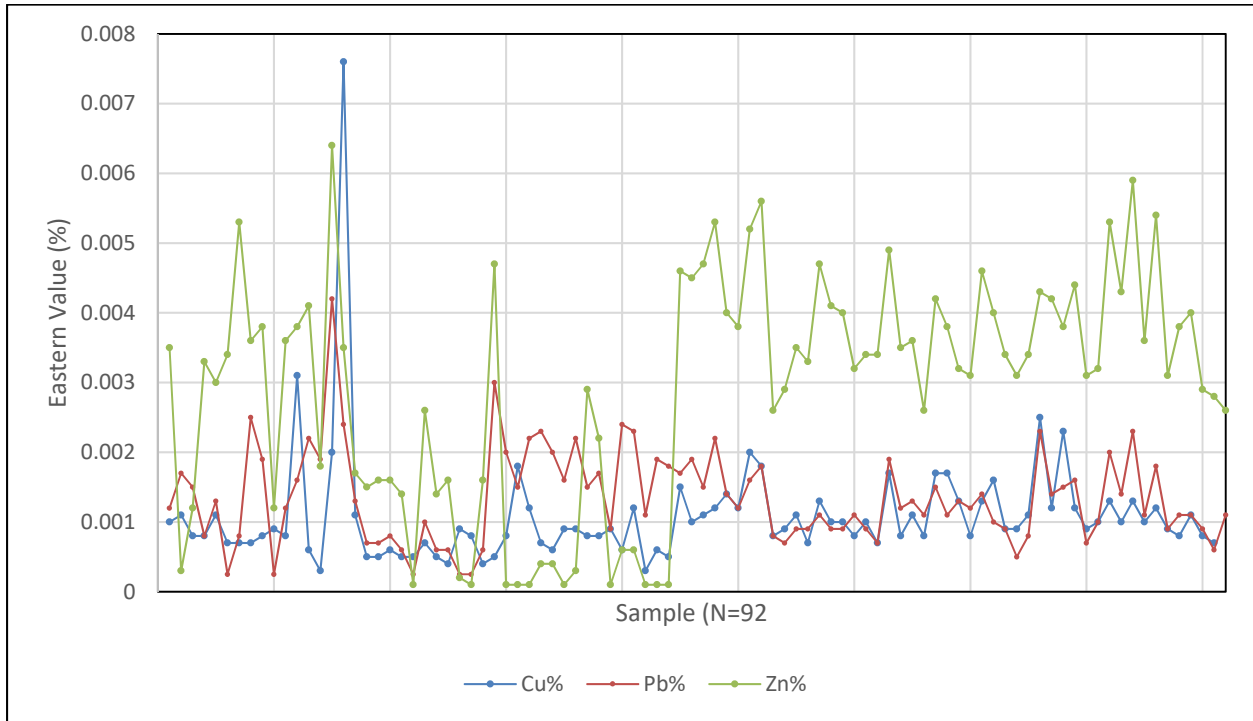
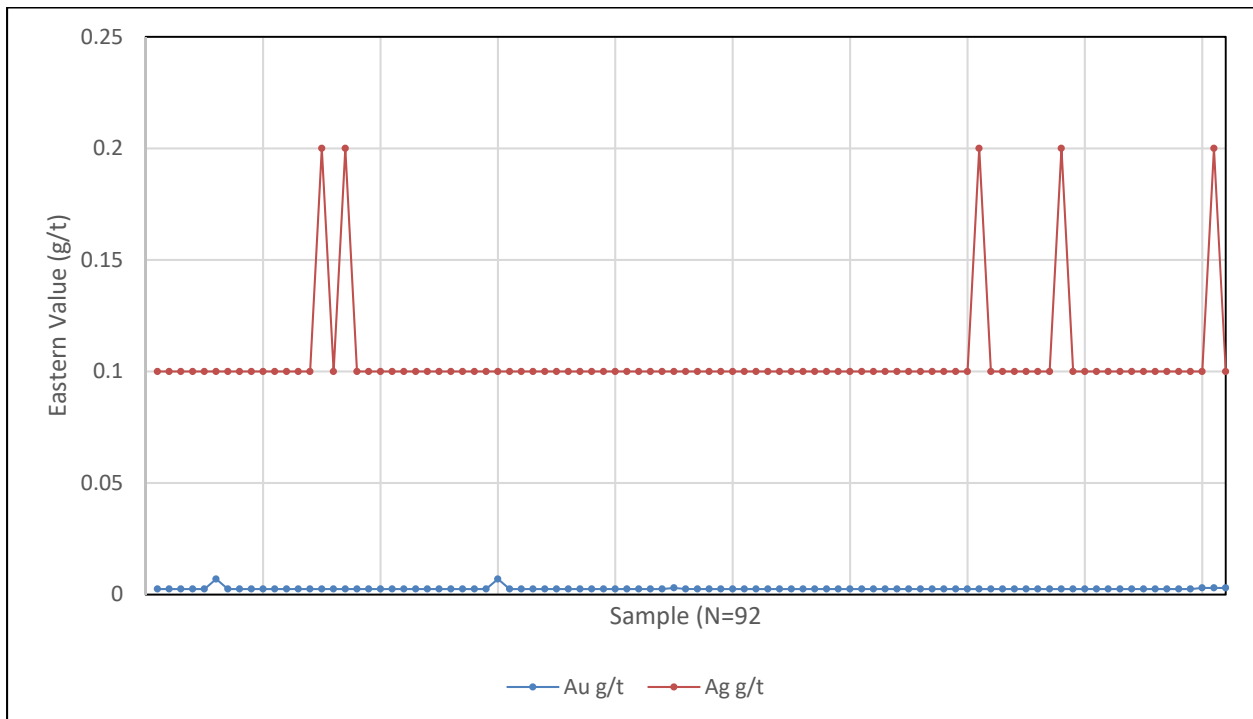


Figure 12-17: 2014/2015 and 2018 Blank Results – Au and Ag g/t (N = 92)



respective method detection limits and Zn values define a trend at or below approximately 50 ppm. Ag and Au values all fall within ranges of twice their respective detection limits. Although low in absolute terms, peak values for all metals except Au correspond with two consecutive samples. Based on these results, Mercator has concluded that no evidence of problematic sample cross-contamination is present in the 2014/2015 and 2018 dataset.

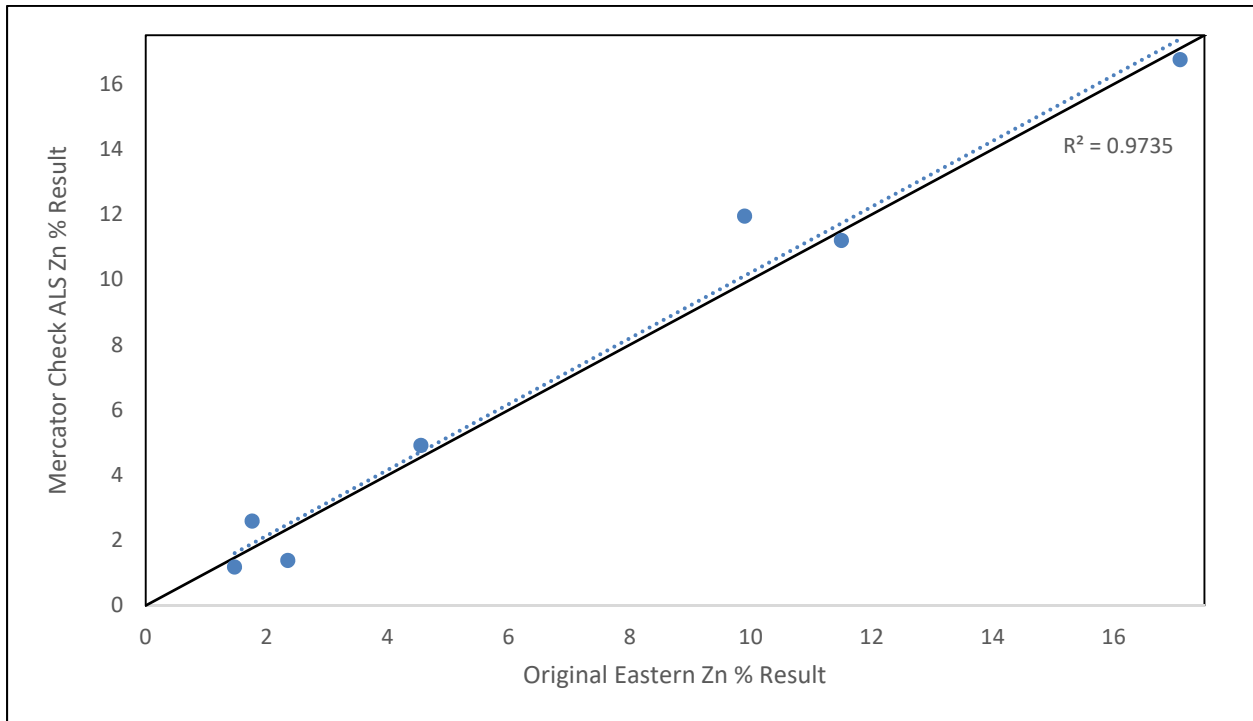
#### 12.4 Mercator Check Sampling Program (2018)

During the site visit and core review by Mercator, 7 quarter core samples were obtained for purposes of check sample analysis against the 2014/2015 and 2018 analytical results. As noted earlier in Section 11, selected sample intervals were re-sampled by Mercator staff during the core reviews that were carried out on November 19<sup>th</sup>, 2018 to November 21<sup>st</sup>, 2018 at the Buchans core logging and storage facility in Buchans.

Quarter core samples for selected core intervals were produced under Mercator supervision using a diamond saw. The remaining quarter core split for each interval was returned to its source box and the sample split retained for analysis was then placed in a labelled plastic bag and sealed. Mercator maintained secure procession of the check samples until preparation of an analytical shipment that included insertion of one blank sample and one certified reference material sample prior to delivery by commercial courier to ALS in Sudbury, ON for determination of specific gravity, crushing and pulverization and analysis of Zn, Pb, Cu, and Ag by ore grade ME-OG46 protocol and Au by fire assay methods. Efforts were made during the core sampling program to obtain representative samples across the deposit grade ranges.

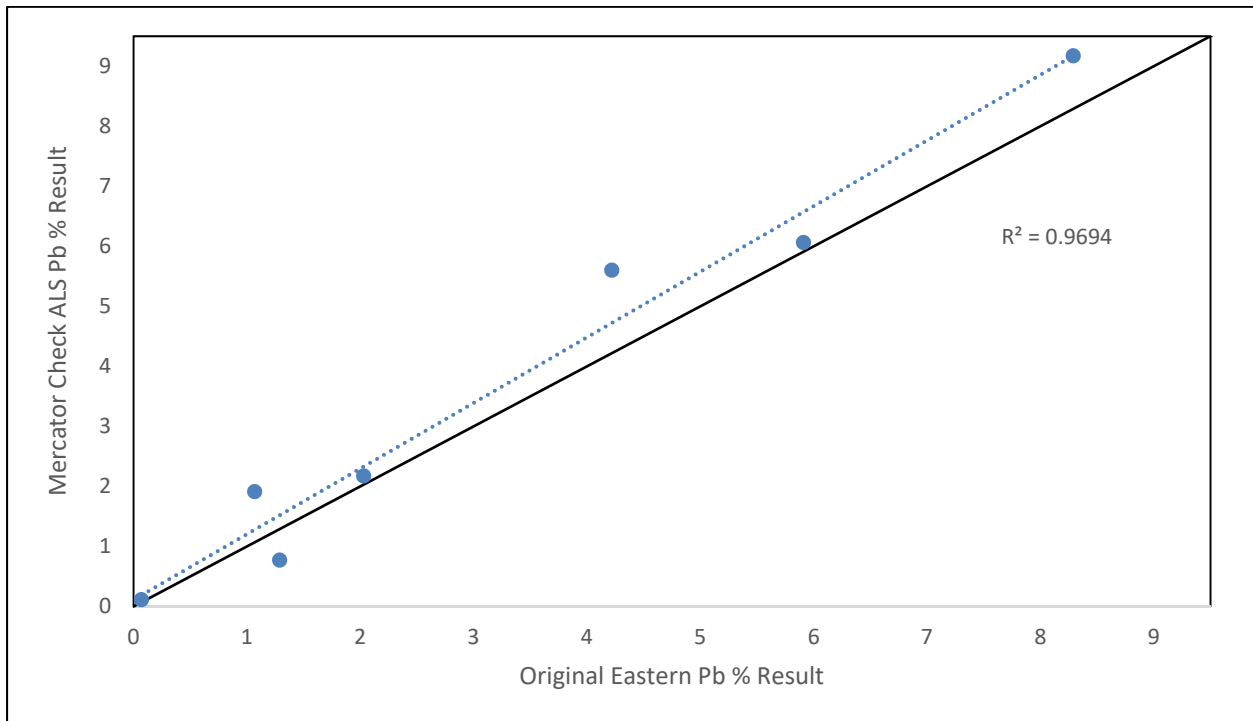
Mercator check sample results for the 7 quarter-core splits are plotted against the original assay values recorded by Buchans in Figures 12-18 to Figure 12-22. Cu, Pb, Zn, Ag and Au results returned from ALS show acceptable correlation with original sample values reported in the project database and no issues were identified with respect to the blank sample and certified reference material results.  $R^2$  values for each data set are displayed on respective plots. Variability between the two sample sets is considered to be primarily influenced by core-scale heterogeneity of metal distribution between the quarter core check samples. Mercator is of the opinion that results of the data verification procedures carried out with respect to the 2014/2015 and 2018 drilling program, plus results of verification work reported previously in Technical Reports by Webster and Barr (2008) and Cullen and Hilchey (2013) with regard to the previous Mineral Resource Estimates, are acceptable.

**Figure 12-18: Mercator Check Sample Results – Zn %**



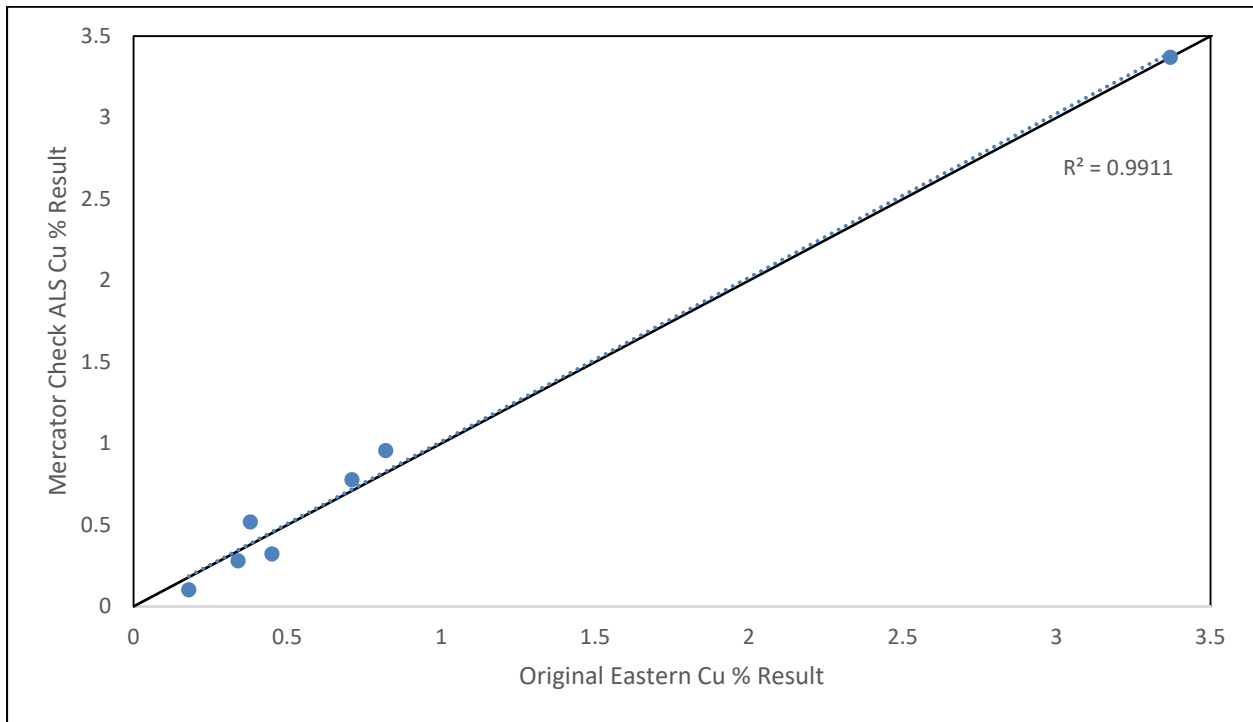
*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-19: Mercator Check Sample Results – Pb %**



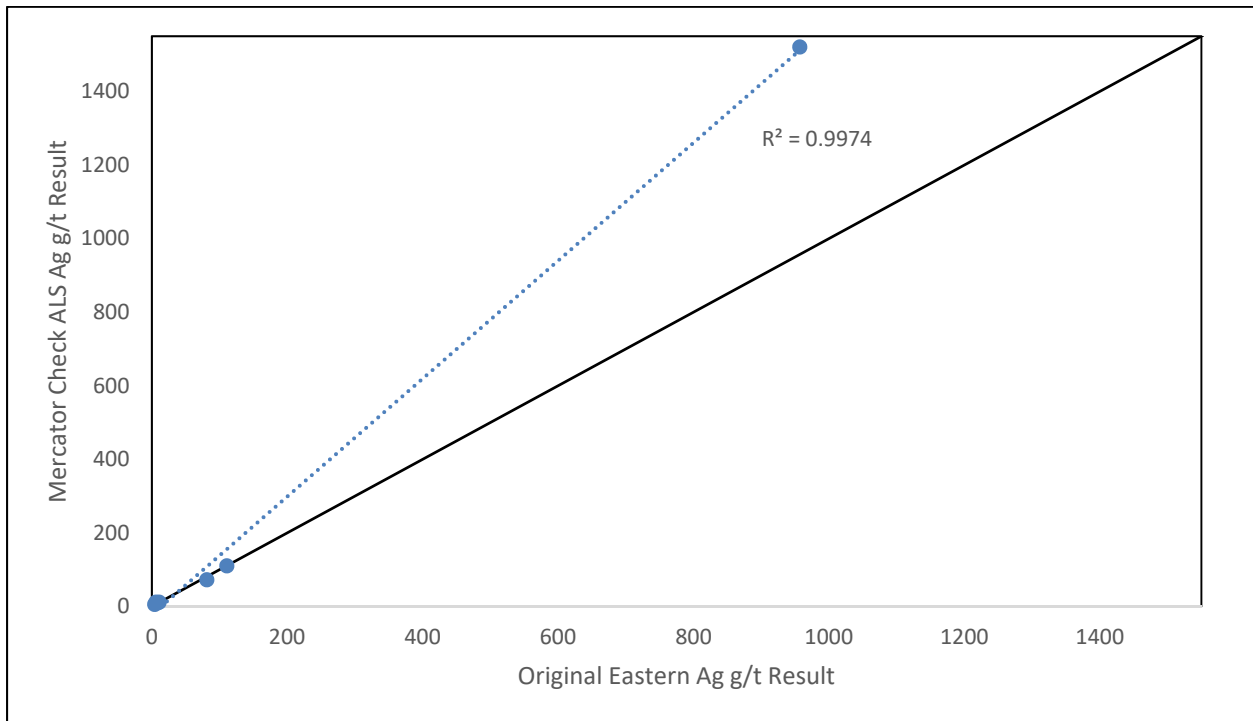
*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-20: Mercator Check Sample Results – Cu %**

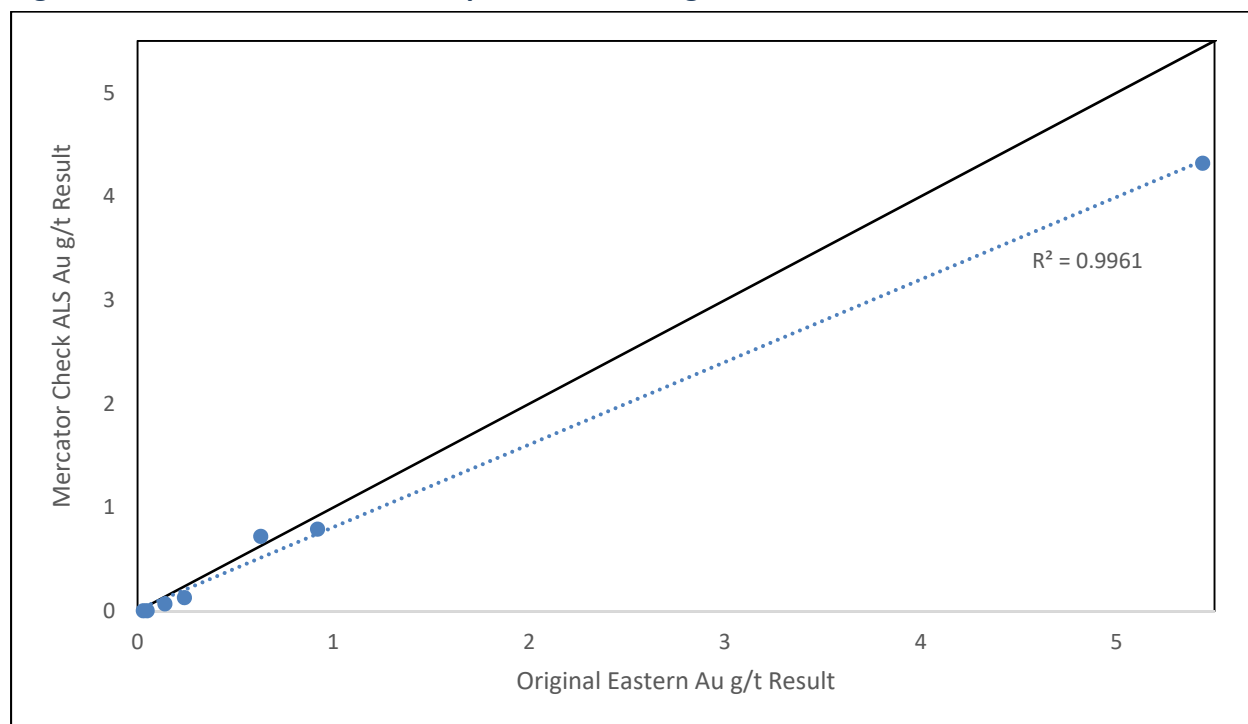


*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-21: Mercator Check Sample Results – Ag g/t**



*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

**Figure 12-22: Mercator Check Sample Results – Au g/t**

*Black line denotes 1:1 correlation; Blue dashed - data linear regression*

### 12.5 Mercator Independent Data Verification and Site Visit (2018)

From November 19<sup>th</sup> to November 21<sup>st</sup>, 2018 author Matthew Harrington, P. Geo., visited the Lundberg Deposit site accompanied by Buchans staff, Paul Moore, P. Geo., Vice President of Exploration, David Butler, P. Geo, Exploration Manager and Derrick Keats, Senior Geological Technician. At that time, drill core was reviewed and sampled at Buchans' core logging and storage facilities and a review of Buchans drill program components, including discussion of protocols for sampling of drill core was carried out.

A survey plan of drill collars was available during the site visit and field checks were undertaken where possible to validate hole numbers, locations and casing orientations with respect to digital database records. Although heavy snow cover was present, six casings from the 2014/2015 and 2018 programs were located and collar coordination check data were collected at each location. Evidence of recent drill activity such as drill pads, drill trails and site markers were located for all drilling areas inspected. NAD83 UTM Zone 21 coordinates for located collars and drill site areas were collected using a Garmin E-trek handheld GPS instrument and these were recorded for later checking of database drill collar location coordinates. Results showed acceptable correlation between datasets, with variance of a few meters recorded. Observations regarding character of

forest cover, site elevations, surface drainage, road and drill pad features, exploration conditions and coordination, and general access road conditions were also noted during the site visit.

As noted above, drill core from the 2014/2015 and 2018 drilling programs was reviewed at Buchans core logging and storage facility in Buchans. Buchans' staff, Paul Moore, P. Geo., Vice President of Exploration, David Butler, P. Geo, Exploration Manager and Derrick Keats, Senior Geological Technician., were present during the core review and sampling program. Quarter core check samples described above in Section 12-3 were collected from drill core at this time with assistance of Buchans staff.

Review of core from both drilling programs provided characterization of lithology, alteration and mineralization styles intersected by recent drill holes. These were found to be consistent with descriptions presented in the digital drill hole database and drill logs. Drill core reviewed came from five holes, these being H-14-3448, H-15-3496, H-18-3515, H18-3516B, and H-18-3519. Drill core review during the site visit confirmed the presence of both stockwork style sulphide mineralization that characterizes the Lundberg and Engine House Zones and massive sulphide mineralization that occurs as remnants of the previously mined Lucky Strike and North orebodies, an extension to the Two Level orebody, and additional mineralization associated with the Airport Thrust. In all instances, good correlation was recognized between drilling program lithological logging and sampling program documentation and the physical evidence of such present in the archived core.

Based on observations made during the site visit and further discussions with Buchans staff, Mercator determined that, to the extent reviewed during the visit, evidence of work programs carried out to date on the property is consistent with descriptions reported by the Company and that procedures employed by Buchans staff are consistent with current industry standards and of good quality.

## 13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

### 13.1 Overview

The following metallurgical test programs have been conducted on samples from the Lundberg and/or Engine House deposits:

- SGS Mineral Services – Lakefield ((Roman and Imeson, 2011): Mineralogy, grindability, heavy liquid separation, batch flotation and locked cycle flotation tests.
- SGS Mineral Services – Lakefield (Legault et. al., 2013): Mineralogy, grindability, batch flotation, locked cycle flotation, solid-liquid separation tests.
- SGS Mineral Services – Lakefield (Patsias and Imeson, 2014): Sample preparation and assays for ore sorting bulk test by Tomra (2014).
- Tomra Sorting Solutions (Tomra, 2014): XRT sensor-based sorting bulk test.
- Thibault & Associates (McKeen and Thibault, 2017): Bench scale dense media separation and batch flotation tests.

The testing completed by SGS in 2011 was used as the basis for the previously filed 2011 PEA report (Coley et. al., 2011), and development of the process flowsheet continued in subsequent studies.

Metal recoveries used in the NSR calculator for this study have been taken from the metallurgical projection in the most recent work by Thibault & Associates in 2017. The Thibault (2017) study was jointly undertaken with Canadian Zinc Corporation and funded in part by the Research & Development Corporation of Newfoundland and Labrador through the GeoEXPLORE Industry-lead program. The test program evaluated dense media separation as a potential pre-concentration technology and development of a bench scale flotation process based on the metallurgical characteristics of the deposit. The Thibault (2017) study also included a process simulation and a conceptual/order of magnitude economic model to identify and evaluate the key factors impacting the economics of the proposed milling facility for producing base metal concentrates.

In the studies from 2011 to 2017, process options that have been evaluated for the Lundberg and Engine House deposits include pre-concentration of the resource material, and flotation for recovery of copper, lead and zinc concentrates.

Being a stockwork deposit, pre-concentration by dense media separation (Thibault, 2017) or XRT sensor-based sorting (Tomra, 2014) was evaluated as a potential means to reject non-sulphide



mineralization ahead of flotation. The use of pre-concentration would increase the feed grades to the mill, reduce the size of the grinding and flotation plant and reduce transportation costs if an off-site milling facility was considered. Dense media separation and XRT sensor-based sorting were both found to be technically viable pre-concentration methods with similar results, and further evaluation is required to determine if there is an economic advantage to either or both technologies (i.e., if there are sufficient overall capital/operating cost advantages to offset any metal loss with the upgrading process).

Improvement of the flotation process has been achieved as the testing has progressed in the various studies. The evaluation of flotation options has included two main flowsheets. The first was the bulk Cu/Pb flowsheet where copper and lead are floated together followed by downstream separation into copper and lead concentrates. The second flowsheet option involved sequential flotation of copper, lead, and zinc into individual concentrates from the outset.

In the most recent open circuit bench scale tests by Thibault (2017), the sequential flotation of copper, lead and zinc from the Lundberg samples has been shown to be more selective, yielding improved copper and zinc concentrate grades compared to the bulk Cu/Pb flowsheet used in the 2011 Preliminary Economic Assessment. The preliminary results show that selective zinc, lead and copper concentrates can be produced at marketable grades relative to smelter schedules. Locked cycle flotation testing needs to be conducted to confirm the sequential flowsheet performance, and the results to date support continuing with the development of the sequential flotation flowsheet.

The main findings of the metallurgical test programs from 2011 to 2017 are summarized in the following sections.

### **13.2 Head Sample Analysis**

A comparison of the composition of the various head samples used in metallurgical test programs since 2011 is shown in Table 13-1. In the first test program (Roman & Imeson, 2011), the samples noted in Table 13-1 are the ones that were used for mineralogical analysis and the final locked cycle flotation testing. In 2013, SGS compiled two separate Lundberg composite samples relative to the resource as defined at the time to approximate a potential scenario of processing higher grade material initially, followed by a decrease in head grades thereafter (i.e., Lundberg Year 1-3 and Lundberg Year 4-8). A separate sample from the Engine House deposit was also prepared

**Table 13-1: Metallurgical Test Sample Analysis**

Element	Units	Prep. by SGS (2011)		Prep. by SGS (2014) [1]	Prep. by SGS (2013) [2]		
		Lundberg Overall Comp.	Lundberg Sample 4	Lundberg Tomra Sorting Sample	Lundberg Year 1-3	Lundberg Year 4-8	Engine House
Cu	%	0.35	0.63	0.36	0.67	0.41	0.98
Pb	%	0.79	0.65	0.59	1.01	0.64	0.66
Zn	%	1.69	1.73	1.46	2.10	1.43	1.78
Fe	%	11.6	9.54	8.12	9.93	9.83	13.7
Au	g/tonne	0.24	0.16	0.08	0.07	0.06	0.14
Ag	g/tonne	7.25	9.55	5.8	7.1	5.5	11.3
Ba	%	0.2	-	-	1.43	2.28	2.42
S	%	10.7	10.7	8.48	9.88	9.77	15.5

Note: [1] The Lundberg Tomra Sorting Sample was used by Tomra (2014) for the bulk ore sorting test, and a sub-sample was also used by Thibault (2017) for dense media separation tests.

[2] Sub-samples of the Lundberg Year 1-3 and Year 4-8 samples prepared by SGS (2013) were also used for dense media separation and flotation tests by Thibault (2017).

for testing. The remaining samples prepared by SGS (2013) and SGS (2014) were freezer stored and these same samples were subsequently used by Thibault (2017) for additional testing.

### 13.3 Mineralogy

#### 13.3.1 SGS (2011)

A sub-sample of the Lundberg Overall Composite sample from the 2011 test program was ground to 80% passing 80-90 micron and subjected to a size by size mineralogy study using QEMSCAN™. The bulk modal mineralization showed that copper was present exclusively as chalcopyrite (no secondary copper), lead only as galena, and zinc exclusively as sphalerite. The semi-massive sulphide sample had gangue consisting of pyrite (13.8%), chlorite (41%), quartz (32%) and minor/trace amounts of carbonates, micas and other minerals. No arsenopyrite was identified. A release analysis showed that the copper, lead and zinc minerals were well liberated for flotation at a P80 of 80-90 micron and that an even coarser grind size could be considered. Given the low clay and pyrite content, and coarser liberation characteristics compared to the SGS database, no major processing challenges related to mineralogy were identified.

#### 13.3.2 SGS (2013)

Three samples from separate areas of the deposit were analyzed using QEMSCAN™. The samples were all ground to approximately 80% passing 106 micron and were identified as Lundberg Year

1-3, Lundberg Year 4-8, and Engine House. The bulk modal composition of the two Lundberg samples was similar to what was found in the SGS (2011) Lundberg Overall Composite sample, with the exception of some trace secondary copper identified as chalcocite. The Engine House sample also had trace chalcocite and contained about double the amount of pyrite compared to the Lundberg samples. The liberation of the sulphide minerals in each of the samples was as follows:

Lundberg Year 1-3: sphalerite 88.1%, chalcopyrite 82.2%, galena 76.6%, and pyrite 92.8%.

Lundberg Year 4-8: sphalerite 89.3%, chalcopyrite 85.9%, galena 82.9%, and pyrite 91.9%.

Engine House: sphalerite 69.0%, chalcopyrite 64.0%, and pyrite 81.6%.

The sulphide minerals in the Lundberg samples were considered to have good liberation for flotation at the grind size of 80% passing 106 microns, but a finer grind size would be needed to improve the liberation of the Engine House sample.

For the Lundberg and Engine house samples, it was concluded that there were no mineralogical factors that should contribute to zinc contamination in the copper and lead concentrates, and no evidence that copper and lead should pose contamination issues in the zinc concentrates. It was noted that a regrind prior to copper and lead concentrate cleaning would be beneficial.

#### **13.4 Grindability Index Testing**

Grindability testing was conducted by SGS (2013), on a single sample labelled Lundberg Comminution. SGS (2013) prepared the Lundberg Comminution sample by crushing, blending, screening and sample splitting accordingly for an SMC test to determine the JK parameters, an SPI® test for SAG Power Index, CEET® Crusher Index (Ci) test, Bond Ball Mill and Rod Mill tests, and an abrasion index test. The results as summarized in Table 13-2 show that the sample was hard to moderately hard and medium in abrasiveness.

**Table 13-2: Lundberg Comminution Sample Grindability Index Summary (Legault, 2013)**

Relative Density	JK Parameters		CEET Ci	SPI® (min.)	Bond Work Indices (kWh/t)		AI (g)
	A x b	DWI (kWh/m³)			RWI	BWI	
2.91	40.0	7.24	2.9	112.5	15.6	17.4	0.242

In addition to the 2013 test results, in SGS (2011) determined the Bond ball mill work index (BWI) to be 16.1 kWh/t for the Lundberg sample identified as Sample 4.

### 13.5 Pre-Concentration

Dense media separation and XRT sensor-based sorting were evaluated as potential technologies to upgrade the Lundberg resource material ahead of grinding and flotation, by selectively rejecting some of the non-sulphide gangue minerals.

#### 13.5.1 Dense Media Separation

Thibault (2017) evaluated dense media separation using bench scale heavy liquid separation tests on the Lundberg Year 1-3, Lundberg Year 4-8 and Lundberg Tomra Sorting samples. All samples were crushed to minus 0.5 inch and the fines were removed at 1 mm prior to upgrading. Table 13-3 compares the results for the three samples at a mass recovery of 70% to the upgraded material, including fines that were initially removed.

Dense media separation was demonstrated to be technically viable and achieved selective rejection of gangue material. Some variability in the performance of the samples was noted, with the highest metal recoveries in the Lundberg Year 1-3 and Lundberg Tomra Sorting Samples. The potential benefits of using dense media separation would be mainly related to economics. Further work is required to determine if there is a net benefit in reducing the mass of material for downstream processing versus loss of payable metal in the upgrading process.

**Table 13-3: Dense Media Separation Upgrading Summary at 70% Overall Mass Recovery**

Sample	Overall Metal Recovery to Sinks + Fines				
	Cu (%)	Pb (%)	Zn (%)	Au (%)	Ag (%)
Lundberg Year 1-3	98.3	96.6	96.5	89.6	95.3
Lundberg Year 4-8	94.7	94.2	93.9	84.8	90.1
Lundberg Tomra Sorting	98.6	95.4	94.5	90.5	85.4
Sample	Overall Upgrade Ratio (Sinks + Fines Relative to Feed)				
	Cu	Pb	Zn	Au	Ag
Lundberg Year 1-3	1.40	1.38	1.38	1.28	1.36
Lundberg Year 4-8	1.35	1.35	1.34	1.21	1.29
Lundberg Tomra Sorting	1.41	1.36	1.35	1.29	1.22

The Thibault (2017) dense media separation test work yielded comparable results to earlier testing by SGS (2011) on another Lundberg sample, at a finer crush size. SGS (2011) performed an initial bench scale dense media separation test using the Lundberg Sample 4 material and heavy liquid to perform separations at varying specific gravity. The sample was finely crushed to minus 0.25 inch and fines were removed at 16 mesh before separation. After recombining the fines with the upgraded product, the test resulted in a recovery of 75% of the initial sample mass along with recoveries of 97.8% copper, 97.0% lead and 96.1% zinc.

### 13.5.2 XRT Sensor-Based Sorting

A bulk composite sample from the Lundberg Deposit weighing approximately 700 kg was prepared and subjected to an XRT sensor-based sorting test (i.e., Lundberg Tomra Sorting Sample). This sample was crushed to minus 1.5 inches and separated into size fractions at the following screen sizes: 1 inch, 0.5 inch and 0.25 inch. Except for the material finer than 0.25 inch, all other size fractions were subjected to a mini-bulk sorting test by Tomra Sorting Solutions in Wedel, Germany (Tomra, 2014). The full-scale sorter used X-ray transmission (XRT) sensor technology with the goal of making a separation between sulphide and non-sulphide mineralization. Two different detector sensitivity settings were tested for determining the split between waste and product material. In addition, single-stage (rougher) separation was compared to two-stage (rougher-scavenger) separation.

The results are summarized in Table 13-4 for the overall upgrading process, after recombining the sorter product and the minus 0.25 inch fines that were not subjected to sorting. Setting 1 resulted in higher metal recoveries compared to Setting 2, and accordingly more mass recovery. At the same mass recovery of 75%, better metal recoveries were achieved with the two-stage

flowsheet (Setting 2) compared to a single stage flowsheet with a less aggressive sensitivity (Setting 1).

XRT sensor-based sorting was concluded to be technically viable for pre-concentrating the Lundberg material, and like dense media separation, further evaluation is required to determine the potential net benefit based on economic factors.

**Table 13-4: XRT Sensor-Based Test Results – Lundberg Tomra Sorting Sample**

Detector Sensitivity	Flowsheet	Recovery to Product + Fines (%)			
		Mass	Cu	Pb	Zn
Setting 1 [1]	1 Stage	75.0%	95.6%	93.0%	93.9%
Setting 1 [1]	2 Stage	79.9%	98.5%	96.8%	97.2%
Setting 2	1 Stage	66.1%	93.9%	89.7%	91.1%
Setting 2	2 Stage	75.4%	98.2%	95.6%	96.3%

Note: [1] Approximately 90% of the material was tested at Setting 1, however, due to small sample size, the remaining 10% of the material (0.25 to 0.5 inch size fraction) was only tested at Setting 2.

### 13.5.3 Comparison of Dense Media Separation and XRT Sensor-Based Sorting

Figures 13-1 through 13-3 compare the bench scale dense media separation (DMS) test results (Thibault, 2017) and the mini-bulk XRT sensor-based sorting results (Tomra, 2014) for the Lundberg Tomra Sorting Sample. Only two sensor settings were tested for XRT sorting compared to the multiple specific gravities for dense media separation, so the mass recovery trends for two-stage sorting covered a smaller range of 75 to 80% mass recovery. Additional sensor settings could expand the range of mass recovery results for upgrading by XRT sensor-based sorting.

In the range of 75 to 80% mass recovery to upgraded material, pre-concentration by two stages of XRT sorting at a 1.5 inch crush size provides comparable grade-recovery performance to dense media separation at a 0.5 inch crush size.

Since both technologies performed almost equally as well, further evaluation of pre-concentration should include both technologies when determining if there is a net benefit to the project. In addition, the dense media separation tests were conducted as static bench scale tests whereas the mini-bulk XRT sorting tests were conducted on a larger scale with continuous feed to a full-scale sorter. Therefore, if dense media separation becomes favorable for further consideration, additional work should be conducted to scale-up the expected dense media separation recoveries incorporating the efficiency of a continuous flow dense media separation cyclone.

Figure 13-1: Lundberg Copper Pre-Concentration by DMS compared to XRT Sensor-Based Sorting

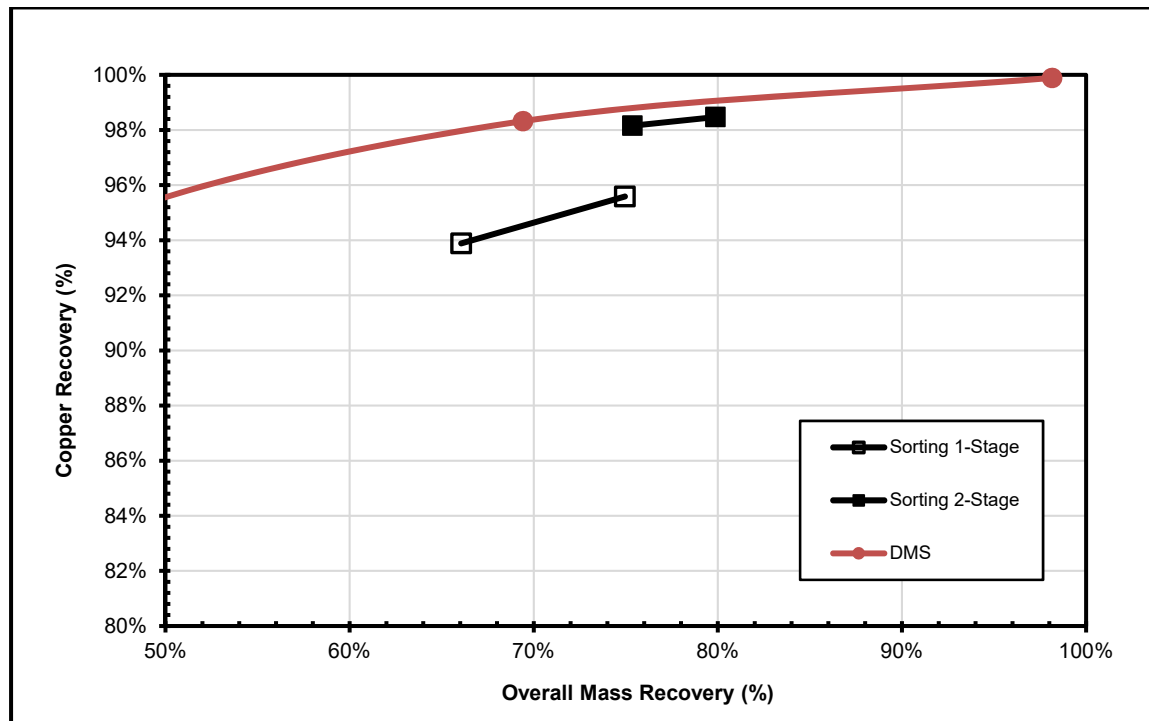
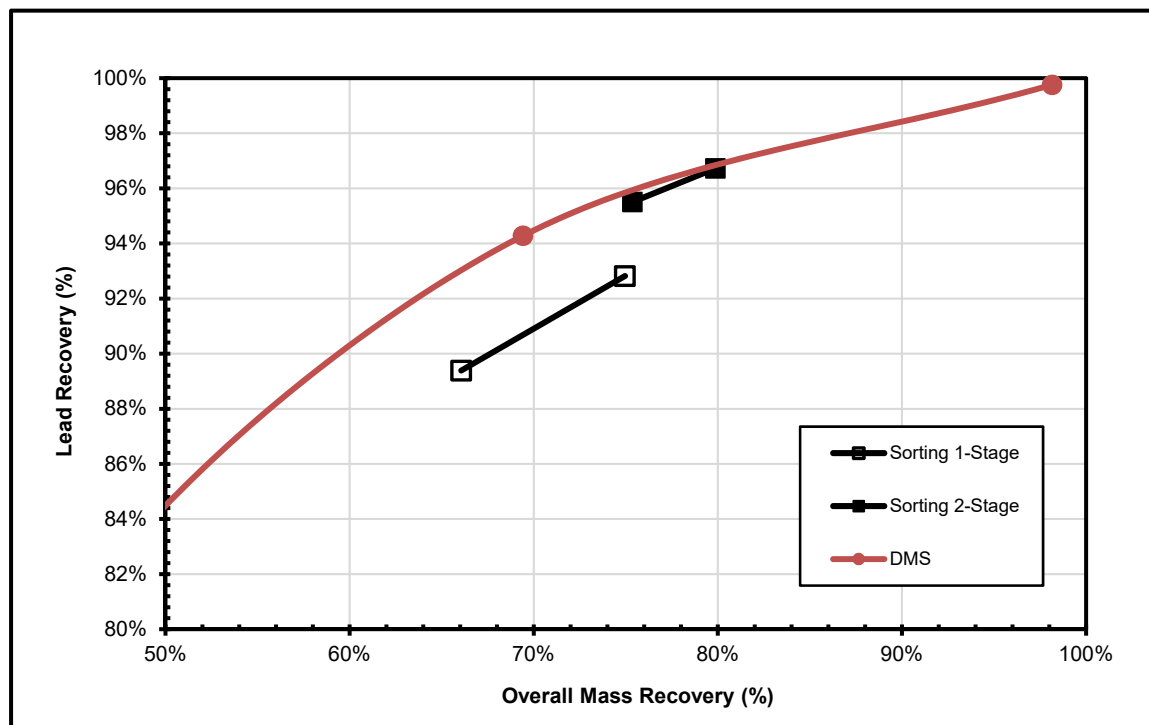
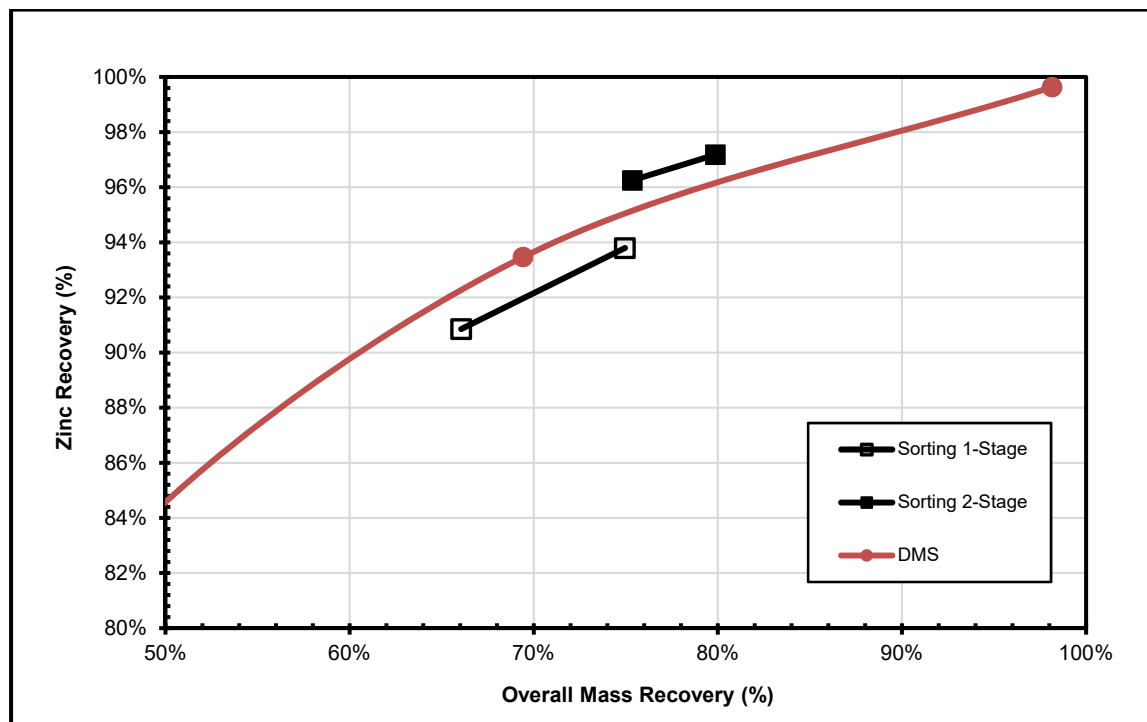


Figure 13-2: Lundberg Lead Pre-Concentration by DMS compared to XRT Sensor-Based Sorting



**Figure 13-3: Lundberg Zinc Pre-Concentration by DMS compared to XRT Sensor-Based Sorting**

## 13.6 Bench Scale Flotation

This section describes the bench scale flotation test work that has been conducted based on two alternative flowsheet configurations – sequential flotation and bulk Cu/Pb flotation.

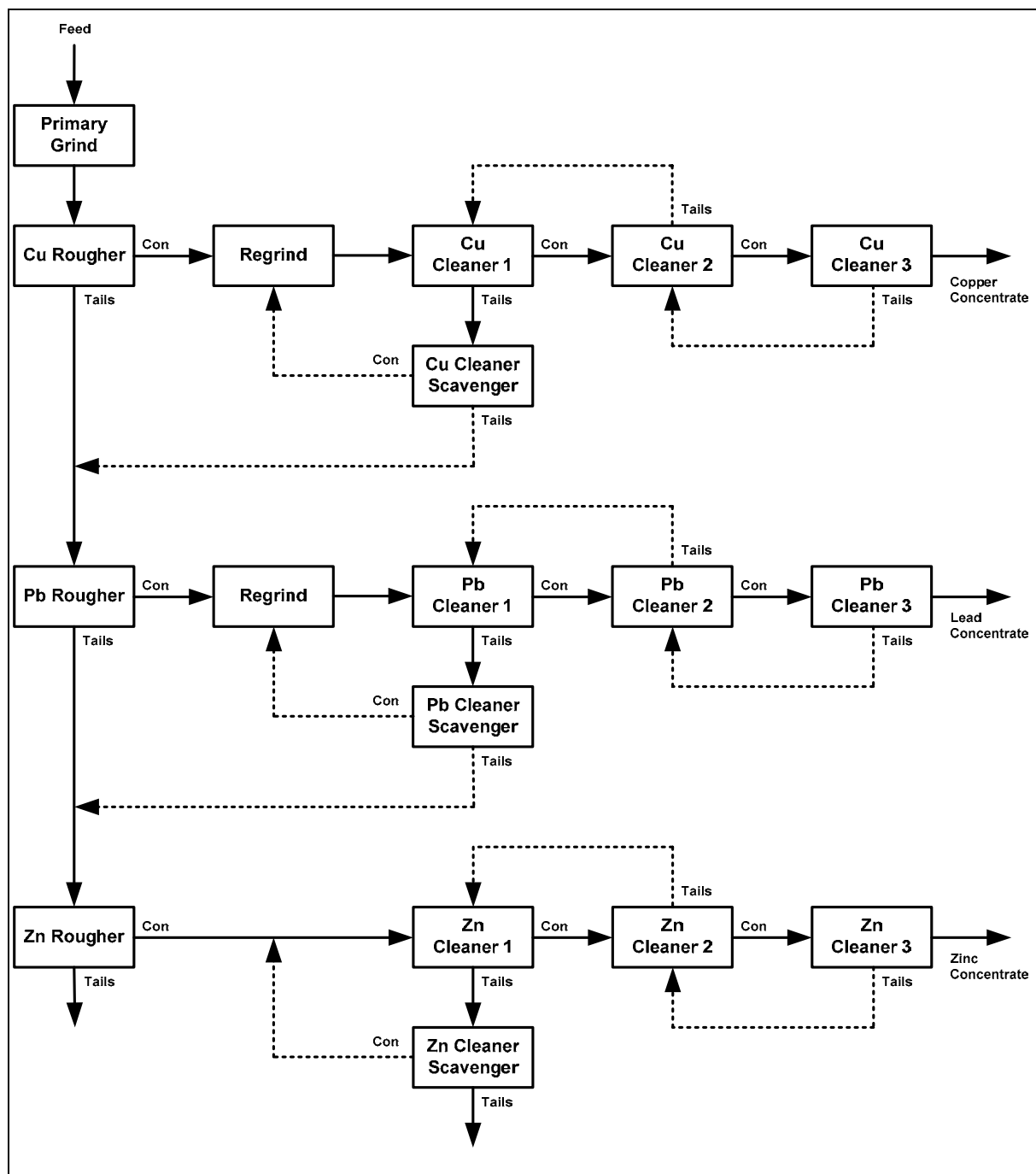
### 13.6.1 Sequential Flotation Flowsheet – Thibault (2017)

The most recent flotation test work on the Lundberg Deposit was conducted by Thibault (2017) and was based on a sequential flowsheet, as illustrated in Figure 13-4. The streams shown in dashed lines were collected and assayed rather than being recycled since the tests were open circuit and locked cycle testing was not conducted. In the sequential flowsheet, copper, lead and zinc concentrates are floated individually and in that order. A regrind was only employed in the copper and lead circuits.

As an initial evaluation of the sequential flotation flowsheet, ten rougher flotation tests and eight open circuit cleaner flotation tests were conducted on the Lundberg Years 1-3 and Lundberg Years 4-8 samples prepared by SGS (2013).



Figure 13-4: Sequential Flotation Flowsheet (Thibault, 2017)



A primary grind size of 80% passing 75 microns was used for the tests. The following regrind sizes were used:

- Lundberg Year 1-3: Cu regrind P<sub>80</sub> of 23 microns, Pb regrind P<sub>80</sub> of 19 microns.
- Lundberg Year 4-8: Cu regrind P<sub>80</sub> of 20 microns, Pb regrind P<sub>80</sub> of 16 microns.

The reagents used for the sequential flow sheet are listed in Table 13-5.

**Table 13-5: Reagent Scheme for Sequential Flotation Flowsheet Tests (Thibault, 2017)**

Reagent Type	Copper Flotation	Lead Flotation	Zinc Flotation
Depressant	ZnSO <sub>4</sub> , Sodium Metabisulphite	ZnSO <sub>4</sub> , NaCN	-
pH Modifier	-	Soda Ash	Lime
Activator	-	NaCN	CuSO <sub>4</sub>
Collector	5100	3418A	5100
Frother	MIBC	MIBC	MIBC

The results of open circuit cleaner flotation tests for the Lundberg samples using the sequential flowsheet are summarized in Table 13-6. The sequential flowsheet results compare to the earlier bulk Cu/Pb flowsheet open circuit results (Table 13-11 – Legault, 2013) as follows:

- The copper concentrate is much higher grade, contains substantially less zinc contamination and for Lundberg Year 4-8, less misplaced lead. Less zinc in the copper concentrate not only improves its quality, but provides the potential to recover more zinc into the zinc concentrate.
- The flotation performance for lead concentrate is similar for the sequential and bulk Cu/Pb flowsheets.
- The sequential flowsheet produced a higher-grade zinc concentrate and was better able to reject pyrite from the zinc concentrate compared to the bulk Cu/Pb flowsheet.

**Table 13-6 Sequential Flowsheet Open Circuit Cleaner Flotation Test Results (Thibault, 2017)**

Test	Sample	Product	Grade (% g/t)						Recovery (%)					
			Cu	Pb	Zn	Fe	Ag	Au	Cu	Pb	Zn	Fe	Ag	Au
FL-159	Year 1-3	Cu Conc	<b>32.1</b>	2.10	1.43	30.7	29	0.16	<b>69.2</b>	2.7	0.8	3.6	6.5	3.3
		Pb Conc	1.00	<b>79.9</b>	2.88	1.60	234	0.73	0.6	<b>30.3</b>	0.5	0.1	15.8	4.6
		Zn Conc	0.68	0.70	<b>67.0</b>	0.97	17	0.11	2.2	1.4	<b>54.2</b>	0.2	5.8	3.5
FL-164	Year 4-8	Cu Conc	<b>31.9</b>	0.94	0.98	28.7	18	0.53	<b>64.2</b>	1.0	0.5	2.2	2.9	5.7
		Pb Conc	0.38	<b>75.9</b>	2.8	2.03	263	1.13	0.4	<b>47.5</b>	0.8	0.1	24.9	7.0
		Zn Conc	0.74	0.51	<b>61.4</b>	1.03	21	0.19	3.5	1.3	<b>67.9</b>	0.2	8.2	4.7

Based on the positive results with the open circuit flotation tests on the two Lundberg samples, Thibault (2017) prepared a METSIM™ mass balance (Table 13-7) to project potential closed-circuit flowsheet performance using the results of each unit operation from the open circuit test. The projection is based on a weighted average of the Lundberg Years 1-3 and Years 4-8 test results to represent an average for the deposit. The projection has not been confirmed by locked cycle testing.

It was concluded from the open circuit test results and flowsheet simulation that the Lundberg Deposit is amenable to processing with the sequential flowsheet, with improved flotation selectivity and concentrate grades compared to the bulk Cu/Pb flowsheet. The results indicate that concentrates can be produced at marketable grades relative to smelter schedules. The projected sequential flowsheet recoveries from Table 13-7 were used as the basis for the current resource estimate.

**Table 13-7: Lundberg Projected Sequential Flotation Grades and Recoveries by METSIM™ Simulation**

Product	Grade (% g/t)						Distribution (%)					
	Cu	Pb	Zn	Fe	Ag	Au	Cu	Pb	Zn	Fe	Ag	Au
Cu Concentrate	<b>31.1</b>	1.63	1.38	29.9	41	1.23	<b>83.0</b>	2.7	0.9	3.5	7.8	13.3
Pb Concentrate	1.08	<b>67.8</b>	4.41	2.87	357	1.31	2.2	<b>84.3</b>	2.3	0.2	50.3	10.5
Zn Concentrate	1.37	1.18	<b>58.4</b>	2.50	36	0.35	8.0	4.3	<b>87.2</b>	0.6	14.8	8.3

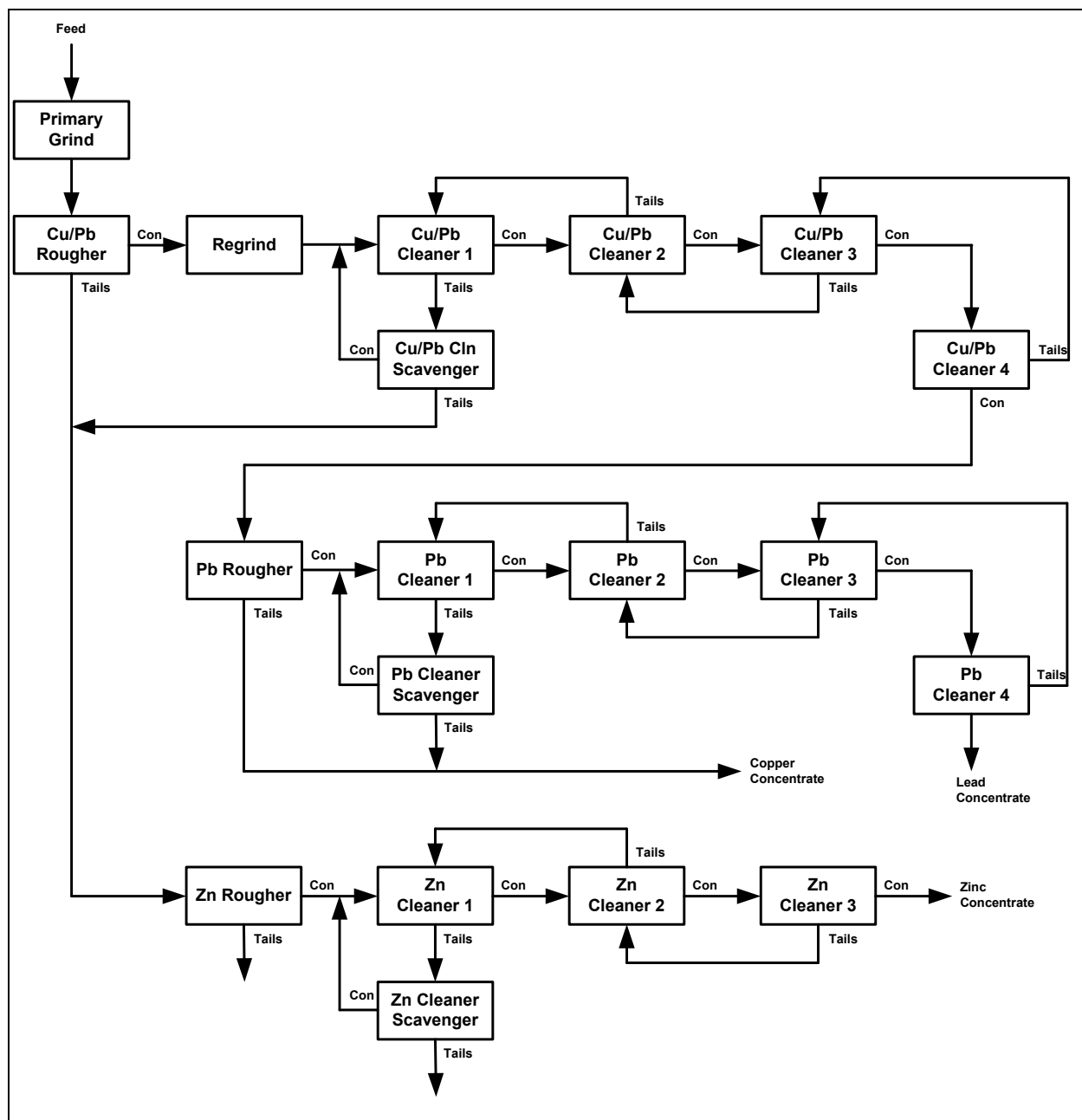
The open-circuit tests and simulation results demonstrate that further locked cycle testing is warranted to confirm the metallurgical performance of the sequential flotation flowsheet.

### 13.6.2 Bulk Cu/Pb Flotation Flowsheet (SGS, 2011 & SGS, 2013)

#### 13.6.2.1 SGS (2011) Flotation Test Work

Thirty open-circuit flotation tests and three locked-cycle flotation tests were conducted as an initial development of the flowsheet for the Lundberg Deposit. All tests were conducted using a bulk copper/lead flotation followed by copper/lead separation, as depicted in Figure 13-5.

Figure 13-5: Bulk Cu/Pb Flowsheet for Test LCT-3 (Roman and Imeson, 2011)



The reagent scheme and grind size were varied in the open-circuit tests, leading to the selection of conditions for the final locked cycle test, LCT-3. The primary grind had a  $P_{80}$  of 52 micron, while the copper/lead rougher concentrate was reground to a  $P_{80}$  of 38 micron. The reagent scheme was as listed in Table 13-8.

**Table 13-8: Reagent Scheme for LCT-3 (Roman and Imeson, 2011)**

Reagent Type	Copper/Lead Flotation	Zinc Flotation
Depressant	NaCN, ZnSO <sub>4</sub> , H <sub>2</sub> SO <sub>3</sub> , Activated Carbon	-
pH Modifier	-	Lime
Activator	-	CuSO <sub>4</sub>
Collector	3418A	SIPX
Frother	U250, MIBC	U250, MIBC

The metallurgical projection based on the last three cycles of the locked cycle test LCT-3 on Lundberg Sample 4 is shown in Table 13-9.

**Table 13-9: Metallurgical Projection from Cycles D-F of LCT-3 on Lundberg Sample 4**

Product	Weight %	Grade					Distribution (wt%)				
		Cu (%)	Pb (%)	Zn (%)	S (%)	Ag (g/t)	Cu	Pb	Zn	S	Ag
Copper Con	2.4	<b>24.1</b>	1.48	5.86	33.8	37.8	<b>89.3</b>	5.6	8.1	8.2	10.5
Lead Con	0.7	1.03	<b>73.9</b>	4.55	16.1	360	1.1	<b>78.7</b>	1.8	1.1	27.8
Zinc Con	2.2	1.96	1.33	<b>53.0</b>	32.6	33.0	6.6	4.6	<b>66.2</b>	7.1	8.2
Final Tails	94.7	0.05	0.054	0.38	8.99	4.95	7.1	8.1	20.7	85.4	53.5
Head (calc)	100.0	0.65	0.64	1.75	10.0	8.8	100.0	100.0	100.0	100.0	100.0

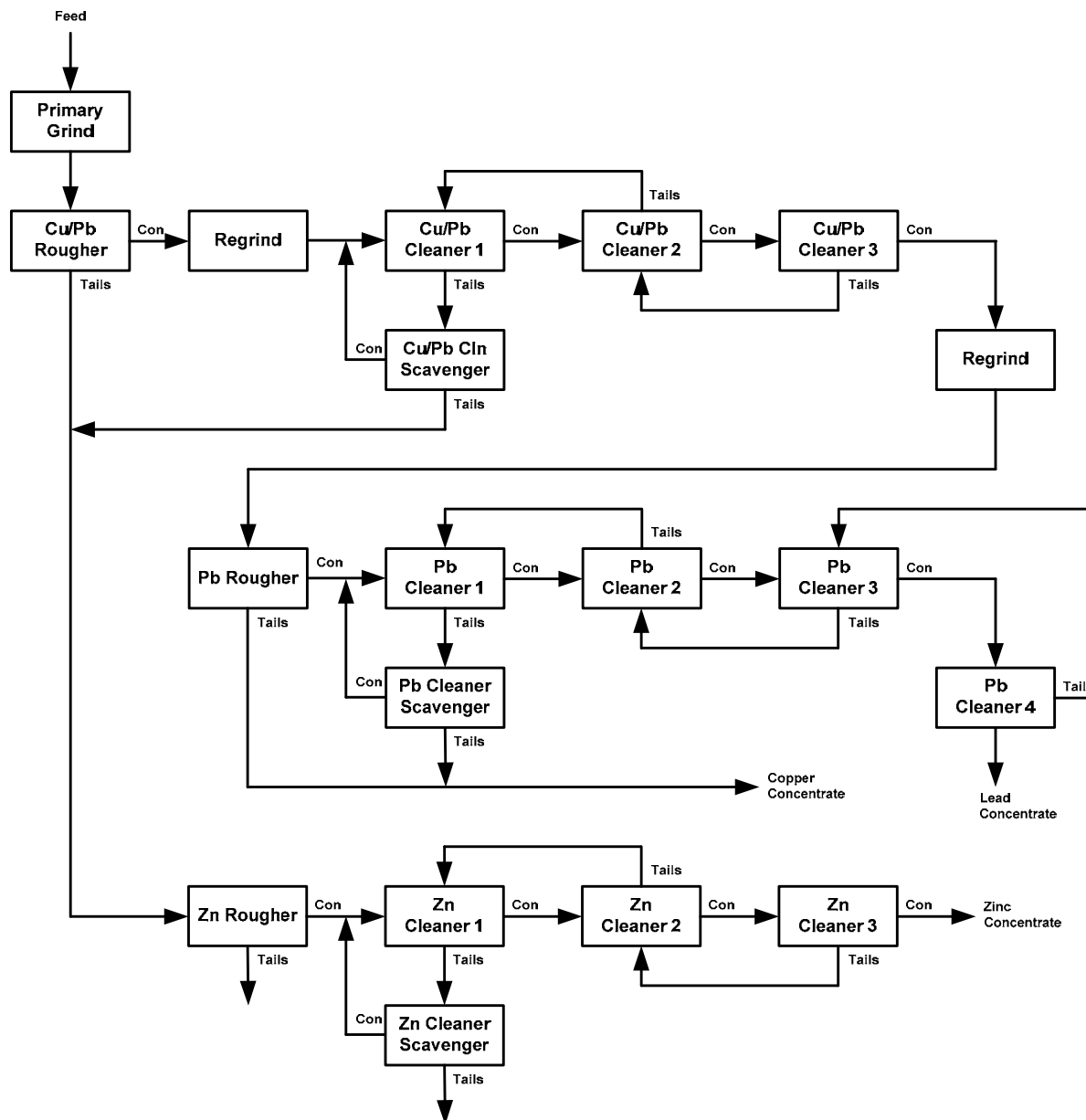
The results of this test program showed good copper recovery at a marginal copper concentrate grade. Areas identified for improvement include increasing the copper concentrate grade and decreasing zinc and lead misplacement in the copper concentrate. The lead circuit produced good grade and recovery results. With over 20% of the zinc remaining in the tailings, the potential for zinc recovery improvement was identified. No other deleterious elements were identified in the concentrates.

In addition to the base metal flotation tests, three initial tests were conducted on zinc flotation tailings to assess the potential to recover a barite concentrate. Barite rougher concentrate grading 5.0% to 8.3% Ba at 44% to 69% recovery from the zinc flotation tailings was achieved. Further work would be required to develop a barite recovery flowsheet.

### 13.6.2.2 SGS (2013) Flotation Test Work

Using the SGS (2011) test program as a starting point for reagent scheme and conditions, five rougher kinetic tests and ten open circuit cleaner flotation tests were conducted on the Lundberg Years 1-3, Years 4-8 and Engine House samples. The open-circuit cleaner tests and five locked cycle flotation tests were completed following the flowsheet in Figure 13-6. The flowsheet was the same as what was used by Roman and Imeson (2011) except the fourth Cu/Pb cleaner stage

Figure 13-6: Bulk Cu/Pb Locked Cycle Flowsheet (Legault, 2013)



was removed and a second regrind was added ahead of the copper/lead separation circuit. The process used a bulk flotation of Cu/Pb together, followed by a downstream separation stage.

The reagents used, as listed in Table 13-10, are similar to what was used in the SGS (2011) test program except the U250 frother was removed, and lime/sodium metabisulphite were introduced as supplementary depressants for tests LCT-3, LCT-4 and LCT-5 only. For the five locked cycle flotation tests, the primary grind had a P<sub>80</sub> of 71 to 81 microns, while the two regrinds

for the copper/lead cleaner circuit and the copper/lead separation circuit had a P<sub>80</sub> ranging from 26 to 34 micron.

**Table 13-10: Reagent Scheme for Open-Circuit and Locked Cycle Tests (Legault, 2013)**

Reagent Type	Copper/Lead Flotation	Zinc Flotation
Depressant	NaCN, ZnSO <sub>4</sub> , Lime, Sodium Metabisulphite, Activated Carbon	-
pH Modifier	-	Lime
Activator	-	CuSO <sub>4</sub>
Collector	3418A	SIPX
Frother	MIBC	MIBC

The open circuit cleaner flotation tests that were the basis for the locked cycle tests LCT-1 and LCT-2 produced the grade and recovery results presented in Table 13-11. For an open circuit test, the copper concentrate grades were relatively low and contained elevated zinc and lead

**Table 13-11: Open Circuit Cleaner Flotation Test Results (Legault, 2013)**

Test	Sample	Product	Grade (% g/t)					Distribution (%)				
			Cu	Pb	Zn	Fe	Ag	Cu	Pb	Zn	Fe	Ag
F9	Year 1-3	Cu Concentrate	<b>25.7</b>	1.31	6.32	27.0	25	<b>48.1</b>	1.6	3.9	3.3	4.9
		Pb Concentrate	1.26	<b>76.2</b>	3.44	3.17	289	1.6	<b>64.5</b>	1.4	0.3	38.6
		Zn Concentrate	0.90	0.66	<b>54.0</b>	7.46	18.6	3.1	1.5	<b>61.0</b>	1.7	6.7
F10	Year 4-8	Cu Concentrate	<b>22.7</b>	4.17	6.33	27.7	50.8	<b>71.4</b>	8.7	5.6	3.5	13.1
		Pb Concentrate	0.48	<b>78.6</b>	2.22	1.98	312	0.2	<b>18.7</b>	0.2	0.0	9.1
		Zn Concentrate	0.89	0.50	<b>59.0</b>	4.03	19.8	4.0	1.5	<b>74.8</b>	0.7	7.4

The results of the locked cycle tests are presented in Table 13-12, with findings highlighted as follows:

- Compared to the SGS (2011) testing on Lundberg Sample 4, the zinc recovery improved, with lower zinc concentrate grades for most of the tests. Copper concentrate grades are lower, with higher zinc and lead contamination. Lead recovery increased, with a lower lead concentrate grade.
- The use of additional depressants in LCT4 and LCT5 did not improve the metallurgy, except for an increase in zinc concentrate grade for the Lundberg Year 4-8 sample.
- The Engine House sample did not respond as well to the lead and zinc flotation compared to the Lundberg samples, and additional work would be required to improve the Engine House flotation performance.
- Additional investigation would be required to improve the copper concentrate grade by reducing zinc, lead and pyrite contamination. Similarly, better pyrite rejection from the zinc concentrate is required to improve its grade.

- The study recommended that the use of a sequential flotation flowsheet instead of the bulk Cu/Pb flowsheet may be beneficial.

**Table 13-12: Metallurgical Projection Summary for Lundberg and Engine House Locked Cycle Tests**

Test	Sample	Product	Grade (% g/t)					Distribution (%)				
			Cu	Pb	Zn	Fe	Ag	Cu	Pb	Zn	Fe	Ag
LCT1	Year 1-3	Cu Concentrate	<b>22.6</b>	2.13	7.63	26.0		<b>86.3</b>	4.8	8.7	6.1	
		Pb Concentrate	0.97	<b>71.2</b>	4.04	3.25		2.0	<b>87.1</b>	2.5	0.4	
		Zn Concentrate	0.99	1.10	<b>56.1</b>	4.77		4.6	3.0	<b>77.2</b>	1.3	
LCT5		Cu Concentrate	<b>21.8</b>	1.49	6.48	26.0	35.4	<b>87.7</b>	4.3	8.8	6.6	14.8
		Pb Concentrate	1.81	<b>63.6</b>	4.62	6.52	240	3.5	<b>88.7</b>	3.0	0.8	48.2
		Zn Concentrate	1.05	0.63	<b>45.1</b>	8.49	22.0	5.0	2.2	<b>72.0</b>	2.5	10.9
LCT2	Year 4-8	Cu Concentrate	<b>19.6</b>	3.01	3.50	28.8		<b>78.3</b>	7.6	3.9	4.9	
		Pb Concentrate	1.95	<b>59.3</b>	4.62	8.62		4.3	<b>83.5</b>	2.9	0.8	
		Zn Concentrate	1.61	0.46	<b>45.0</b>	11.2		11.0	2.0	<b>85.6</b>	3.2	
LCT4		Cu Concentrate	<b>18.3</b>	3.28	4.70	28.1	46.8	<b>82.1</b>	8.1	5.4	4.9	15.6
		Pb Concentrate	1.53	<b>60.2</b>	3.58	9.19	257	3.8	<b>83.6</b>	2.3	0.9	48.0
		Zn Concentrate	1.12	0.57	<b>50.4</b>	7.87	25.4	7.5	2.1	<b>86.6</b>	2.0	12.7
LCT3	Engine House	Cu Concentrate	<b>23.0</b>	1.61	2.98	29.3	63.0	<b>85.7</b>	8.9	5.8	7.0	24.8
		Pb Concentrate	2.24	<b>46.1</b>	7.79	11.9	188	2.4	<b>73.4</b>	4.4	0.8	21.3
		Zn Concentrate	1.68	1.01	<b>40.4</b>	13.1	9.4	5.9	5.3	<b>74.3</b>	2.9	3.5

### 13.7 Solid/Liquid Separation (Legault, 2013)

Preliminary settling and filtration tests were conducted on flotation concentrate and tailings samples from the SGS (2013) test program. Due to limitations in concentrate sample availability, a combined Cu/Pb concentrate sample, a zinc concentrate sample, and a final tailings sample were tested. In all settling tests, BASF Magnafloc 155 was used as the flocculant. Static settling tests on the concentrates resulted in 74-76 wt% underflow concentration and a dynamic settling test on the flotation tailings achieved 69 wt% underflow concentration. Vacuum filtration of the two concentrates produced 15-17% moisture, suggesting that typical pressure filtration would be required to reduce the concentrate moisture content for transportation. Vacuum filtration of the thickened flotation tailings yielded 18-23% filter cake moisture.

### 13.8 Conclusions

Test work to date has shown that the sulphide minerals in the Lundberg Deposit are well-liberated for recovery by flotation at typical grind sizes. A sequential flotation flowsheet has been developed and tested to produce selective copper, lead and zinc concentrates at marketable grades. The sequential flotation flowsheet has improved upon earlier test work results that used a bulk Cu/Pb flowsheet.



Locked cycle flotation testing has not yet been completed on the sequential flowsheet, but a process simulation was used to project metallurgical performance of the flowsheet from open-circuit test results, and these results have been used in the NSR calculator for the resource estimate. Projected metal recoveries with the sequential flowsheet are 83.0% Cu, 13.3% Au, and 7.84% Ag in the copper concentrate, 84.3% Pb, 10.5% Au, and 50.3% Ag in the lead concentrate, and 87.2% Zn, 8.28% Au, and 14.8% Ag in the zinc concentrate. Projected grades in concentrates are 31.1% Cu in the copper concentrate, 67.8% Pb in the lead concentrate and 58.4% Zn in the zinc concentrate.

Based on improved flotation selectivity with the sequential flowsheet, locked cycle testing is recommended to continue development of the flowsheet and confirm the metallurgical projection.

Pre-concentration of the resource material ahead of flotation has been evaluated as an option, using either dense media separation or XRT sensor-based sorting. Both processes were found to be technically viable for upgrading the Lundberg samples by rejecting gangue. At 25% rejection of the initial mass, the recovery of copper, lead and zinc to the upgraded material ranged from 95% to 98%. Economic evaluation is required to determine if there is a net benefit associated with reducing the mass for downstream processing compared with the loss of metals during upgrading.

## 14.0 MINERAL RESOURCE ESTIMATE

### 14.1 Introduction

The definition of Mineral Resource and associated Mineral Resource categories used in this report are those recognized under National Instrument 43-101 and set out in the Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves *Definitions and Guidelines* (the CIM Standards, as amended in 2014). Assumptions, metal threshold parameters, and deposit modeling methodology associated with this Mineral Resource Estimate are discussed below in report Sections 14.2 through 14.1.

### 14.2 Geological Interpretation Used in Resource Estimation

The Lundberg Deposit surrounds the former Lucky Strike mine site, where ASARCO operated a near-surface underground and glory hole mining operation until mine closure in 1984. The Lundberg Deposit is mainly comprised of stockwork mineralization surrounding and lying below the previously mined Lucky Strike orebody, but includes some massive sulphide mineralization that was not mined by former operations. Detailed discussions regarding the geological setting, mineralization and deposit type appeared previously in sections 7 and 8, respectively, of this Report.

Stockwork mineralization at Buchans consists of a network of sulphide veins and veinlets that cut strongly altered and sulphidized host rocks. The largest known concentration of stockwork and disseminated mineralization is the Lundberg zone that underlies the Lucky Strike deposit. The stockwork mineralization has a higher ratio of pyrite to base metal sulphides than the in situ sulphide zones and is typified by presence of fine to coarse grained pyrite with lesser amounts of chalcopyrite, sphalerite, galena and barite (Thurlow and Swanson, 1981). This mineralization occurs within felsic volcanic rocks of the Buchans River Formation below the Lucky Strike deposit and extends into underlying mafic to intermediate volcanic rocks of the Ski Hill Formation. The Lundberg zone stockwork mineralization comes to surface on the eastern edge of the zone and forms an elongate, wedge-shaped body that is 250 m deep on the western end. The highest concentration of sulphide mineralization lies in close proximity to the Lucky Strike massive sulphide zone and mineralization is more diffuse away from the zone. A second zone of stockwork mineralization is associated with the previously mined Engine House zone, which is located immediately south of the Lucky Strike deposit, and this zone has a higher proportion of chalcopyrite compared to other base metal sulphides.

### 14.3 Overview of Resource Estimation Procedure

The Lundberg Deposit Mineral Resource Estimate is based on a three-dimensional block model developed using Geovia Surpac® Version 6.9 (Surpac) modelling software and includes two zones of predominantly stockwork style sulphide mineralization, including zinc, lead, and copper, and associated localized gold and silver mineralization. Two zones, the Lundberg zone and the Engine House zone, comprise the Lundberg Deposit and are defined by validated results of 263 diamond drill holes and 7,972 core samples.

A net smelter return (NSR) calculator spreadsheet was prepared by Stantec and used by Mercator in combination with an optimized pit shell developed by MineTech to define limits of the current Lundberg Deposit Mineral Resource. Interpolated metal grades for each Mineral Resource block were input into the NSR calculator, which determined the cash value per tonne of each Mineral Resource block based on the potential revenue from concentrate produced less smelter treatment costs, transportation costs and royalties. Long-term metal prices of \$3.00 US/lb Cu, \$1.00 US/lb Pb, \$1.20 US/lb Zn, \$1,250 US/oz Au and \$17.00 US/oz Ag were used in the NSR calculator. Metallurgical recoveries and concentrate grades were based on the most recent test work reported in “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” (Thibault & Associates Inc., 2017). The NSR calculator used estimates for long-term smelter and shipping terms based on market conditions for similar concentrates.

Geological solid models were developed using both Surpac and Seequent Leapfrog Geo Version® 4.4 (Leapfrog) modelling software. High and low grade domains were defined based on NSR values. Stockwork style mineralized intercepts were developed with a minimum width of five downhole metres supporting a minimum average NSR value of \$40 US/t for definition of high grade domains. Low grade domains were developed with a minimum width of five downhole metres supporting a minimum average NSR value of \$15 US/t. In-situ and transported style massive sulphide mineralized intercepts were developed with a minimum width of three downhole metres supporting a minimum average NSR value of \$50 US/t. The resulting intervals were used to generate mineralization solids that were projected along strike and down dip by half the distance to the nearest drill hole or by 25 m where constraining drill hole data were not present.

The Lundberg zone is defined by four high grade stockwork solid models that form tabular bodies elongated northwest-southeast with gentle northwest plunges below and to the east of the Lucky Strike Glory Hole and steep northwest plunges to the west of the Lucky Strike Glory Hole. The peripheral low grade solid model forms a tabular body elongated northwest-southeast with a

pronounced keel at depth and has similar orientation as the high grade domains. The Engine House zone stockwork is defined by one high grade solid model forming a tabular body that dips to the west, plus an irregular, tabular, low grade solid model along the footwall of the high grade domain. Three discrete tabular solid models striking southeast and dipping steeply to the southwest were developed above the hanging wall, or to the west, of the Engine House zone, and these define semi-massive to massive sulphide mineralization associated with the Airport Thrust. An additional 10 solid models were developed that define massive sulphide style mineralization. These are generally small and tabular in shape and include seven solid models defining remnant mineralization at the previously mined North orebody zone (a sib-zone of the Lucky Strike orebody), two solid models defining the northwest extension of the previously mined Two Level zone (a sub-zone of the Lucky Strike orebody), and one solid model defining isolated pods of massive sulphide mineralization intersected to the east of the Lucky Strike glory hole.

Inverse distance squared grade interpolation ( $ID^2$ ) methodology was used to assign grades for zinc (%), lead (%), copper (%), silver (g/t), gold (g/t), density ( $g/cm^3$ ), and barite (%) constrained within the mineralized solid models using 1.5 m downhole assay composites and a block discretization of 2 (X) by 2 (Y) by 2 (Z). Interpolation parameters applied were the same for the definition of NSR \$15 US/t, \$40 US/t, and \$50 US/t grade domains. Three passes were used during interpolation, with progressively increasing range and decreasing number of included composites for each pass. Ellipsoid ranges used for the first interpolation pass were 50 m for the major axis, 33.33 m for the semi-major axis, and 16.67 m for the minor axis. The second and third interpolation passes reflect ellipsoid ranges of one and a half times and two and a quarter times the ranges used in the first interpolation pass, respectively. Interpolation ellipsoid ranges were determined through consideration of variography results, geological interpretation, and drill hole spacing. Interpolation passes one, two, and three required a minimum of seven, five, and one contributing assay composites, respectively, to create valid blocks. The maximum number of contributing composites was constrained to twelve for the first interpolation pass, with no more than three contributing composites from a single drill hole, eight for the second interpolation pass, with no more than two contributing composites from a single drill hole, and four for the third interpolation pass, with no drill hole restriction. A block size of 5 m (x) by 5 m (y) by 5 m (z) was used.

Interpolated metal grades for each block model block were input into the NSR calculator to establish NSR values for each block and these were used by MineTech to develop an optimized Mineral Resource pit shell. Optimization parameters include mining at \$3 US per tonne, processing at \$15 US per tonnes, and a General and Administrative (G&A) cost of \$2 US per tonne mined. Mineral Resources interpolated with either the first or second interpolation passes that

occur within the optimized pit shell were classified as Indicated category Mineral Resources and those interpolated with the third interpolation pass that occur within the optimized pit shell were classified in the Inferred category. Mineral Resource categorization was applied using solid models that outline the required parameters and occur within the optimized pit shell. A cut-off value of \$20 US/t NSR was used to report Mineral Resources.

#### 14.4 Data Validation

Buchans provided Mercator with a compiled drill hole database for the Lundberg Property in Microsoft Access® GEMS Logger format. The Lundberg database is coordinated in the NAD83 UTM Zone 21 system and consists of 3,717 drill holes for a total length of 438,527 metres and 23,540 associated core samples. Mercator imported the complete property database into Surpac and implemented validation routines that detect specific data entry logical errors associated with sample records, drill hole lithocode intervals, collar tables and down hole survey tables.

Initial compilation of pre-2007 drill hole data was completed to support the historic 2008 Mineral Resource Estimate (Webster and Barr, 2008) and several corrections, assumptions, and adjustments have been made with respect to the pre-2007 drill hole dataset. Historical drill hole collar elevations have been converted to metric elevations relative to sea level, and have had 8 m added to the values used historically in order to match them with the modern survey datum surveyed by Red Indian Surveys of Grand Falls, NL. Where historical drill logs listed “Tr” (trace) as an assay value, it was assumed that this was a trace amount above detection, and was given a numerical value of 0.001 in the database in their respective unit of measure. Where historical drill logs listed “NIL” as an assay value, it was assumed that this was an amount below detection, and was given a numerical value of 0.0001 or 0 (zero) in the database in their respective unit of measure.

Since the 2013 Mineral Resource Estimate, Buchans has relogged more than 650 holes totalling more than 123,000 metres of drill core, including approximately 420 historic holes within the Lundberg Deposit area. Significant portions of this work have been entered into the current digital drilling database but much of the detailed relogging information remains to be entered. Hardcopy interpreted paper sections have been compiled in each of the areas, including results from the relogging program, and were used to refine the current geological interpretation for the property.

A detailed validation procedure against original assay records, including review of digital certificates and assay samples sheets, was performed. Several drill programs operated by

Buchans (2008, 2012, 2014/2015, 2018) include samples that have been analyzed at both Eastern and ALS and when both were present, results provided by Eastern were given priority. Barite analysis and density determinations were provided by ALS. The Lundberg Deposit is defined by 7,972 core samples from 263 diamond drill holes within the Mineral Resource Estimate limits.

Included un-sampled intervals for drill holes with partial sampling were assigned “0” grade (zero % or g/t) grade for all metals. Included un-sampled intervals for drill holes with limited to no sampling were either assigned “0” grade (zero % or g/t) for all metals or ignored. Such intervals were assigned a sample identification attribute in the drilling database of MGS\_NS (Mercator Geological Services No Sample). Un-sampled drill holes were ignored in areas of the deposit where geological drill hole data were compiled and supported the presence of a well mineralized stockwork zone, but analytical results were not available. Unsampled or partially sampled intervals in historic drill holes that were later twinned and sampled during a Buchans operated drill program were also ignored and the more recent Buchans information was relied upon.

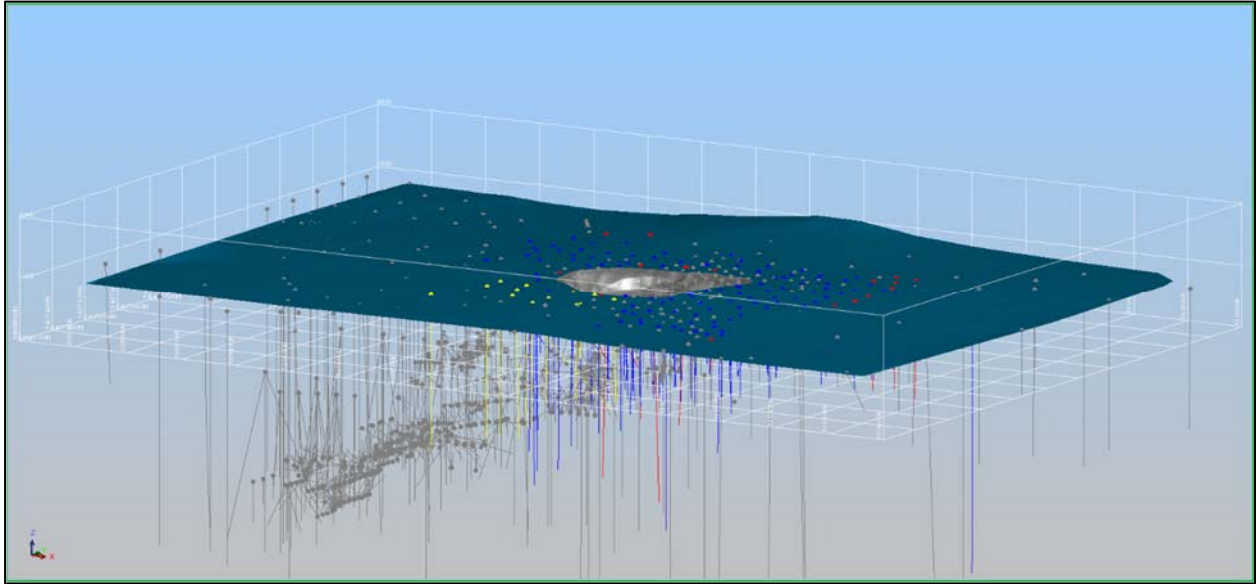
A net smelter return (NSR) calculator spreadsheet was prepared by Stantec and used by Mercator in combination with the MineTech optimised pit shell to define the limits of the current Lundberg Deposit Mineral Resource. Assay metal grades for each sample were input into the NSR calculator and an NSR value was appended to each sample in the drill hole assay database.

Implementation of the database validation and review procedures described above resulted in minor litho-code and assay entry corrections. These were incorporated to create the validated and functional drilling database used in the current Mineral Resource Estimate.

## **14.5 Surface, Lithological, and Domain Modelling**

### **14.5.1 Topography**

The digital terrain model (DTM) of contoured topography developed by Mercator for the 2008 and 2013 Mineral Resource Estimate was retained for the current Mineral Resource Estimate. The majority of the current Mineral Resource solid models are constrained by the upper boundary of the Buchans River Formation or the bedrock-overburden interface. Where applicable, the topographic surface DTM was applied as the top surface constraint (Figure 14-1).

**Figure 14-1: Isometric View to the Northwest of the Topographic Surface**

#### 14.5.2 Historic Mine Workings Model

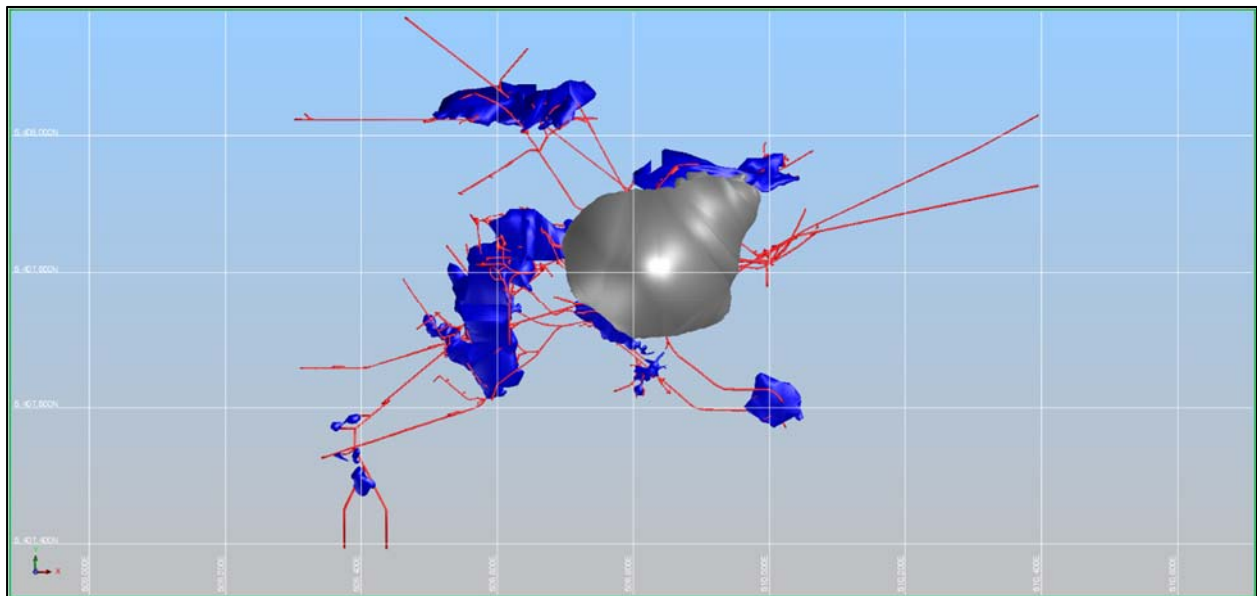
The historic underground workings and historic open pit digital model developed by Mercator for the 2008 and 2013 Mineral Resource Estimate was revised for use in the current Mineral Resource Estimate. The original three-dimensional solid model was based on digitized workings outlines digitized from archived hard copy maps and sections. Mercator and Buchans collectively reviewed scanned historic maps and sections for the Lucky Strike, Lucky Strike Extension, North orebody zone, Engine House zone, Two Level zone, Low Grade Two Level, New Years Extension, and the West orebody zone to develop the digital solid model of mine workings. Based on additional digital capture from historic maps and sections, continued compilation of historic drill hole data carried out since the last Mineral Resource Estimate, and results from recent drill programs, revisions were made to the earlier stope solid models for the Lucky Strike, North orebody zone, Two Level zone and Low Grade Two Level solids. Completely new stope solid models were developed for the Lucky Strike Extension, Lucky Strike Low Grade, New Years Extension and West orebody zone. Underground development solid models were also locally modified and/or expanded where appropriate. The Glory Hole DTM surface and the Engine House stope solid model were retained from the previous Mineral Resource Estimate.

The Lucky Strike glory hole was modelled in 2007 by Eagle mapping from stereographic triangulation of historic aerial photography. The elevation of the glory hole and surrounding surface DTM elevations were provided in UTM (NAD83) co-ordinates and the elevation datum

for these data was increased by 3 m to match the modern survey datum surveyed by Red Indian Surveys of Grand Falls, NL in 2007.

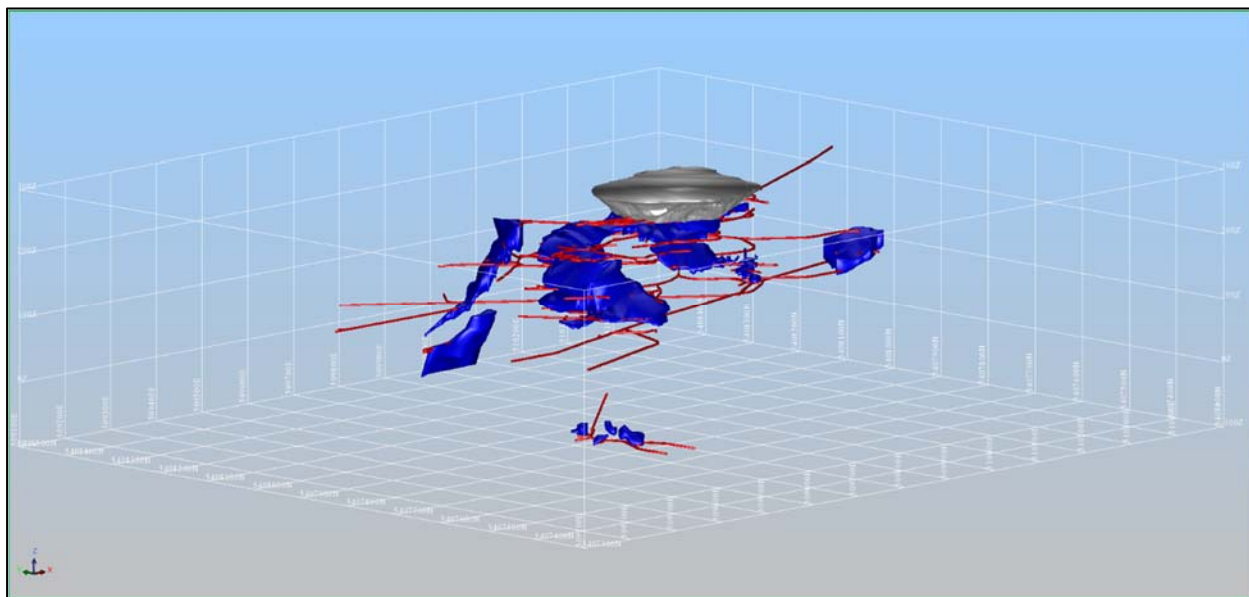
Partial percent volume assignment was used to estimate the block volume of stope and underground development solid models. Stopes are assumed to be predominantly back-filled, based on historical records and Buchans drilling results, and were assigned a bulk density of  $1.92 \text{ g/cm}^3$ . Underground development and the glory hole were assumed to be open and were treated as void space. Historic mine workings solid models appear in Figure 14-2 and 14-3.

**Figure 14-2: Plan View to the Historic Mine Workings Solid Models (Blue = Stopes, Red = Underground Development, Grey = Glory Hole)**





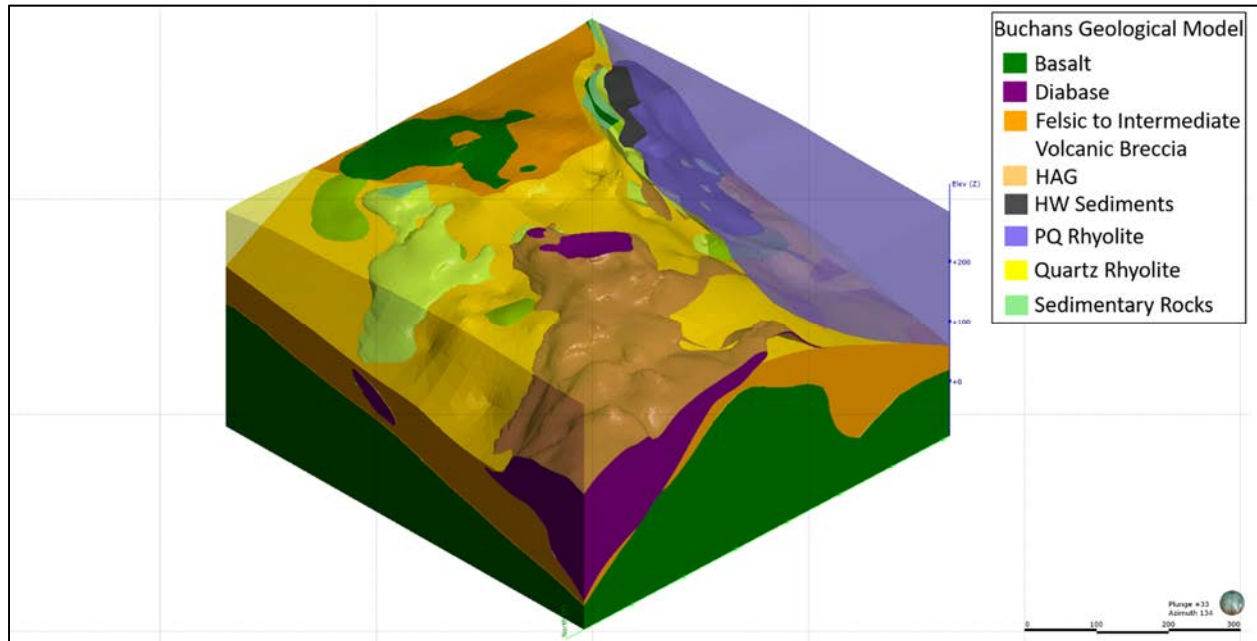
**Figure 14-3: Isometric View to the Northeast of the Historic Mine Workings Model (Blue = Stopes, Red = Underground Development, Grey = Glory Hole)**



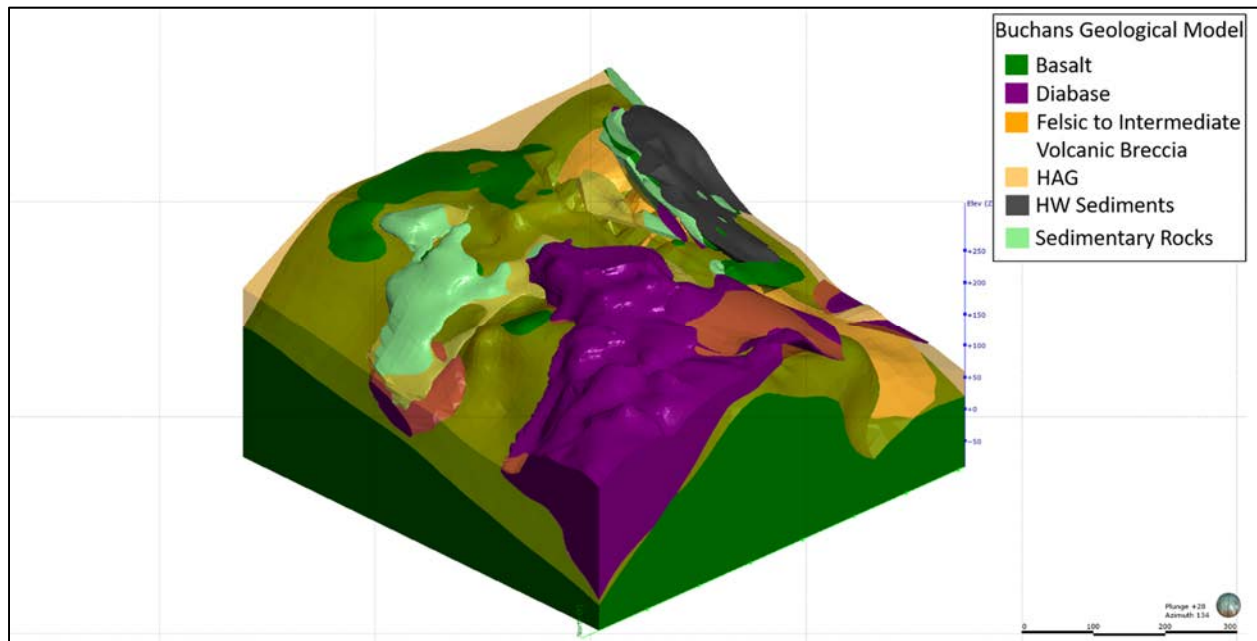
### 14.5.3 Lithological and Grade Domain Solid Models

To support development of a revised geological model, Buchans provided Mercator with new interpreted geological cross sections for the entire Lundberg Deposit. The cross sections reflect interpretations developed by Buchans staff based on the 2014/2015 drilling data and relogging results completed since the 2013 Mineral Resource Estimate. The detailed cross-sections and surface geological maps from Buchans were geo-referenced in Leapfrog by Mercator and then displayed in relation to the project drill hole data to develop contact points for the major lithological intervals. The structural and chronological relationships represented on section and communicated by Buchans staff informed the generation of a series of 15 m resolution surface meshes which were subsequently used to create individual lithological bedrock solid models (Figure 14-4 and Figure 14-5). The Leapfrog geological model and the associated relogged drill hole data supported the interpretation and development of the current grade domain solid models.

**Figure 14-4: Isometric View to the Southeast of the Lundberg Deposit Geological Model**



**Figure 14-5: Isometric View to the Southeast of the Lundberg Deposit Geological Model**

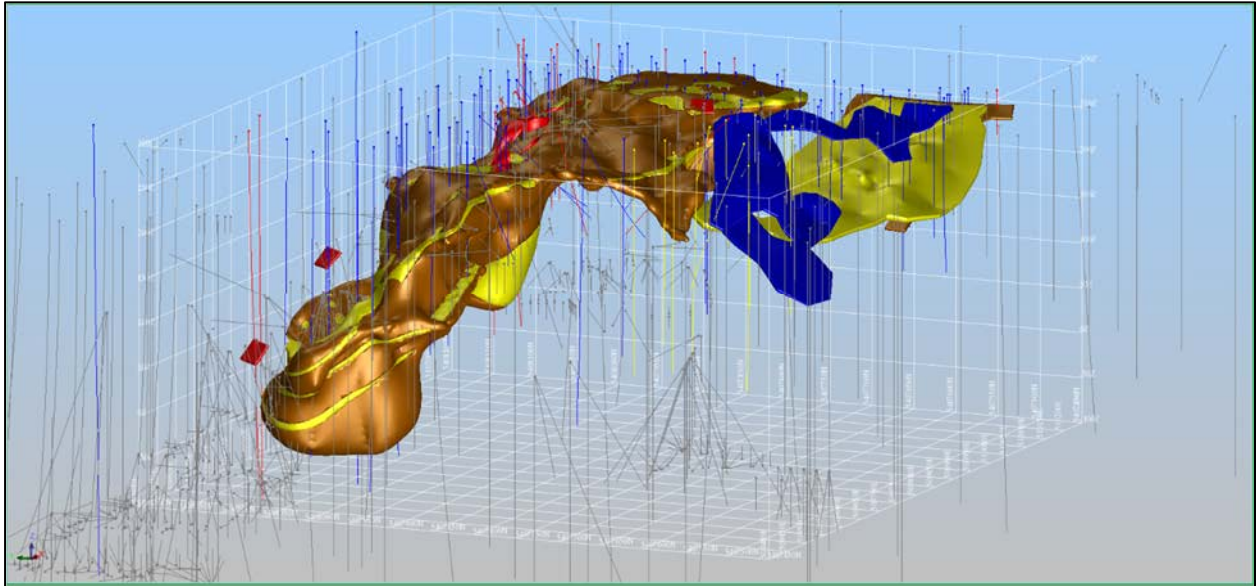


Geological solid models were developed using both Surpac and Leapfrog modelling software. Drill holes were first displayed sectionally with the geological model unit assignment and drill hole assay data included. Stockwork style mineralized intercepts were developed using a minimum width factor of five downhole metres supporting a minimum average NSR value of \$40 US/t for definition of high grade domains. A minimum width factor of five downhole metres supporting a minimum average NSR value of \$15 US/t was used for definition of low grade domains. Massive sulphide and transported style mineralization intercepts were developed with a minimum width of three downhole metres supporting a minimum average NSR value of \$50 US/t. The outer contact points of each intercept were used to generate hanging wall and footwall surface meshes, and the meshes were subsequently used to develop 3D solid models for each unit with a 2.5 m mesh resolution. Solid models were projected along strike and down dip by half the distance to the nearest drill hole or by 25 m where constraining drill hole data was not present. The developed solid models, presented in Figure 14-6, were reviewed on a sectional basis, validated, and subject to a query-based drill hole snap check to insure integrity.

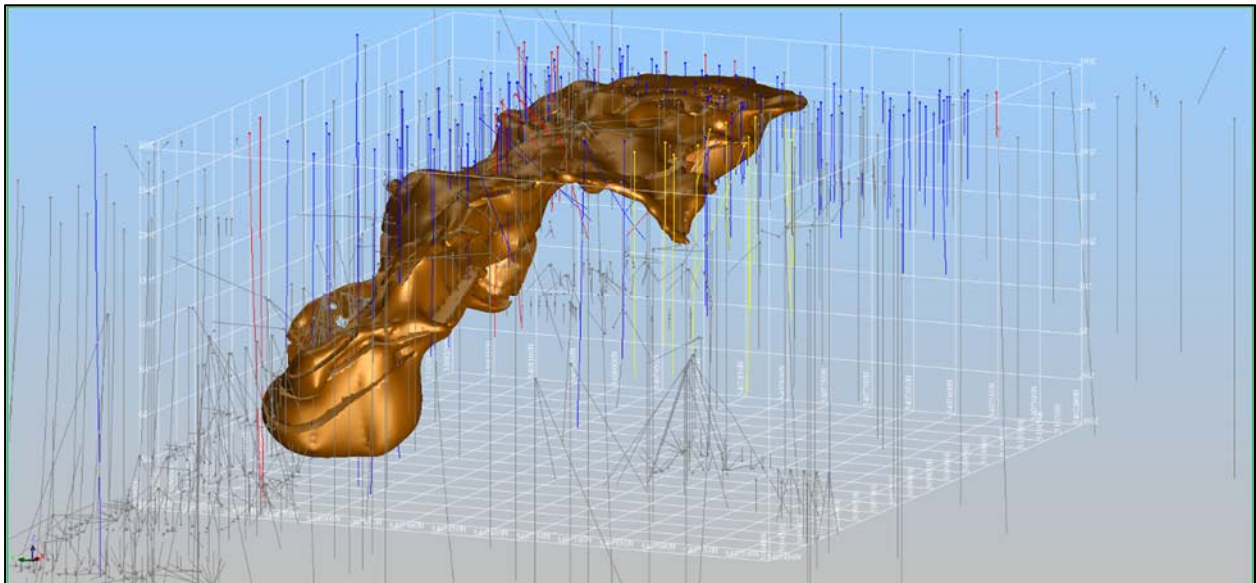
The Lundberg zone is defined by four high grade and one low grade stockwork solid models. High grade stockwork solids form tabular bodies elongated northwest-southeast with gentle northwest plunges below and to the east of the Lucky Strike glory hole and steep northwest plunges to the west of the Lucky Strike glory hole. The peripheral low grade solid model consists of a tabular body elongated northwest-southeast with a pronounced keel at depth. It has the same general orientation as the high grade domains (Figure 14-7 and 14-8). The Engine House zone stockwork is defined by one high grade solid model forming a tabular body that dips to the west and one irregular, tabular, low grade solid model that occurs along the footwall of the high grade domain (Figure 14-9). Three discrete tabular solid models striking southeast and dipping steeply to the southwest were developed above the hanging wall, or to the west of the Engine House zone, that define semi-massive to massive sulphide mineralization associated with the Airport Thrust (Figure 14-10). An additional 10 solid models were developed that define massive sulphide style mineralization that occurs as restricted dimension, square to rectangular shapes. Seven of these were developed to define remnant mineralization associated with the previously mined North Orebody, two were developed to define a northwest extension of the previously mined Two Level mineralization, and one was developed to model isolated pods of massive sulphide mineralization intersected east of the Lucky Strike glory hole (Figure 14-11).

Grade domain solid models were depleted for volume associated with the historic mine workings solid models. Partial percent volume assignment was used to estimate the block volume of the depleted grade domain solid models.

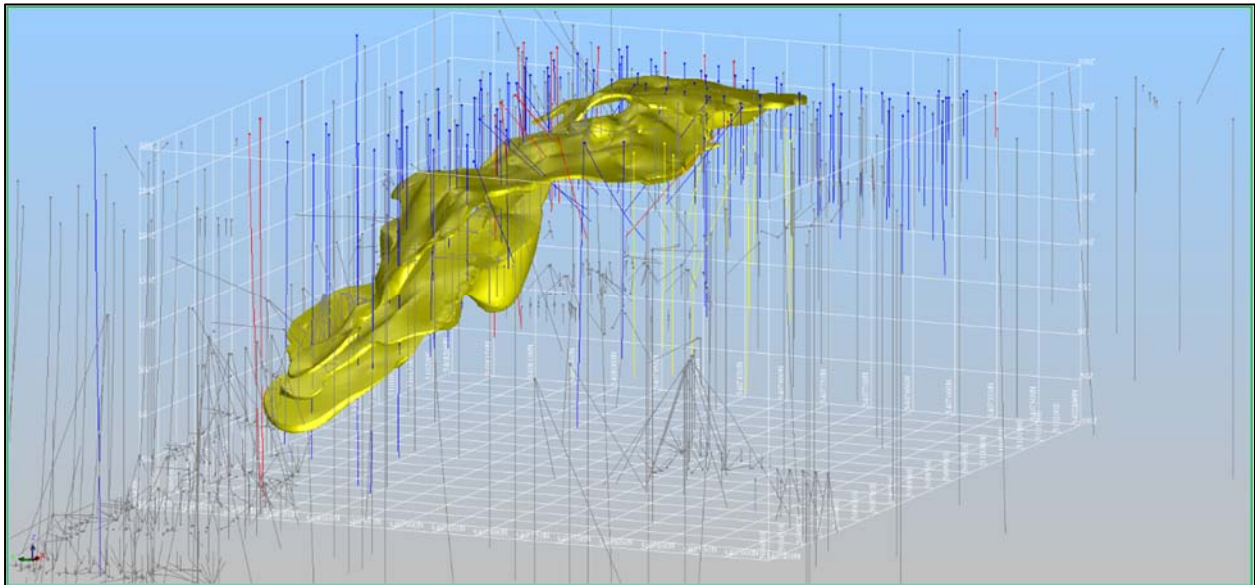
**Figure 14-6: Isometric View to the Northeast of all Lundberg Mineral Resource Grade Domain Solid Models (Brown = NSR \$15 US/t, Yellow = NSR \$40 US/t, Blue (Airport) and Red (MS) = NSR \$50 US/t)**



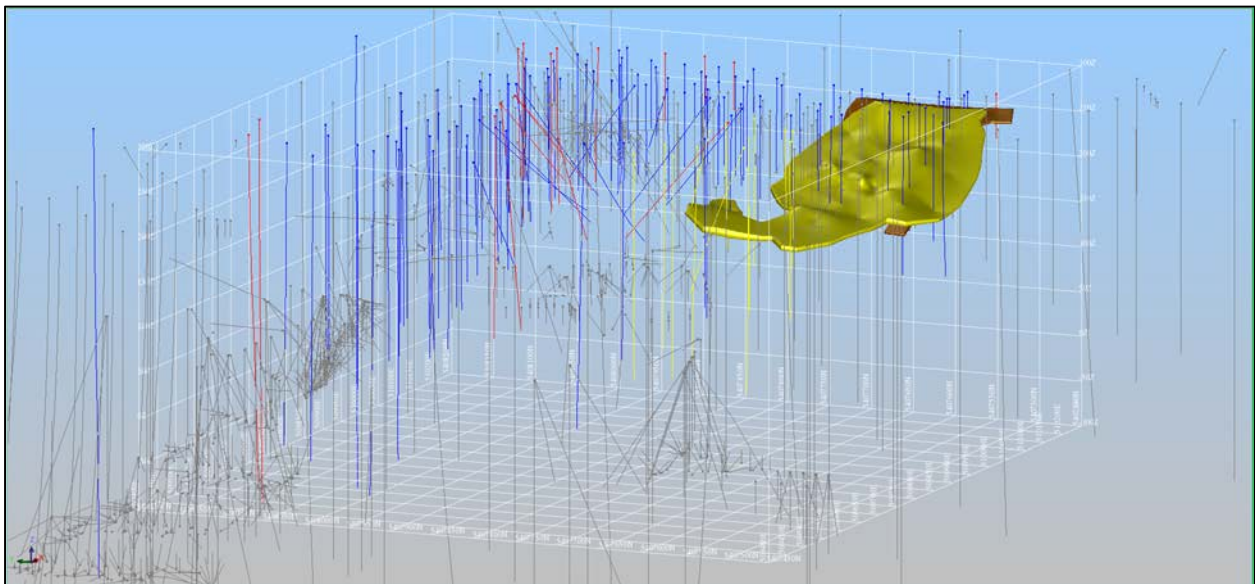
**Figure 14-7: Isometric View to the Northeast of the Lundberg NSR \$15 US/t Mineral Resource Grade Domain Solid Model**



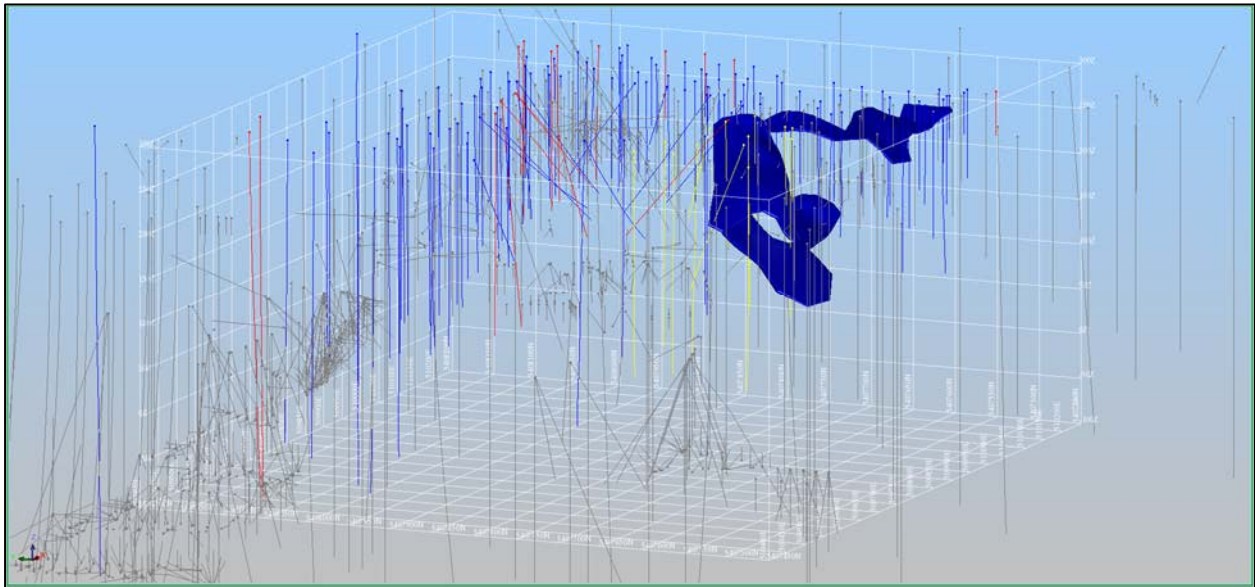
**Figure 14-8: Isometric View to the Northeast of the four Lundberg NSR \$40 US/t Mineral Resource Grade Domain Solid Models**



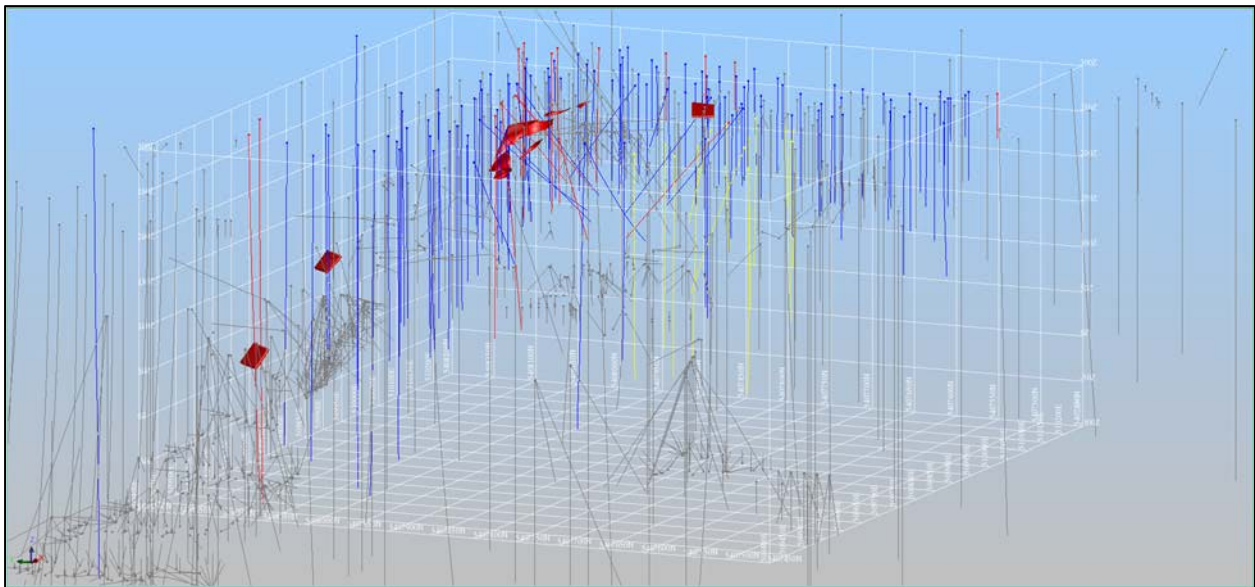
**Figure 14-9: Isometric View to the Northeast of the Engine House Zone NSR \$15 US/t (Brown) and NSR \$40 US/t (Yellow) Mineral Resource Grade Domain Solid Models**



**Figure 14-10: Isometric View to the Northeast of the three Airport Thrust NSR \$50 US/t Mineral Resource Grade Domain Solid Models**



**Figure 14-11: Isometric View to the Northeast of the ten Massive Sulphide NSR \$50 US/t Mineral Resource Grade Domain Solid Models**



## 14.6 Drill Hole Assays and Downhole Composites

To facilitate compositing of downhole assay data, a drill hole intercept table consisting of drill hole intervals to be composited for each area was created using solid model drill hole intersections. Assay sample length statistics showed a mean sample length of 1.12 m, minimum length of 0.1 m, maximum length of 25.3 m, and a 1.53 m length corresponding to the 90<sup>th</sup> percentile. Downhole assay composites measuring 1.5 m in length and constrained to the drill hole intercepts for each area were created for zinc (%), lead (%), copper (%), silver (g/t), gold (g/t) and barium (%) using Surpac's "best-fit" method. Minimum and maximum acceptable composite lengths were selected at 1.125 m and 1.875 m, respectively, and composites created outside the minimum and maximum support thresholds were manually modified to meet the selection criteria.

A total of 2,746 assay composites were created for the NSR \$40 US/t grade domains, with lengths ranging from 1.125 m to 1.825 m and a mean length of 1.51 m. A total of 3,101 assay composites were created for the NSR \$15 US/t grade domains, with lengths ranging from 1.125 m to 1.83 m and a mean length of 1.49 m and 220 assay composites were created for the NSR \$50 US/t grade domains, with lengths ranging from 1.125 m to 1.8 m and a mean length of 1.50 m.

Included un-sampled intervals for drill holes with partial sampling were diluted to "0" (zero % or g/t) grade for all metals. Included un-sampled intervals for drill holes with limited to no sampling were either diluted to "0" (zero % or g/t) grade for all metals or ignored. Diluted intervals were assigned a sample identification of MGS\_NS (Mercator Geological Services No Sample). Ignored un-sampled drill hole holes reflect areas of the deposit where geological drill hole data has been compiled and supports the presence of a well mineralized stockwork zone, but analytical results are lacking. Unsampled intervals or partially sampled intervals in historic drill that were twinned and sampled during a later Buchans operated drill program were ignored in favor of the newer Buchans data.

Assay composite descriptive statistics were reviewed independently for NSR \$40 US/t (Lundberg and Engine House Zone), NSR \$15 US/t (Lundberg and Engine House Zone) and NSR \$50 US/t (Airport Thrust and massive sulphide) grade domains and results are presented in Table 14-1, 14-2, and 14-3 respectively. No high-grade capping factors were applied to drill core sample analytical results. Through analysis of metal grade distribution, it was determined that high metal values in the assay dataset occur within zones where drill log descriptions of lithology and mineralogy support the presence of spatially correlative higher grade material. Maximum metal levels present are also considered to be consistent with the mineralization styles present.

**Table 14-1: Descriptive Statistics for the 1.5m Downhole Assay Composites within the NSR \$40 US/t Grade Domain Solid Models (Lundberg Zone and Engine House Zone)**

Parameter	Zinc (%)	Lead (%)	Copper (%)	Silver (g/t)	Gold (g/t)	*Barium (%)
Mean Grade	2.30	0.94	0.66	7.97	0.09	0.88
Maximum Grade	23.10	9.81	6.42	283.35	3.36	48.79
Minimum Grade	0.00	0.00	0.00	0.00	0.00	0.00
Variance	5.93	1.13	0.60	221.03	0.04	13.31
Standard Deviation	2.43	1.06	0.77	14.87	0.21	3.65
Coefficient of Variation	1.06	1.13	1.18	1.86	2.22	4.16
Number of Composites	2,746	2,746	2,746	2,746	2,746	2,746

\* Barium is converted to barite (BaSO<sub>4</sub>) for the Mineral Resource by barite % = barium % / 0.58

**Table 14-2: Descriptive Statistics for the 1.5m Downhole Assay Composites within the NSR \$15 US/t Grade Domain Solid Models (Lundberg Zone and Engine House Zone)**

Parameter	Zinc (%)	Lead (%)	Copper (%)	Silver (g/t)	Gold (g/t)	*Barium (%)
Mean Grade	0.64	0.26	0.14	2.29	0.03	0.30
Maximum Grade	11.2	7.1	4.65	71.04	0.90	18.04
Minimum Grade	0.00	0.00	0.00	0.00	0.00	0.00
Variance	0.48	0.13	0.04	18.00	0.00	0.86
Standard Deviation	0.69	0.37	0.21	4.24	0.06	0.93
Coefficient of Variation	1.09	1.40	1.54	1.85	1.78	3.12
Number of Composites	3,101	3,101	3,101	3,101	3,101	3,101

\* Barium is converted to barite (BaSO<sub>4</sub>) for the Mineral Resource by barite % = barium % / 0.58

**Table 14-3: Descriptive Statistics for the 1.5m Downhole Assay Composites within the NSR \$50 US/t Grade Domain Solid Models (Airport Thrust and Massive Sulphide zones)**

Parameter	Zinc (%)	Lead (%)	Copper (%)	Silver (g/t)	Gold (g/t)	*Barium (%)
Mean Grade	6.23	3.51	0.65	83.17	0.89	2.77
Maximum Grade	26.2	18.47	8.91	483.84	5.53	48.94
Minimum Grade	0.00	0.00	0.00	0.00	0.00	0.00
Variance	29.75	10.14	1.07	7850.65	0.71	87.53
Standard Deviation	5.45	3.18	1.04	88.60	0.84	9.37
Coefficient of Variation	0.86	0.91	1.60	1.07	0.95	3.38
Number of Composites	220	220	220	220	220	220

\* Barium is converted to barite (BaSO<sub>4</sub>) for the Mineral Resource by barite % = barium % / 0.58



## 14.7 Variography

Mercator prepared experimental downhole variograms from the 1.5 m assay composite dataset and also created experimental directional variograms. Best results were obtained from assessment of Zn and NSR values restricted to the NSR \$40 US/t grade domains.

Acceptable spherical model results were obtained for experimental Zn and NSR downhole variograms, thereby providing assessment of global nugget values and creating a basis of consideration for interpolation ellipsoid minor axis ranges (Figure 14-12 and Figure 14-13). Directional Zn variogram modelling provided ranges of 90 m for the major axis of continuity and 50 m for the semi-major axis of continuity, showing primary trends oriented west-northwest and secondary trends oriented north-northeast (Figure 14-14). No plunge or dip component was identified during the directional Zn variogram assessment. Directional NSR variogram modelling provided ranges of 40 m for the major axis of continuity and 30 m for the semi-major axis of continuity, showing primary trends oriented northeast and secondary trends oriented northwest (Figure 14-15). Gentle to moderate plunges were defined in both orientations.

Experimental variogram results routinely showed sills significantly above or below the variance and are heavily influenced from local data clustering. Grade, thickness and distribution homogeneity of the stockwork mineralization in the minor axis direction, or the downhole direction, appears to affect variograms results for the primary grade trends.

Interpolation ellipsoid ranges were developed through consideration of the variogram assessment, geological interpretation, project history, drill hole spacing, and Mineral Resource categorization requirements. A multi-pass interpolation approach consisting of three separate stages was developed to populate the block model using progressively increasing ellipsoid ranges for each pass (Table 14-4).

**Table 14-4: Interpolation Ellipsoid Ranges (m) and Experimental Variogram Parameters**

Interpolation Pass	Range (m)		
	Major	Semi- Major	Minor
1	50.00	33.33	16.67
2	75.00	50.00	25.00
3	112.50	75.00	37.50

Figure 14-12: Downhole Experimental Variogram of Lundberg Zn Assay Composites

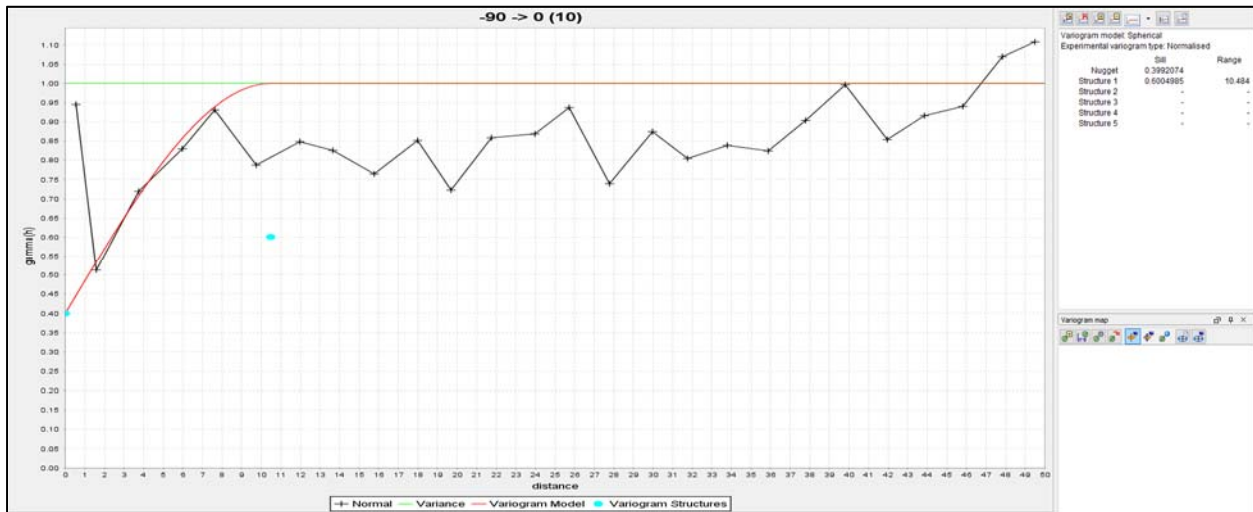
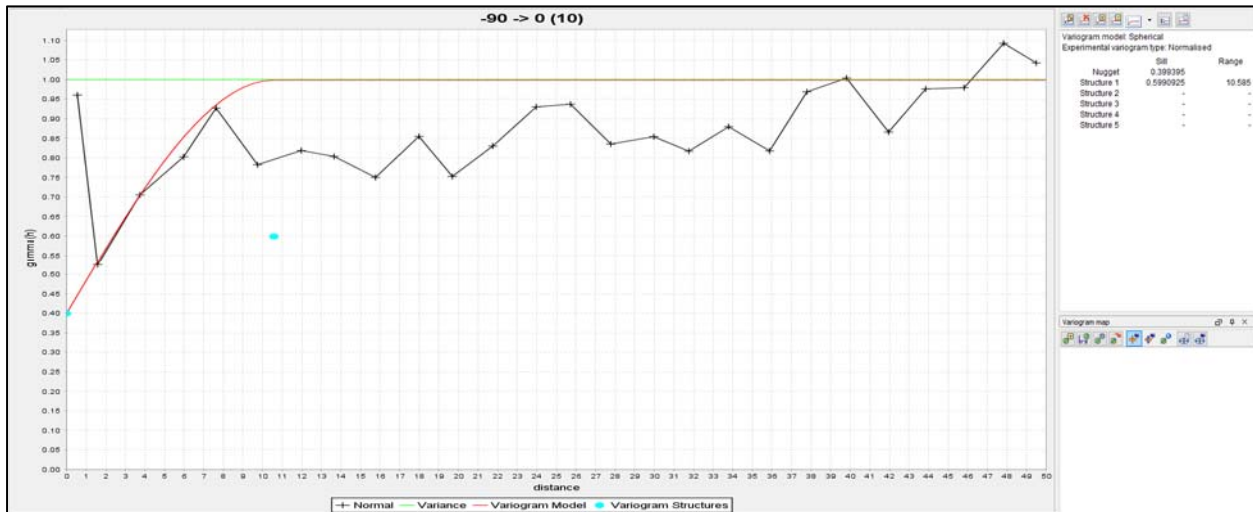
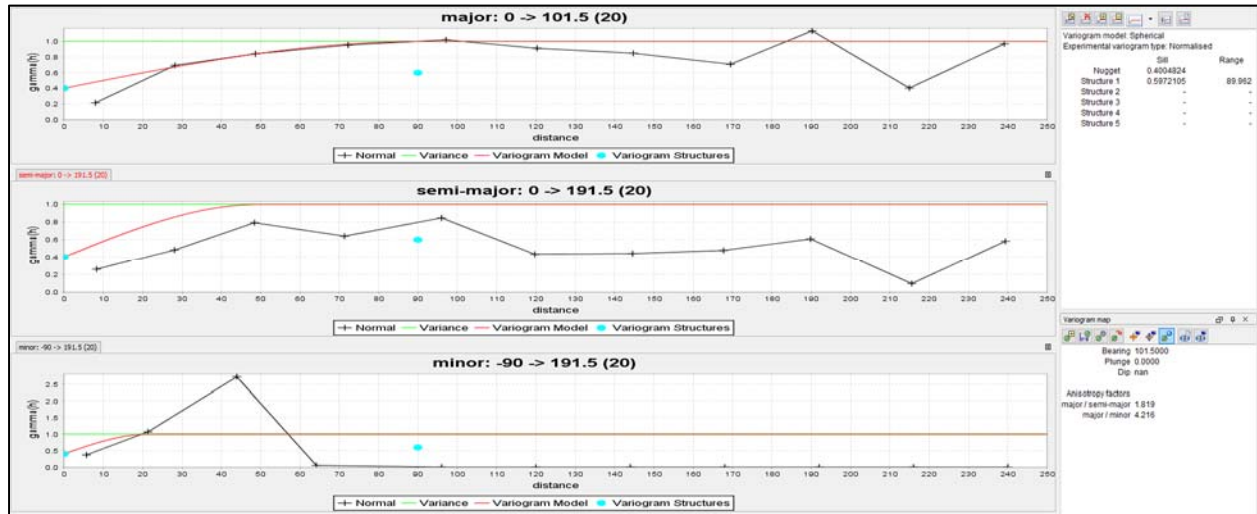


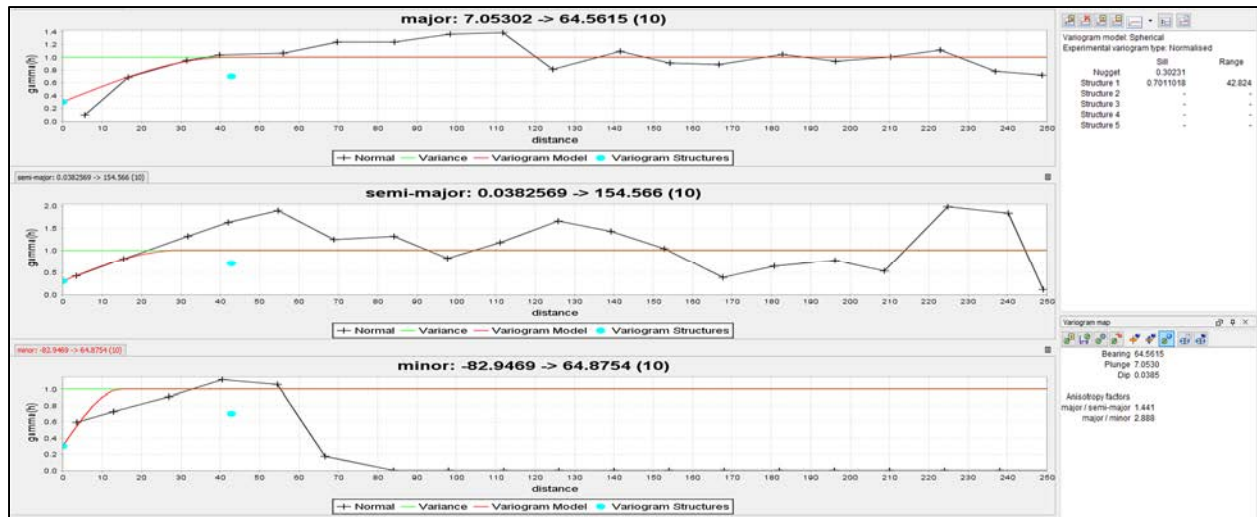
Figure 14-13: Downhole Experimental Variogram of Lundberg NSR Assay Composites



**Figure 14-14: Directional Experimental Variogram (Lag 24) of Lundberg Zn Assay Composites**



**Figure 14-15: Directional Experimental Variogram (Lag 5) of NSR Assay Composites**



Interpolation ellipsoids were oriented along the general geological trends identified for each deposit area solid and locally modified for changes in solid geometry. Ellipsoids for the Lundberg zone strike northwest, and show moderate to steep plunges in the strike direction and moderate dips towards the northeast. The primary direction of continuity is oriented in the strike direction. Ellipsoids for the Engine House zone strike south and have moderate to steep dips towards the west. The primary direction of continuity is oriented in the dip direction. Ellipsoids for the Airport Thrust strike southeast and have moderate to steep dips towards the southwest. The primary direction of continuity is oriented in the dip direction. Ellipsoids for the North Orebody massive sulphide domain strike west and show steep dips towards north. The primary direction of continuity is oriented in the strike direction. The number of interpolation domains for each deposit area are summarized in Table 14-5.

**Table 14-5: Lundberg Deposit Interpolation Sub-domains**

Zone	Grade Domain	Interpolation Domains
Lundberg	NSR \$40 US/t	13
Lundberg	NSR \$15 US/t	7
Lundberg/Massive Sulphide	NSR \$50 US/t	4
Engine House	NSR \$40 US/t	3
Engine House	NSR \$15 US/t	2
Engine House/Airport	NSR \$50 US/t	4
Total		33

### 14.8 Setup of Three-Dimensional Block Model

The Lundberg Deposit Mineral Resource Estimate is coordinated in the NAD83 UTM Zone 21 coordinate system and the minimum and maximum extents are presented in Table 14-6. The block model is based on a standard block size of 5m (x) by 5m (y) by 5m (z) with no sub-blocking or rotation applied.

**Table 14-6: Lundberg Deposit Block Model Extents**

*Minimum Coordinates			*Maximum Coordinates		
Y (m)	X (m)	Z (m)	Y (m)	X (m)	Z (m)
5407370	509075	-150	5408360	510530	350

\*NAD83 UTM Zone 21 coordinate system.

## 14.9 Mineral Resource Estimation

Inverse distance squared (ID<sup>2</sup>) grade interpolation methodology was used to assign block grades for zinc (%), lead (%), copper (%), silver (g/t), gold (g/t), and barite (%) within the Lundberg Deposit block model based on the 1.5 m assay composites. As reviewed earlier, interpolation ellipsoid orientation values and ranges used in the estimation reflect trends determined from variography as well as sectional interpretations of geology and grade distributions for the deposit. Block volumes were estimated from solid models using partial percentage volume calculation with a precision of 4.

Grade interpolation was constrained to the block volumes defined by solid models using the 3 interpolation pass approach previously discussed. Interpolation passes, implemented sequentially from pass one to pass three, progressed from being restrictive to more inclusive in respect to the composites available and number of composites required to assign block grades. Table 14-7 summarizes the included composite parameters. Block discretization was set at 2 (Y) x 2 (X) x 2 (Z).

**Table 14-7: Included Composite Parameters for Each Interpolation Pass**

Interpolation Pass	Included Composite Parameters		
	Minimum	Maximum	Maximum/Hole
1	7	12	3
2	5	8	2
3	1	4	4

Grade domain boundaries were set as hard boundaries for grade estimation purposes and grade interpolation was restricted to the 1.5 m assay composites associated with the drill hole intercepts assigned to each deposit area solid. Adjacent and connecting interpolation domain areas within a grade domain unit were assigned soft domain boundaries for grade estimation purposes. As such, the 1.5 m assay composites in adjacent and connecting related domains contribute to the overall zone grade interpolation.

## 14.10 Density

A comprehensive density determination dataset is present for most of the drill holes completed Buchans and these were used to develop an interpolated density model for the Lundberg Deposit. Downhole density composites measuring 1.5 m in length, constrained to the drill hole intercepts for each area, were created for density using Surpac's "best-fit" method. Intervals with

no density determinations were ignored during compositing, which includes all drilling prior to 2007. Descriptive statistics of downhole assay composites are presented in Table 14-8. Interpolation parameters for the density model reflect those used during the metal grade interpolations previously described.

**Table 14-8: Descriptive Statistics for 1.5m Downhole Density Composites**

Parameter	Density (g/cm <sup>3</sup> )
Mean Density	2.92
Maximum Density	4.64
Minimum Density	2.25
Variance	0.05
Standard Deviation	0.22
Coefficient of Variation	0.07
Number of Composites	3038

#### 14.11 Net Smelter Return (NSR) Calculator

A net smelter return (NSR) calculator spreadsheet was prepared by Stantec Consulting Ltd. and used by Mercator in the Mineral Resource estimation procedure in combination with the optimized pit shell to define the limits of the current Lundberg Deposit Mineral Resource. Interpolated metal grades for each interpolated block were input into the NSR calculator, which determined the potential cash value per tonne of each interpolated block based on the revenue from concentrate produced after consideration of net smelter treatment costs, concentrate payable factors, transportation costs and royalties. Calculated NSR block values were imported into the block model as block model attributes.

Long-term metal prices of \$3.00 US/lb Cu, \$1.00 US/lb Pb, \$1.20 US/lb Zn, \$1,250 US/oz Au and \$17.00 US/oz Ag were used in the NSR calculator and reflect a consensus developed from market forecast data available to Buchans plus review of public record forecasts and analysis of trailing average pricing trends. Projected metallurgical recoveries and concentrate grades were based on the most recent test work reported in the report titled “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” prepared by the metallurgical consulting firm Thibault & Associates Inc. in 2017 (Thibault and Associates, 2017). Projected metal recoveries applied are 83.0% Cu, 13.3% Au, and 7.84% Ag in the copper concentrate, 84.3% Pb, 10.5% Au, and 50.3% Ag in the lead concentrate, and 87.2% Zn, 8.28% Au, and 14.8% Ag in the zinc concentrate. Project grades are 31 % Cu in the copper concentrate, 67.8% Pb in the lead concentrate and 58.4 % in the zinc concentrate. The NSR calculator used

estimates for long-term smelter and shipping terms based on market conditions for similar concentrates.

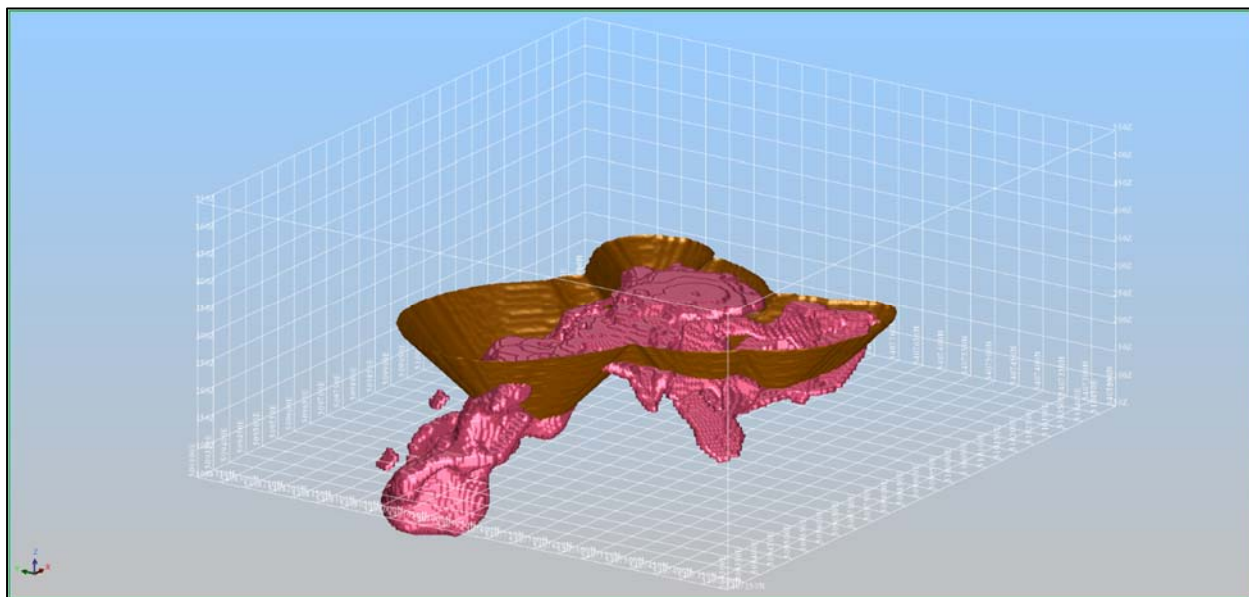
#### 14.12 Pit Optimization

A Mineral Resource pit shell was developed and optimized by MineTech for the Lundberg Deposit block model. The pit shell was optimized against the NSR block value which includes metal pricing stated above against a total mining and processing cost of \$20 US per tonne. Additional optimization parameters are presented in Table 14-9. MineTech provided Mercator with a vector outline of the optimum pit shell and Mercator converted the outline into a DTM surface that could be used for categorization and reporting of Mineral Resources. The optimized pit shell is presented in Figure 14-16 along with the block model representation of interpolated Lundberg Deposit blocks.

**Table 14-9: Parameters used for Pit Optimization**

Parameter	
Mining per Tonne (\$US)	\$3
Waste Mining per Tonne (\$US)	\$2.5
G&A per Tonne (\$US)	\$2
Processing per Tonne (\$US)	\$15
Mining Dilution %	10%
Mining Recovery %	95%

**Figure 14-16: 2018 Lundberg Deposit Mineral Resource Optimized Pit Shell (Brown) and extent of interpolated Lundberg Deposit blocks (Pink)**



#### 14.13 Resource Category Parameters Used in Current Estimate

Definitions of Mineral Resources and associated Mineral Resource categories used in this report are those recognized under NI 43-101 and set out in the CIM Standards (as amended in 2014). Mineral Resources presented in the current estimate have been assigned to Inferred and Indicated Mineral Resource categories.

**Measured Resources:** No interpolated resource blocks were assigned to this category.

**Indicated Resources:** Indicated Mineral Resources are defined as all blocks with interpolated metal grades and density values from the first or second interpolation passes that occur within the limits of the \$20 US/t NSR optimized pit shell.

**Inferred Resources:** Inferred Mineral Resources are defined as all blocks with interpolated metal grades and density values from the first, second, or third interpolation passes, that occur within the \$20 US/t NSR optimized pit shell that were not previously assigned to the Indicated Mineral Resource category.

Application of the selected Mineral Resource categorization parameters specified above provided a distribution of Indicated and Inferred Mineral Resource Estimate blocks occurring within limits of the \$20 US/t NSR optimized pit shell for the Lundberg Deposit. To eliminate



isolated and irregular category assignment artifacts, the peripheral limits of blocks in close proximity to each other that share the same category designation and demonstrate reasonable continuity were wireframed and developed into discrete solid models. All blocks occurring within these category solid models were re-classified to match that model's designation. This process resulted in more continuous zones of each Mineral Resource Estimate category and limited occurrences of orphaned blocks of one category occurring as imbedded patches in other category domains. All blocks identified as supporting massive sulphide mineralization or occurring within a 5 m buffer of the Low Grade Two Level stope model were assigned as Inferred Mineral Resources based on uncertainty of grade distribution and extents of historic mine workings.

Mercator is of the opinion that drill hole density is sufficient to define Measured Mineral Resources in some areas of the Lundberg Deposit. However, areas of high drill hole density are typically associated with historic underground drilling around areas of historic mining. The potential uncertainty associated with the spatial extents of historic mining and respective influence of historic underground drilling have resulted in the categorization of these areas as Indicated Mineral Resources rather than Measured Mineral Resources.

#### **14.14 Mineral Resource Estimate Tabulation**

Block grade, block density and block volume parameters for the Lundberg Deposit were estimated using methods described in preceding sections of this report. Subsequent application of Mineral Resource category parameters resulted in the Lundberg Deposit Mineral Resource Estimate presented below in Table 14-10. Figures 14-17 through 14-23 present isometric views of block grade distributions represented in the current Mineral Resource Estimate. Full page graphics that further illustrate the distribution of Lundberg Deposit block grades relative to the optimised pit shell are included in Appendix I.

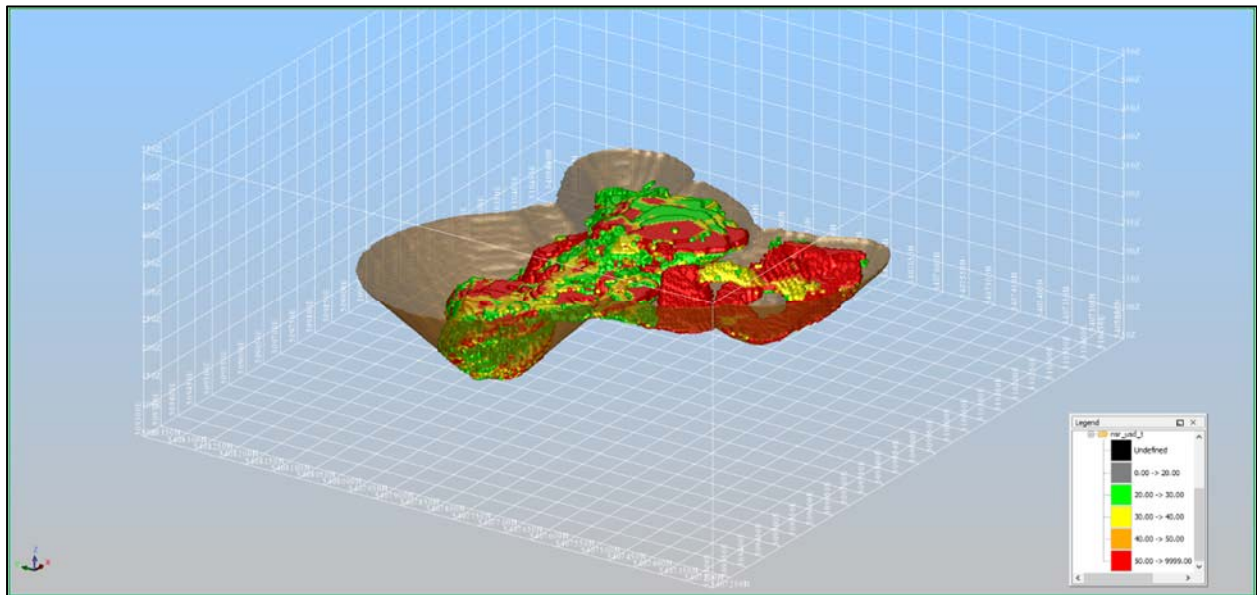
The Mineral Resource Estimate is reported at a cut-off grade of \$20 US/t NSR within the optimized pit shell and is considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open-pit mining methods.

**Table 14-10: Lundberg Deposit Mineral Resource Estimate – Effective Date: February 28, 2019**

NSR Cut-off (\$US/t)	Category	Rounded Tonnes	Zn %	Pb %	Cu %	Ag g/t	Au g/t	Zn Eq. %	NSR (\$US/t)	Strip Ratio
20	Indicated	16,790,000	1.53	0.64	0.42	5.69	0.07	3.38	54.98	2.9
	Inferred	380,000	2.03	1.01	0.36	22.35	0.31	4.46	72.95	

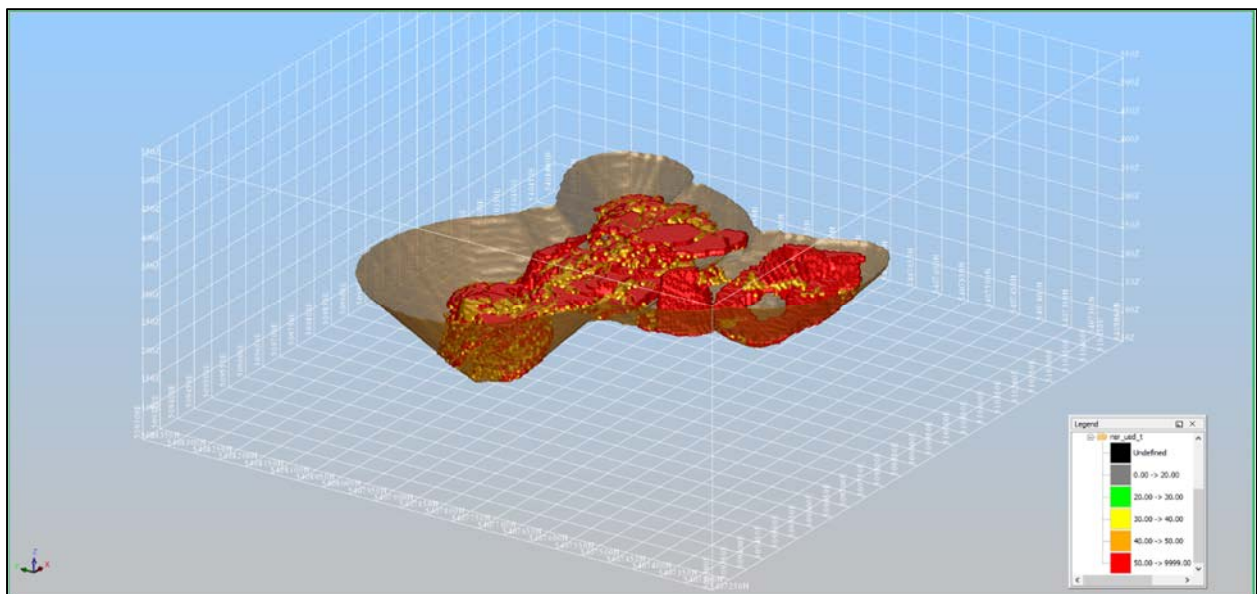
1. Mineral Resource tonnages have been rounded to the nearest 10,000. Totals may vary due to rounding.
2. Price assumptions used were \$1.20 US/lb Zn, \$1.00 US/lb Pb, \$3.00 US/lb Cu, \$1250 US/oz Au, and \$17 US/oz Ag.
3. Metallurgical recoveries to concentrates are based on the “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” (Thibault & Associates Inc., 2017). Metal recoveries are 83.0% Cu, 13.3% Au, and 7.84% Ag in the copper concentrate, 84.3% Pb, 10.5% Au, and 50.3% Ag in the lead concentrate, and 87.2% Zn, 8.28% Au, and 14.8% Ag in the zinc concentrate.
4. Net Smelter Return (NSR) \$US/t values were determined by calculating the value of each Mineral Resource model block using an NSR calculator prepared by Stantec Consulting Ltd.. The NSR calculator uses the stated metal pricing, metallurgical recoveries to concentrates, concentrate payable factors and current shipping and smelting terms for similar concentrates.
5. Zinc Equivalent metal grade (Zn Eq. %) was calculated as follows using metal pricing, metallurgical recoveries to concentrates, and concentrate payable factors as applied in the NSR calculator:  $Zn\ Eq\ \% = Zn\ \% + ((Cu\ \% \times 22.046 \times 0.8020 \times 3) + (Pb\ \% \times 22.046 \times 0.8010 \times 1) + (Au\ g/t / 31.10348 \times 0.2198 \times 1250) + (Ag\ g/t / 31.10348 \times 0.6514 \times 17)) / (1.20 \times 22.046 \times 0.7412)$ .
6. The Mineral Resource pit shell was developed and optimized by MineTech International Limited. Optimization parameters include: mining at \$3 US per tonne, processing at \$15 US per tonne, and G&A at \$2 US per tonne (total \$20 US per tonne).
7. A cut-off value of \$20 US/t NSR within the optimized pit shell was used to estimate Mineral Resources.
8. Mineral Resources were interpolated using Inverse Distance Squared methods applied to 1.5 metre downhole assay composites.
9. Results of an interpolated Inverse Distance Squared bulk density model ( $g/cm^3$ ) were applied.
10. Mineral Resources are considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open pit mining methods.
11. Mineral Resources do not have demonstrated economic viability.
12. This estimate of Mineral Resources may be materially affected by environmental, permitting, legal title, taxation, socio-political, marketing, or other relevant issues.

**Figure 14-17: Isometric View to the Northeast of the \*Lundberg Deposit Mineral Resource Estimate NSR Distribution at \$20 US/t NSR Cut-off**



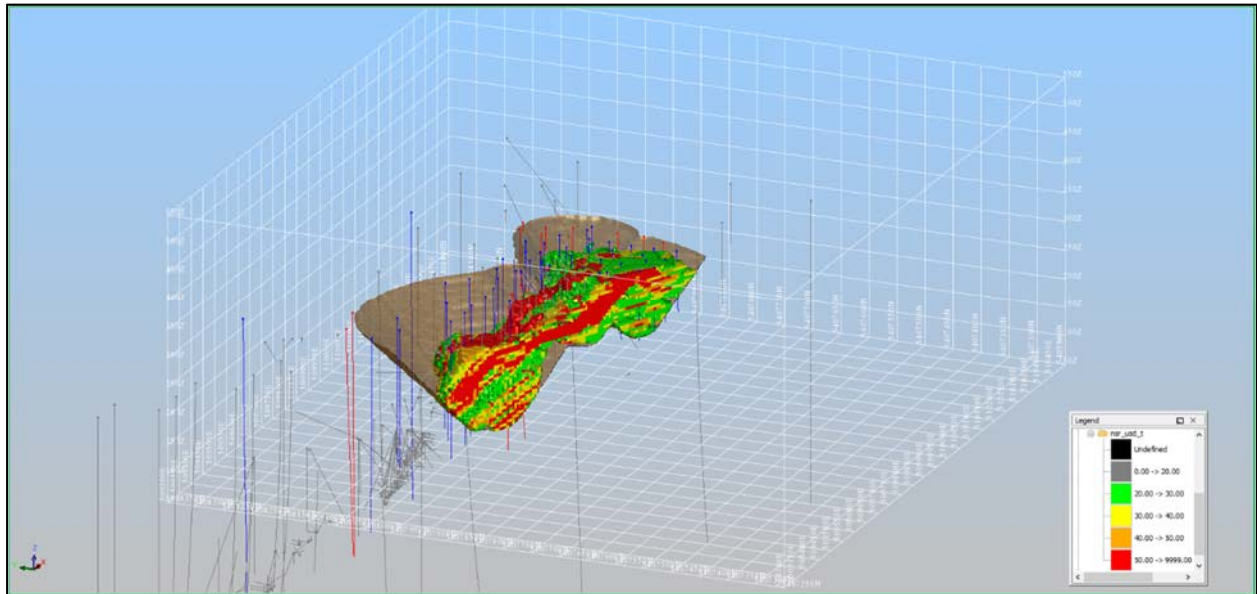
*\*Optimized pit shell is brown*

**Figure 14-18: Isometric View to the Northeast of the \*Lundberg Deposit Mineral Resource Estimate NSR Distribution at \$40 US/t NSR Cut-off**



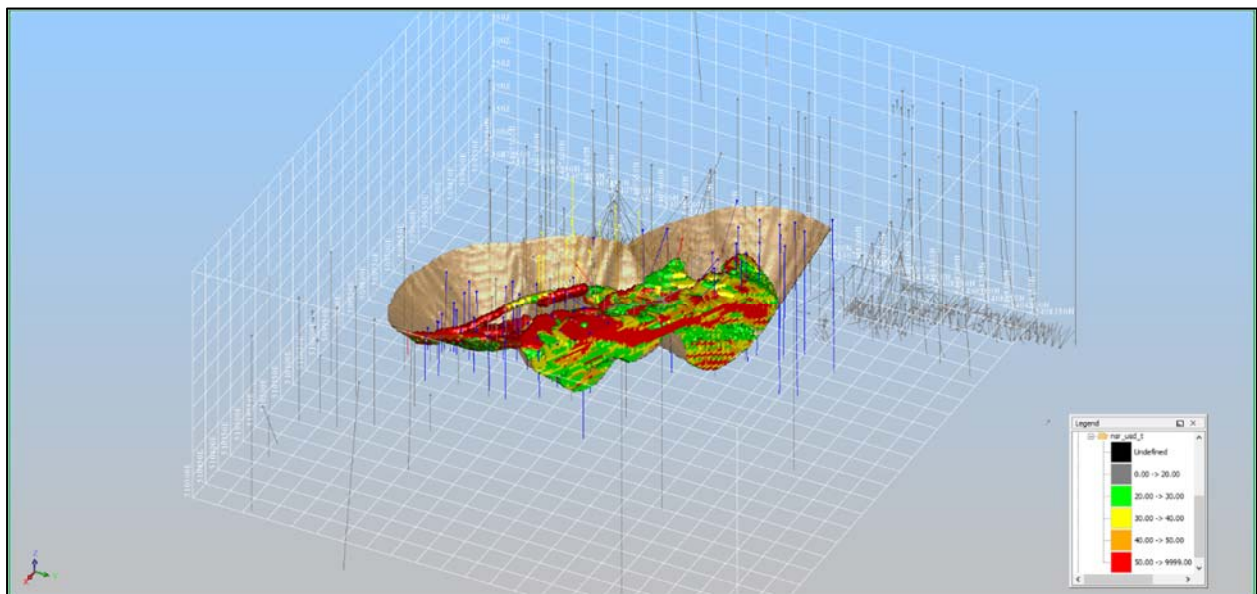
*\*Optimized pit shell is brown*

**Figure 14-19: Isometric View to the Northeast of a Representative Northwest-Southeast Cross-Section of the \*Lundberg Deposit Mineral Resource Estimate NSR Distribution at \$20 US/t NSR Cut-off**



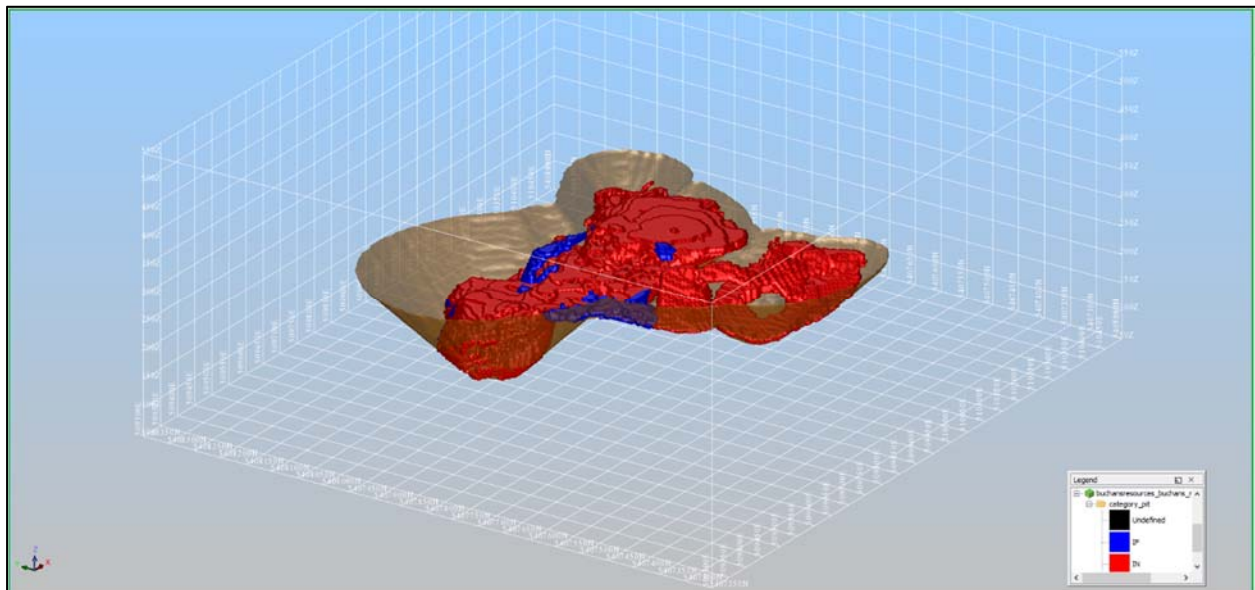
*\*Optimized pit shell is brown*

**Figure 14-20: Isometric View to the Southwest of a Representative Northwest-Southeast Cross-Section of the \*Lundberg Deposit Mineral Resource Estimate NSR Distribution at \$20 US/t NSR Cut-off**



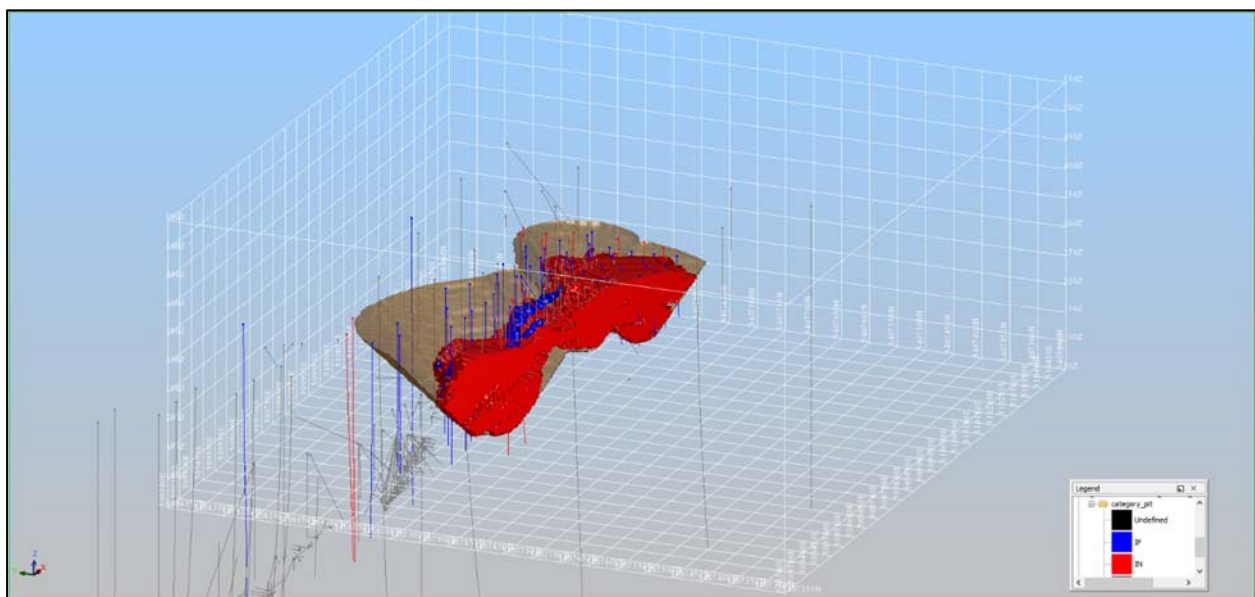
*\*Optimized pit shell is brown*

Figure 14-21: Isometric View to the Northeast of the \*Lundberg Deposit Mineral Resource Estimate Category Distribution at \$20 US/t NSR Cut-off



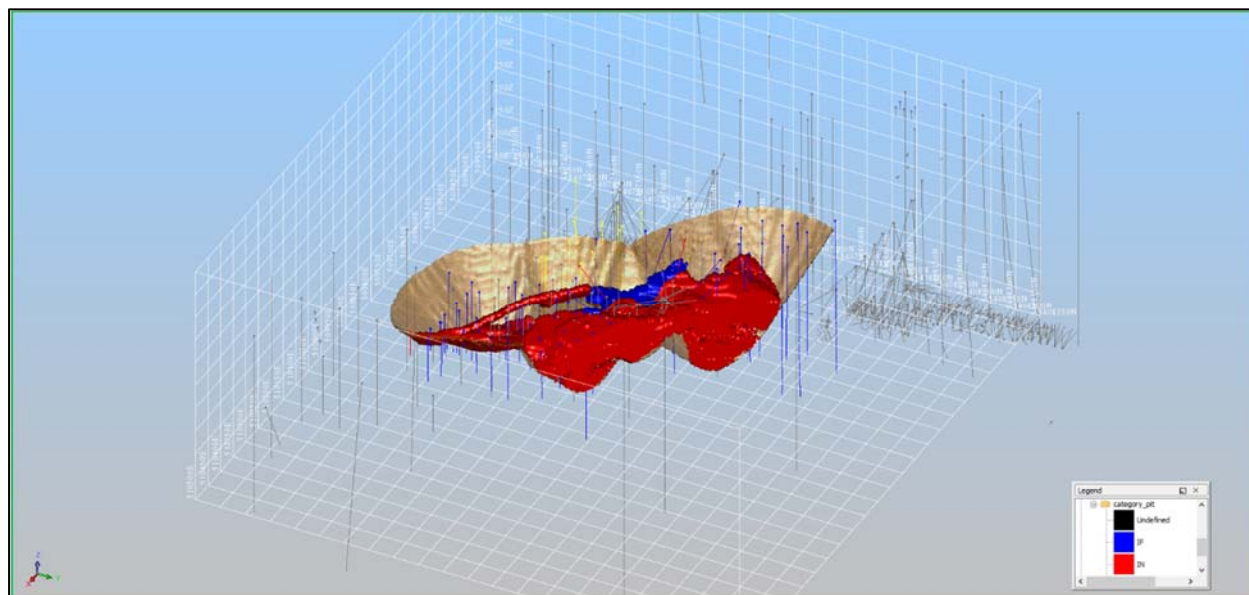
*\*Optimized pit shell is brown*

Figure 14-22: Isometric View to the Northeast of a Representative Northwest-Southeast Cross-Section of the \*Lundberg Deposit Mineral Resource Estimate Category Distribution at \$20 US/t NSR Cut-off



*\*Optimized pit shell is brown*

**Figure 14-23: Isometric View to the Southwest of a Representative Northwest-Southeast Cross-Section of the \*Lundberg Deposit Mineral Resource Estimate Category Distribution at \$20 US/t NSR Cut-off**



*\*Optimized pit shell is brown*

Tonnages at various NSR cut-off values within the optimized pit are highlighted in Figures 14-24 and Table 14-11 and reflect sensitivity to cut-off grades. The Mineral Resource Estimate sensitivity analysis demonstrates that considerable tonnage exists at higher cut-off thresholds. For example, a cut-off of \$40 US/t NSR per tonne results in an Indicated Mineral Resource tonnage of 9.2 million tonnes at a zinc equivalent grade of 4.67% and a cut-off of \$50 US/t NSR results in an Indicated Mineral Resource tonnage of 7 million tonnes at a zinc equivalent grade of 5.32%. The sensitivity analysis also demonstrates that a high proportion of the contained metal is retained at the higher cut-off thresholds and indicates that both lower grade - higher tonnage and higher grade - lower tonnage mining scenarios should be assessed in future economic studies.

Figure 14-24: Lundberg Deposit Grade (NSR) - Tonnage Chart

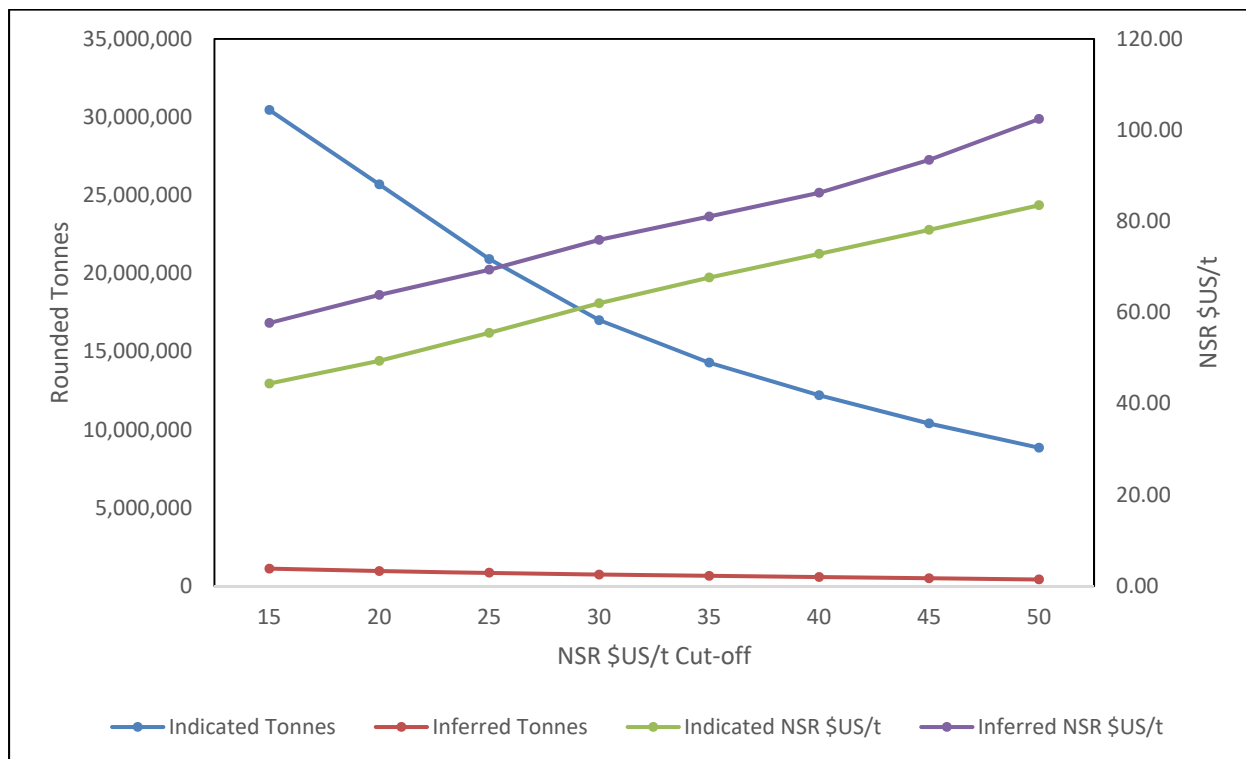


Table 14-11: Lundberg Deposit Cut-Off Grade Sensitivity Report

NSR Cut-off (\$US/t)	Category	Rounded Tonnes	Zn %	Pb %	Cu %	Ag g/t	Au g/t	Zn Eq. %	NSR (\$US/t)
15	Indicated	18,750,000	1.43	0.59	0.39	5.29	0.07	3.14	51.08
	Inferred	430,000	1.84	0.91	0.33	19.95	0.30	4.05	65.89
20*	Indicated	16,790,000	1.53	0.64	0.42	5.69	0.07	3.38	54.98
	Inferred	380,000	2.03	1.01	0.36	22.35	0.31	4.46	72.95
25	Indicated	14,360,000	1.68	0.70	0.46	6.30	0.08	3.71	60.49
	Inferred	300,000	2.38	1.20	0.41	26.62	0.36	5.22	84.96
30	Indicated	12,170,000	1.84	0.77	0.51	7.00	0.08	4.08	66.44
	Inferred	240,000	2.82	1.43	0.44	31.78	0.41	6.06	99.05
35	Indicated	10,540,000	1.98	0.82	0.55	7.64	0.09	4.39	71.70
	Inferred	210,000	3.15	1.61	0.48	36.15	0.45	6.76	110.21
40	Indicated	9,240,000	2.10	0.87	0.59	8.25	0.10	4.67	76.52
	Inferred	180,000	3.44	1.77	0.51	40.39	0.50	7.37	120.20
45	Indicated	8,050,000	2.23	0.93	0.64	8.90	0.10	5.01	81.58
	Inferred	150,000	3.86	2.04	0.56	47.15	0.55	8.32	135.70
50	Indicated	6,990,000	2.37	0.98	0.68	9.61	0.11	5.32	86.75
	Inferred	130,000	4.34	2.33	0.61	54.78	0.62	9.36	152.64

\* Mineral Resource Estimate cut-off

### 14.15 Barite Model

Mercator developed a barite % model in conjunction with the Mineral Resource Estimate to evaluate the economic potential of barite as an accessory product during an open pit mining scenario. Estimation and interpolation parameters are the same as those used for the Mineral Resource Estimate previously described. Interpolated block values of barium percent (Ba %) were converted to barite % ( $\text{BaSO}_4$ ) using the following conversion:  $\text{BaSO}_4 \% = \text{Ba \%} / 0.58$ .

At the Mineral Resource cut-off of \$20 US/t NSR within the optimized pit shell there is an estimated average grade 1.4  $\text{BaSO}_4$  % for the Lundberg Deposit. While massive barite occurs locally in the Lundberg Deposit and was included in the previous Mineral Resource Estimate (Cullen and Hilchey, 2013), it does not support sufficient levels at the deposit scale to be considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open pit mining methods. Barite is therefore omitted from the current Mineral Resource Estimate and does not contribute to \$US/t NSR and Zinc Equivalent % calculations.

### 14.16 Validation of Mineral Resource Models

Results of block modelling were reviewed in three dimensions and compared on a section by section basis with associated drill hole data. Block grade distributions were deemed to show acceptable correlation with the drill hole data. Visual inspection of metal distribution trends also showed consistency between the block model and the independently derived geological interpretations of the deposit. In addition, block model statistics for all interpolated blocks were reported and tabulated at a zero cut-off value to facilitate inspection of associated statistical parameters. Results appear below in Table 14-12 and Table 14-13 and include relatively low coefficient of variation values for Cu, Pb and Zn and typically higher values for Au and Ag. Block values are lower than composite values due to the large difference in population sizes.



**Table 14-12: Descriptive Statistics for the Lundberg Deposit 1.5m Downhole Assay Composites**

Parameter	Zinc (%)	Lead (%)	Copper (%)	Silver (g/t)	Gold (g/t)
Mean Grade	1.59	0.69	0.39	7.79	0.09
Maximum Grade	26.2	18.47	8.91	483.84	5.53
Minimum Grade	0.00	0.00	0.00	0.00	0.00
Variance	5.49	1.36	0.40	615.44	0.07
Standard Deviation	2.342	1.17	0.63	24.81	0.27
Coefficient of Variation	1.47	1.70	1.62	3.18	2.92
Number of Composites	6067	6067	6067	6067	6067

**Table 14-13: Descriptive Statistics for the Lundberg Interpolated Blocks**

Parameter	Zinc (%)	Lead (%)	Copper (%)	Silver (g/t)	Gold (g/t)
Mean Grade	1.16	0.50	0.28	5.20	0.07
Maximum Grade	16.42	7.74	6.74	309.50	2.79
Minimum Grade	0.00	0.00	0.00	0.00	0.00
Variance	1.41	0.31	0.11	185.18	0.02
Standard Deviation	1.19	0.56	0.33	13.61	0.14
Coefficient of Variation	1.02	1.11	1.17	2.62	2.10
Number of Composites	126054	126054	126054	126054	126054

Block volume estimates for each Mineral Resource solid were compared with corresponding solid model volume reports generated in Surpac and results show good correlation, indicating consistency in volume capture and block model volume reporting. Mercator also created horizontal swath plots, in both northing and easting directions, and vertical swath plots for the global Lundberg block values, tonnages and average assay composite values. The resulting spatial distribution trends of the average assay grades and the average block grade values compare acceptably (Figure 14-25 to Figure 14-30). As noted previously in the coefficient of variation values, Au and Ag distributions are more variable than those for Cu, Pb and Zn.

Variance between the assay composite and block grade values is considered to be associated with two main factors: drill hole data clustering of underground drill holes in areas of historic mining and below the Lucky Strike glory hole, and block volume depletion of the historically mined areas. As such, assay composite grade values can locally have a high bias with respect to the block grade values.

Figure 14-25: Lundberg Deposit Easting Swath Plot – Zn %, Pb %, Cu %

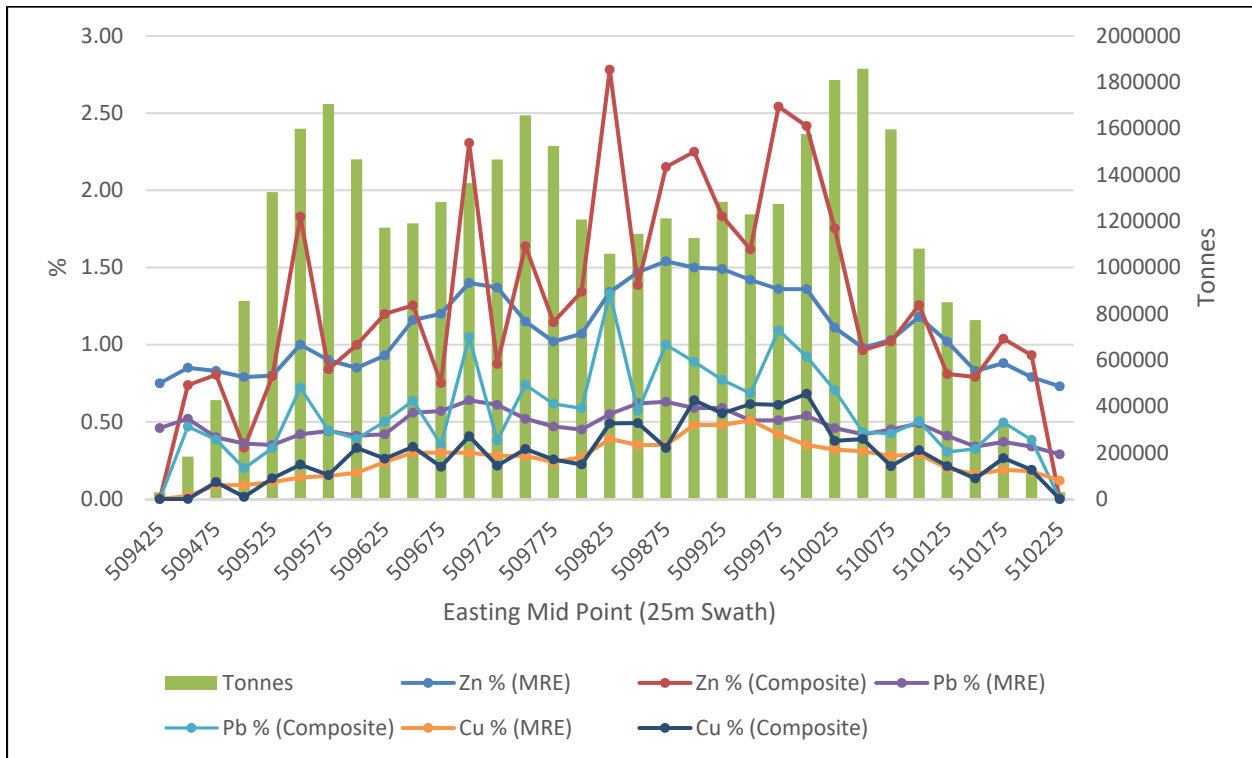


Figure 14-26: Lundberg Deposit Easting Swath Plot – Ag g/t, Au g/t

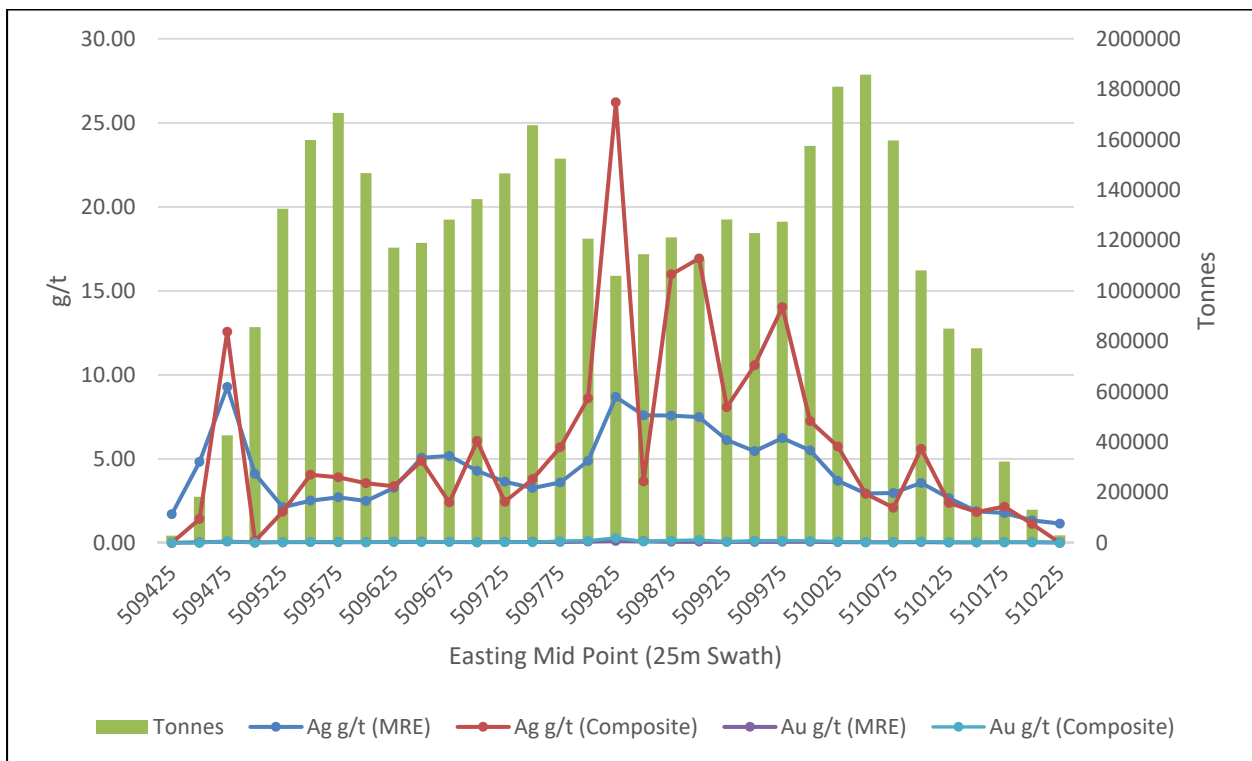


Figure 14-27: Lundberg Deposit Northing Swath Plot – Zn %, Pb %, Cu %

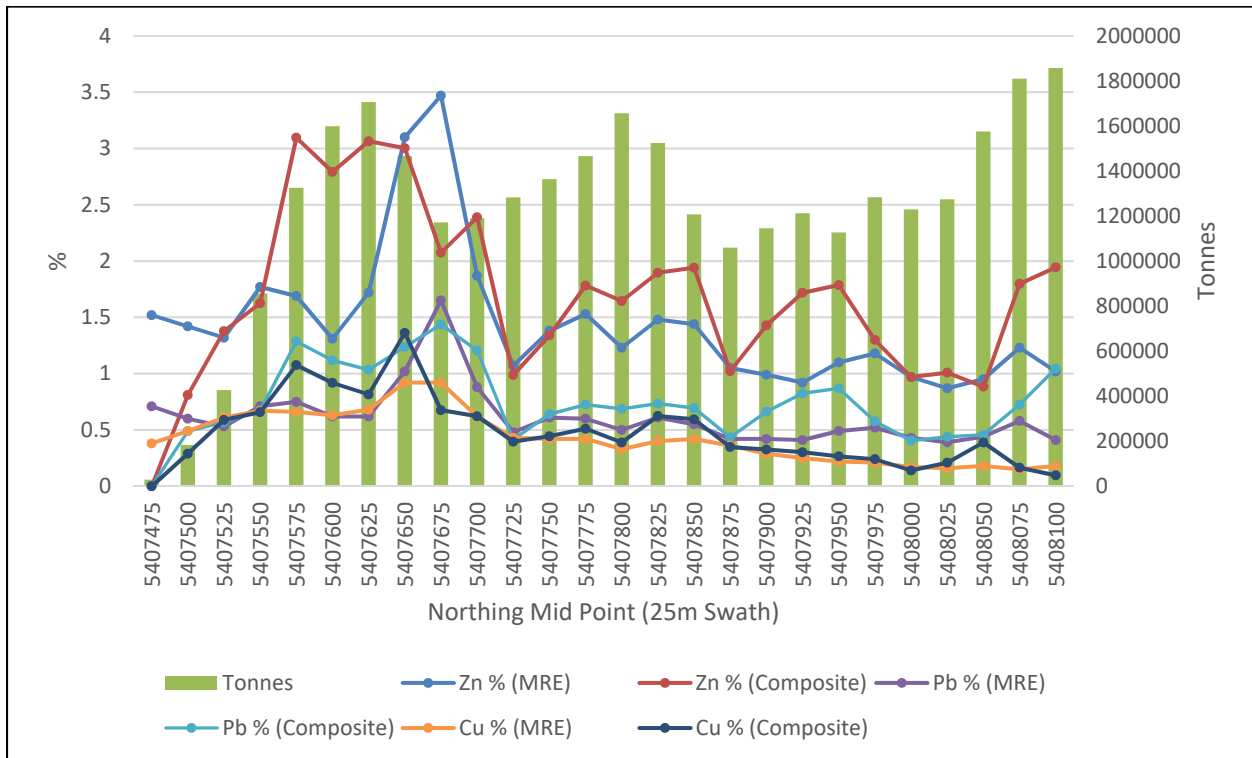


Figure 14-28: Lundberg Deposit Northing Swath Plot – Ag g/t, Au g/t

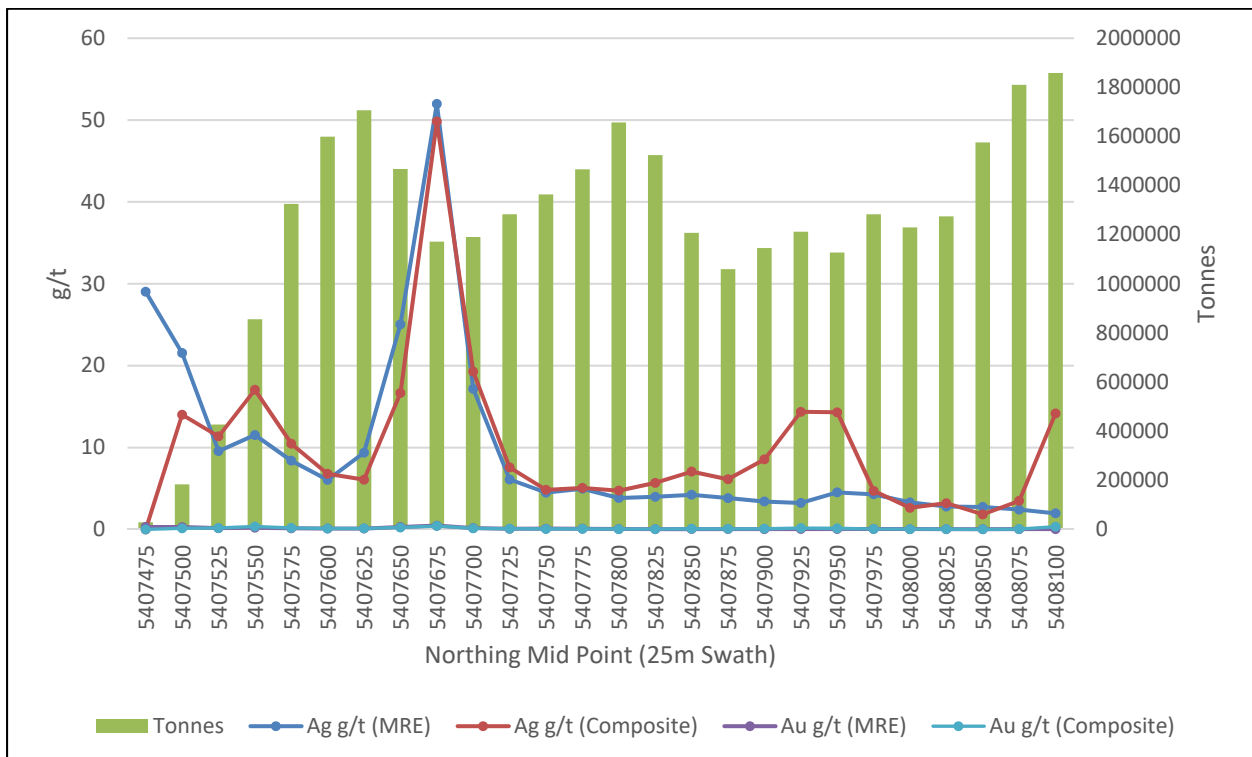


Figure 14-29: Lundberg Deposit Elevation Swath Plot – Zn %, Pb %, Cu %

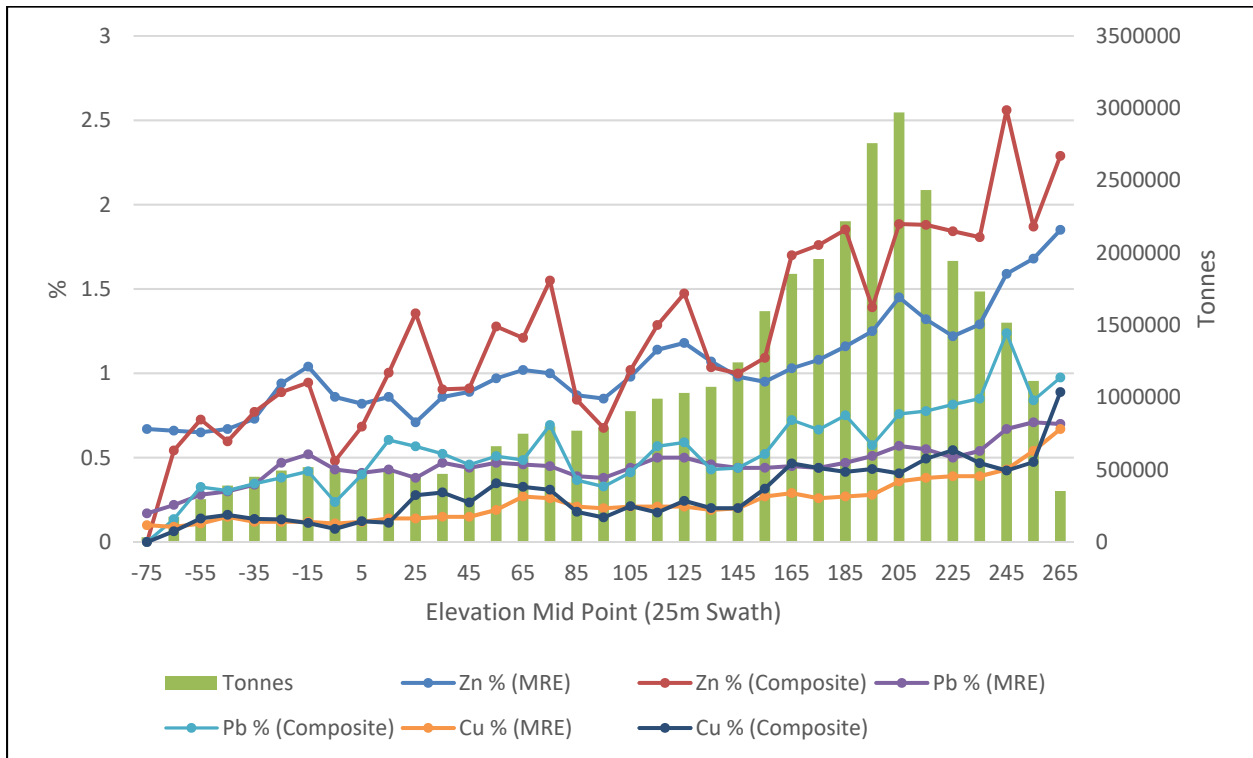
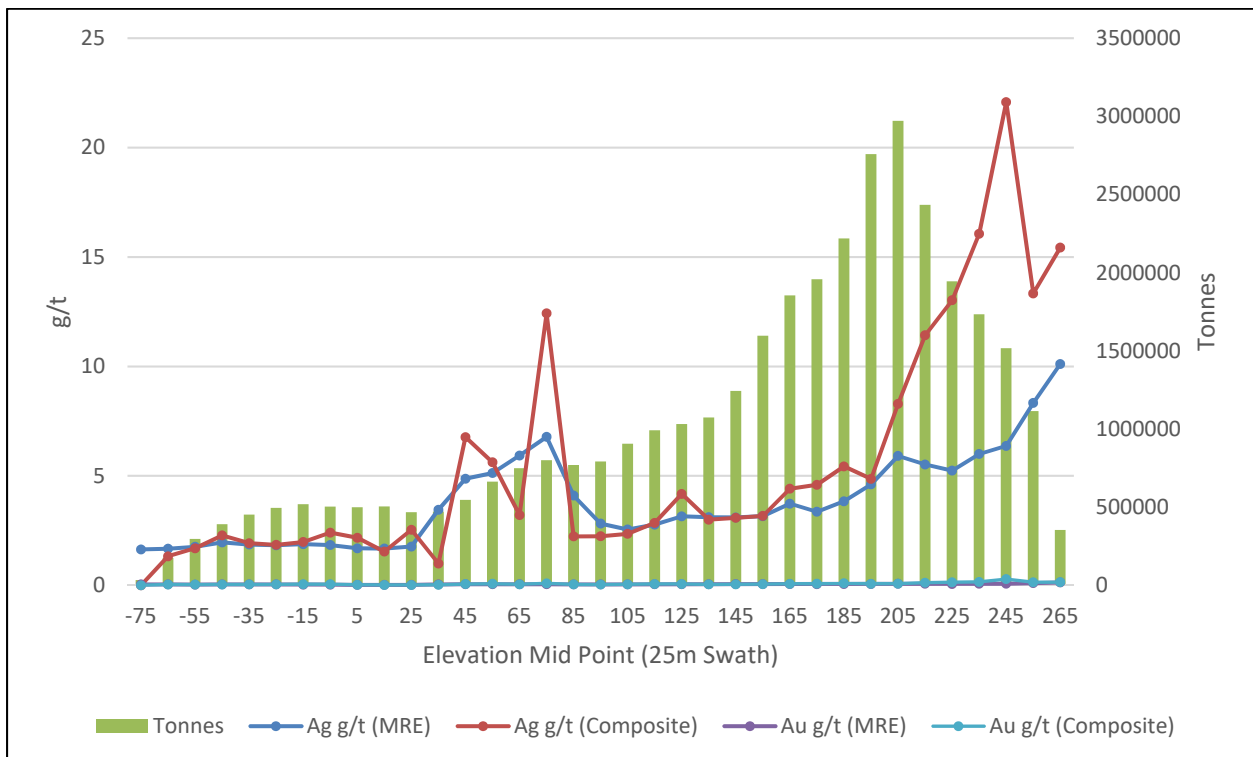


Figure 14-30: Lundberg Deposit Elevation Swath Plot – Ag g/t, Au g/t



A Nearest Neighbour (NN) check model for the Lundberg Deposit was performed to check the inverse distance squared (ID<sup>2</sup>) interpolation methodology and results appear in Table 14-14. Interpolation parameters reflect those used in the ID<sup>2</sup> model. Results of the NN modeling showed that average grades and tonnage closely match those of the ID<sup>2</sup> model. Results of the two methods are considered sufficiently consistent to provide an acceptable check.

**Table 14-14: Comparison Between ID<sup>2</sup> and NN Methodologies**

NSR US/t Cut-off	Interpolation Method	Tonnes	Zn (%)	Pb (%)	Cu (%)	Ag (g/t)	Au (g/t)
0	ID <sup>2</sup>	36,808,508	1.15	0.49	0.28	4.35	0.06
0	NN	36,808,508	1.15	0.50	0.29	4.57	0.06
20	ID <sup>2</sup>	26,653,673	1.42	0.61	0.36	5.40	0.07
20	NN	27,666,680	1.38	0.59	0.35	5.46	0.06

## 15.0 MINERAL RESERVE ESTIMATES

There are no current Mineral Reserves at the Lundberg Deposit.

## 16.0 MINING METHODS

This section is not applicable.

## 17.0 RECOVERY METHODS

This section is not applicable.



## 18.0 PROJECT INFRASTRUCTURE

This section is not applicable.

## 19.0 MARKET STUDIES AND CONTRACTS

This section is not applicable.

## 20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

Since completing the 2011 PEA described in Section 6.2.7 of this Report, Buchans has undertaken initial reviews of environmental studies, permitting and social or community impact as deemed appropriate to identify and initiate further studies and assessments required to prepare a Pre-Feasibility study for the Lundberg project. This work primarily consists of a Phase One Technical Report prepared by Sikumiut Environmental Management Ltd. (Sikumiut) In November 2012 (Ledrew, 2012), as well as limited follow-up field investigations consisting of water sampling undertaken within the Lucky Strike glory hole, immediately above the Lundberg Deposit (Sikumiut, 2013).

The Lundberg Deposit is situated within lands associated with the past-producing Lucky Strike mine with most of the area overlying the deposit having been cleared for historical mining operations. The deposit is located immediately adjacent to the community of Buchans which has a population of approximately 700. Access to the deposit area is excellent via paved Route 370.

The historic tailings ponds from the former ASARCO mining operations are located south of the Lundberg Deposit and are not currently permitted for storage of any additional tailings. Environmental liability for past mining by precursor firms related to Abitibi Consolidated Inc. was addressed in a Supreme Court of Canada ruling handed down on December 7th, 2012. That decision assigned responsibility to the government of Newfoundland and Labrador for environmental clean-up of impacts associated with past mining activities following expropriation by the Province of various assets of Abitibi Consolidated Inc.

Since 2012, the government of Newfoundland and Labrador has undertaken work to remediate certain impacts associated with past mining operations at Buchans, including removal of lead in soils within the community and remedial work to stabilize the historic tailings dam. If a decision is made to build a mine of the Lundberg Deposit, the issue of site liabilities will be addressed in the related environmental assessment and permitting process.

Buchans has not undertaken additional studies or assessments of the Lundberg site, though it believes addition monitoring and assessment have been undertaken by the Province of Newfoundland and Labrador, as the current holders of liabilities related to legacy issues associated with historic mining at the Buchans mine site, including the Lundberg Deposit area and adjacent environs.

To date, Buchans has accessed lands in the Buchans area for the purpose of its exploration activities, including lands controlled by the municipality of Buchans and the Company is required to advise the municipality of on-going activities of this nature that occur within its boundaries.

Agreements have not been established to access any lands that may be required for the purposes of future mine development and establishment of associated infrastructure, however sufficient lands exist in the area of the Lundberg Deposit to potentially accommodate future open pit mine development and establishment of required milling infrastructure plus tailings impoundment and waste rock storage areas.

Buchans has maintained a positive and cooperative relationship with the immediately adjacent town of Buchans, including open communication conducted by face to face meetings, and other correspondence as well as inclusion of the Buchans Town Council (Mayor and Town Manager) on applications and correspondence, related to the Company's field operations and informal project updates.

Buchans has found the Town of Buchans to be generally receptive and supportive of the Company's efforts to advance the Lundberg Deposit towards development. As a former mining town originally established to support mining operations over the mine's 56 year historic mine life, as well as having been home to many employees of Teck Resources Limited's Duck Pond Mine located 60Km distant, the population is aware of the potential impacts and benefits of future mine development. Among these are the potential employment benefits projected by the 2011 PEA which estimated a workforce of approximately 135 staff (Imeson, 2011), with additional support and spin-off employment.

## 20.1 Sikumiut

The 2012 Phase One report prepared by Sikumiut included an initial review of previous reports and studies; consultation with selected regulators, client representatives and local contacts, as well as a site visit. The report presented a brief overview of the project and summary of information collected prior to the date of their 2012 Phase One report.

The report recognized the Lundberg Deposit area as a "brownfield" site with legacy issues related to past mining operations, as well as having an abundance of previous environmental monitoring and assessment studies related to previous mining.

The report also provided an overview description of the existing environment, both in terms of the Buchans mining legacy; as well as environmental data; a review of the regulatory regime applicable to environmental processes and approvals required to progress the Lundberg project through Prefeasibility. Also included in the report was a brief discussion and analysis of environmental issues, approval strategy, and legacy/liability concerns. Recommendations were also provided for additional actions as required to progress the project through Prefeasibility and potentially Feasibility.

Sikumiut's 2013 report documented a field program to collect water and sediment quality information within the Lucky Strike glory hole, as recommended in the 2012 Phase One report. The recommend sampling program was one of many recommended actions and expectedly confirmed legacy issues related to the glory hole, a site of past mining.

## 21.0 CAPITAL AND OPERATING COSTS

This section is not applicable.

## 22.0 ECONOMIC ANALYSIS

This section is not applicable.

## 23.0 ADJACENT PROPERTIES

Buchans controls mineral rights covering 115 km<sup>2</sup> (11,582 hectares) considered prospective for volcanogenic massive sulphide (“VMS”) Zn-Pb-Cu-Ag-Au base metal deposits within the Buchans region district of central Newfoundland. These are addressed herein as Adjacent Properties with respect to the Lundberg Deposit due to their potential to contribute at some time in the future to a central milling complex strategy that could potentially include Lundberg. Notwithstanding this potential, Buchans is not suggesting or concluding that the current Lundberg Deposit Mineral Resource Estimate is in any manner dependent on geology, mineral deposits or exploration potential of any of the Adjacent Properties identified in this Report.

Buchans properties host four undeveloped deposits with current Mineral Resource Estimate prepared in accordance with National Instrument 43-101. In addition to Lundberg, the Company’s deposits include three smaller, higher grade, massive sulphide VMS “satellite” deposits located less than 20 km south of Buchans, on the opposite side of Red Indian Lake, namely the Daniels, Bobbys and Tulks Hill deposits.

Lundberg is the largest and most advanced deposit with respect to metal inventory, Mineral Resource definition, metallurgical testing and economic studies, is the subject of the updated Mineral Resource Estimate supported by this Technical Report.

Buchans’ exploration strategy in central Newfoundland is to continue to build on its existing resource base with the aim of developing either a stand-alone open pit mine, centred on the Lundberg stockwork deposit, or a number of smaller higher-grade VMS deposits that could be developed simultaneously and processed in a central milling facility; either with or without contribution from a development project at Lundberg.

In addition to the Buchans deposit, the Lamarchant, Boomerang and Domino VMS deposits held by NorZinc Ltd. (NorZinc) in central Newfoundland, all of which have current Mineral Resource Estimates prepared in accordance with NI 43-101, could also potentially contribute to a central milling facility. This is more fully explored in the Thibault and Associates (2016) report that addresses the central milling facility concept. As a result, the NorZinc Ltd. deposits can also be classified as Adjacent Properties.

Notwithstanding the potential for Adjacent Properties noted in this Report to influence future mineral development strategies in central Newfoundland, Buchans is not suggesting or concluding



that the current Lundberg Deposit Mineral Resource Estimate is in any manner dependent on geology, mineral deposits or exploration potential of any of these Adjacent Properties.

### 23.1 Buchans VMS Properties

At Buchans, BMC's existing, 57 km<sup>2</sup>, land position covers the majority of the Buchans Camp's productive horizon rocks as well as most of the Camp's past producing orebodies and undeveloped prospects. This land position, coupled with Buchans substantial experience and knowledge of the Buchans deposits, presents an opportunity for the Company to explore for, and potentially discover and develop, new high-grade deposits comparable to those historically mined by ASARCO.

Buchans' VMS exploration plans focus on discovery of new high-grade deposits in areas adjacent to the Lundberg Deposit. This exploration proposes to target areas with potential to host buried Buchans-style deposits comparable to the Lucky Strike deposit, where ASARCO mined 5.6 million tonnes of high-grade massive sulphide ore with an average head grade of 18.4% Zn, 8.6% Pb, 1.6% Cu, 112 g/t Ag & 1.7 g/t Au.

The planned exploration programs will endeavor to apply modern technologies and revised exploration models, unavailable to ASARCO prior to 1984, while also utilizing more recent exploration results and knowledge generated by Buchans through its exploration efforts over the past 10 years. Within this knowledge base are datasets generated by Buchans' exploration activities including Buchans' systematic relogging of approximately 123,000 metres of archived drill core in the Camp. This relogging program was initiated at the Lundberg/Lucky Strike area in 2014 and has since extended outwards to cover most of the Camp's undeveloped sulphide prospects and past producing orebodies. Buchans believes its relogging data lends itself to the application of modern 3-dimensional modelling and further believes use of such modelling should provide valuable geological constraints for the application of modern geophysical techniques adapted for detection of Buchans-style orebodies.

Among the target areas already identified at Buchans are several targets previously described in Section 6 of this Report as they are located within 3.5 kilometres from the Lundberg Deposit and therefore have potential to benefit Lundberg's direct future development. These target areas received initial exploration drilling in 2018 as 11 drill holes, totaling 2,906 m, were drilled to test four targets areas for additional higher-grade sulphide mineralization including: the Lucky Strike North, Oriental East, Sandfill and Middle Branch target areas.

As summarized earlier in Section 9.0, results from the Two Level (Lucky Strike) area include hole H-18-3524 that intersected 1.8 m (core length) of 0.76% Cu, 3.15% Pb, 5.57% Zn, 90.5 g/t Ag and 0.37 g/t Au, including 1.0 m assaying 1.26% Cu, 4.87% Pb, 8.70% Zn, 133.2 g/t Ag and 0.47 g/t Au (see Buchans news release dated November 19, 2018 for details). This hole, drilled near the end of the 2018 program, extends mineralization 70 m north of historic underground workings at the Two Level deposit and indicates the deposit extends northwards, where potential remains to identify additional higher-grade mineralization, either close by or more distally along strike or down plunge.

Drilling at the Sandfill prospect included hole H-18-3513 that intersected multiple sections of transported breccia mineralization, including: 7.0 m of 0.69% Cu, 1.58% Pb, 5.15% Zn, 33.5 g/t Ag and 0.21 g/t Au (see Buchans news release dated September 17, 2018). A subsequent hole, H-18-3525, drilled 170 m west of H-18-3513, returned 0.30 m of 0.04% Cu, 0.34% Pb, 1.93% Zn, 75.8 g/t Ag and 0.242 g/t Au at a depth of 420 m (see Buchans news release dated January 23, 2019 for details). Buchans believes the Sandfill area holds exploration potential for discovery of transported-breccia sulphide deposits comparable to several of the Buchans Camp's historically mined, high-grade orebodies.

Drilling at the Middle Branch prospect in 2018 consisted of hole H-18-3522 that was drilled to test the Middle Branch transported breccia sulphide prospect. This hole intersected approximately 33 m of Buchans mine horizon rocks starting 533 m down the hole, including 0.30 m assaying 0.07% Pb, 0.16% Zn, 162.80 g/t Ag and 0.054 g/t Au (see Buchans news release dated December 21, 2018). Buchans believes this area remains poorly tested by limited historic drilling, and that the area holds exploration potential for discovery of transported-breccia sulphide deposits comparable to several of the Buchans Camp's historically mined, high-grade orebodies.

## 23.2 Victoria Lake Supergroup Properties

Buchans holds interests in two other advanced base metal properties in central Newfoundland, located 15 to 35 km south of the Company's Buchans Property on the south side of Red Indian Lake. These properties are prospective for VMS base metal deposits within a separate belt of rocks of similar age to the Buchans host rocks that possess different geological characteristics. Known as the Victoria Lake Supergroup (Evans and Kean, 2002), this belt of rocks hosts several undeveloped VMS deposits as well as the past producing Duck Pond copper-zinc mine where Teck Resources Limited mined 5.0 million tonnes of ore with an average grade of 4.4% Zn, 2.7% Cu, 53 g/t Ag, 0.6 g/t Au between 2007 and 2015.

Buchans' properties located in this area south of Red Indian Lake include the 100%-owned, 52.25 km<sup>2</sup> (5,225 hectares) Tulks North property that hosts two Mineral Resource Estimates including the Bobbys and Daniels VMS deposits. In addition, Buchans owns a 100% interest in its 3.65 km<sup>2</sup> (365 hectares) Tulks Hill property, a portion of which (0.73 km<sup>2</sup>) is held as a 49% interest in a joint venture with Prominex Resources Corp. and hosts the undeveloped Tulks Hill deposit.

### 23.3 Tulks North Property

The Tulks North property hosts several undeveloped base metal sulphide prospects and deposits that remain a focus of exploration for BMC as the company has completed several exploration programs within this property since 2007. The property hosts several sulphide prospects as well as two Mineral Resource Estimates including the Bobbys and Daniels VMS Deposits; and both deposits host additional exploration potential at depth below known resources.

The Bobbys Deposit is estimated by Scott Wilson Roscoe Postle Associates Inc. to host a current Indicated Mineral Resource prepared in accordance with NI 43-101 that totals 1,095,000 tonnes averaging 0.86% Cu, 0.44% Pb, 4.61% Zn, 16.56 g/t Ag and 0.20 g/t Au, as well as an Inferred Mineral Resource of 1,177,000 tonnes averaging 0.95% Cu, 0.27% Pb, 3.75% Zn, 10.95 g/t Ag and 0.06 g/t Au, at a 1.1% copper equivalent cut-off, as reported by Agnerian (2008). This Mineral Resource Estimate is based on drilling completed prior to 2018.

The Daniels Deposit is estimated by Mercator to host a current Indicated Mineral Resource prepared in accordance with NI 43-101 that totals 929,000 tonnes averaging 0.34% Cu, 2.50% Pb, 5.13% Zn 101.4 g/t Ag and 0.63 g/t Au as well as an Inferred Mineral Resource of 332,000 tonnes averaging 0.30% Cu, 2.13% Pb, 4.61% Zn, 85.86 g/t Ag and 0.53 g/t Au, at a 2% Zn cut-off, as reported by Webster et al. (2008). This Mineral Resource Estimate is based on exploration completed prior to 2018.

Recent work completed by Buchans in 2016 includes a metallurgical research program to investigate the metallurgical and economic viability of utilizing a central milling facility to develop several VMS base metal deposits located in central Newfoundland. The metallurgical research program (RDC study) was undertaken in collaboration with Canadian Zinc Corporation (CZN) and funded in part by the Research & Development Corporation of Newfoundland and Labrador (RDC) through its GeoEXPLORE Industry-led research funding program.

The RDC study included bench scale metallurgical test work on five deposits with current Mineral Resource Estimates prepared in accordance with NI 43-101, including Buchans' Lundberg, Bobbys

and Daniels deposits and NorZinc's Lemarchant and Boomerang-Domino deposits. Of these, all but the Lundberg Deposit are located within Victoria Lake Supergroup rocks south of Red Indian Lake. Results of the RDC study applicable to the Lundberg Deposit are described in Section 13 of this Report.

Results of the RDC study confirm that selective zinc, lead and copper concentrates at marketable grades can be produced using a common flotation flowsheet for the deposits utilizing sequential flotation technology for processing within a conceptual centralized processing facility and support the use of a common flowsheet for the development of these deposits (see Buchans Resources (Minco Plc) press release dated November 3, 2016 for details).

Recognizing the technical viability for the concept of processing mineralization from additional deposits located in the region through a central processing facility, BMC undertook additional exploration within its Tulks North property in 2018, including drilling down plunge, below the Daniels Deposit and down-plunge below the Bobbys Deposit (5 holes, totaling ~2,800 metres (see Buchans news release dated December 20, 2018 for details).

This work returned drilled intercepts of semi-massive to massive sulphide mineralization down plunge at both deposits. In particular, drilling at the Bobbys Deposit extended semi-massive to massive sulphide mineralization down plunge to a vertical depth of 475 m, where one hole intersected semi-massive to massive sulphides assaying 17.02% combined base metals over a core length of 0.85 m that remains open at depth. At the Daniels Deposit, results of the 2018 drilling program extended mineralization below the known resource to vertical depths of 472 m.

In addition, Buchans also undertook property-wide, SkyTEM airborne geophysical surveys over its Tulks North property as part of a larger survey that included surveying of more than 1,000-line kilometres over its Buchans and Tulks North properties. These surveys provided coverage over Buchans' key exploration prospects and deposits within the Tulks North property and results are expected to assist future exploration targeting within the property.

Buchans also completed borehole geophysical surveying of several drill holes at the Bobbys and Daniels deposits within the Tulks North property in 2018. Results from these surveys are also expected to assist future exploration targeting at these deposits.

On the basis of the above information, the Victoria Lake Supergroup area, including Buchans' Tulks North Property, is interpreted to hold potential for discovery and possible development of additional VMS base metal deposits. Based upon findings of the RDC study, Buchans exploration

of deposits within this adjacent region may benefit development of the Lundberg Deposit, should resources be identified that could provide additional future sources of economically viable base metal sulphide mineralization.

## 24.0 OTHER RELEVANT DATA AND INFORMATION

The authors are not aware of any other relevant data or information that should be presented in support of the current Mineral Resource Estimate.

## 25.0 INTERPRETATION AND CONCLUSIONS

The purpose of this Technical Report is to provide current scientific and technical information related to the Lundberg Project. It specifically supports the updated Mineral Resource Estimate for the Lundberg Deposit, as described in a Buchans news release dated March 1st, 2019 (available on SEDAR under the Company's profile).

The Lundberg Deposit described in this Technical Report is of volcanogenic massive sulphide association and occurs within the NE-SW trending Central Mobile Belt (CMB) in central Newfoundland. It is hosted by Lower Ordovician volcanic rocks of the Buchans Group that range in composition from basalt to rhyolite. Five main Zn-Pb-Cu-Ag-Au deposits were historically mined at Buchans and all occur in association with the same felsic stratigraphic horizon within the Buchans Group. The Lundberg Deposit surrounds the former Lucky Strike mine site, where ASARCO operated a near-surface underground and glory hole mining operation until mine closure in 1984. The Lundberg Deposit is mainly comprised of stockwork mineralization surrounding and lying below the Lucky Strike orebody but includes some massive sulphide mineralization that was not mined by former operations.

Stockwork mineralization at Buchans consists of a network of sulphide veins and veinlets that cut strongly altered and sulphidized host rocks. The largest known concentration of stockwork and disseminated mineralization is the Lundberg zone that underlies the Lucky Strike deposit. The stockwork mineralization has a higher ratio of pyrite to base metal sulphides than the in situ sulphide zones and is typified by presence of fine to coarse grained pyrite with lesser amounts of chalcopyrite, sphalerite, galena and barite. This mineralization occurs within felsic volcanic rocks of the Buchans River Formation below the Lucky Strike deposit and extends into the underlying Ski Hill Formation, where sulphide-bearing stockwork mineralization occurs at tens to hundreds of metres below the deposit. At depth, mineralization thins and feathers out into lower grade, semi-conformable zones of alteration. The Lundberg zone stockwork mineralization comes to surface on the eastern edge of the zone and forms an elongate, wedge-shaped body that is 250 m deep on the western end. The highest concentration of sulphide mineralization lies in close proximity to the previously mined Lucky Strike massive sulphide zone and mineralization is more diffuse away from the zone. A second zone of stockwork mineralization is associated with the Engine House zone, which is located immediately south of the Lucky Strike deposit, and this zone has a higher proportion of chalcopyrite to other base metal sulphides.

In 2008, an Inferred Mineral Resource Estimate of 20.7 million tonnes averaging 1.68% Zn, 0.72% Pb, 0.38% Cu, 5.92 g/t Ag and 0.07 g/t Au at a 1% Zn cut-off (effective date of November 3, 2008)

was prepared for the Lundberg and Engine House zones by Mercator (Webster and Barr, 2008). This Mineral Resource Estimate is now historic in nature and should no longer be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

In 2011, a Preliminary Economic Assessment of the Lundberg Deposit was completed by Wardrop (2011 PEA) based on a regularized model of the 2008 Mineral Resource Estimate (Coley et al., 2011). The 2011 PEA identified the combined Lundberg and Engine House zones as having potential to support stand-alone 5,000 t per day open pit mining and milling operations, containing 17.28 Mt of Inferred Mineral Resources with an average grade of 1.63% Zn, 0.69% Pb, 0.40% Cu, 5.96 g/t Ag, 0.07 g/t Au and 1.24% Ba, over a 10-year life of mine (LOM). The mining schedule showed that a total of 52.93 Mt of waste material would be moved over the 10-year LOM with an overall stripping ratio of 3.06 t/t (waste/resource). This PEA is now historic in nature and should not be relied upon and the Mineral Resource Estimate for which the 2011 PEA was based on is also historic in nature and should not be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

The 2008 Lundberg deposit Mineral Resource Estimate was subsequently updated by Mercator in 2013 to include an Indicated Mineral Resource of 23.44 million tonnes averaging 1.41% Zn, 0.60% Pb, 0.35% Cu, 5.31 g/t Ag and 0.07 g/t Au, as well as Inferred Mineral Resource of 4.31 million tonnes grading 1.29% Zn, 0.54% Pb, 0.27% Cu, 4.47 g/t Ag and 0.08 g/t Au at a cut-off value of \$15 Net Smelter Return (NSR) (Cullen and Hilchey, 2013). Definition of Mineral Resources in 2013 was constrained by grade solid models and restricted to within 350 m of the surface elevation, but an optimized pit shell was not applied. The 2013 Mineral Resource Estimate included mineralization below the limits of the open pit projected by the 2011 PEA. This Mineral Resource Estimate is now historic in nature and should no longer be relied upon. It is superseded by the current Mineral Resource Estimate (effective date February 28, 2019).

Metallurgical testing on the Lundberg and Engine House zones was conducted between 2011 and 2017 by SGS - Lakefield, Tomra Sorting Solutions and Thibault & Associates. The sulphide minerals in the Lundberg samples were well-liberated at typical grind sizes for recovery by flotation and no potential challenges related to mineralogy were identified. The Lundberg Deposit was shown to be amenable to pre-concentration by either dense media separation or XRT sensor-based sorting, with both technologies providing similar results of 95% to 98% recovery of copper, lead and zinc after rejection of 25% of the initial mass. Two alternative flotation flowsheets and reagent schemes have been tested on the same Lundberg samples for recovery of copper, lead and zinc concentrates: a bulk Cu/Pb flowsheet and a sequential flowsheet. Preliminary testing of the sequential flotation flowsheet has shown marketable



copper, lead and zinc concentrate grades with improved flotation selectivity compared to the bulk Cu/Pb flowsheet. The sequential flotation flowsheet has been tested in open-circuit on samples from the Lundberg Deposit; locked cycle testing has not yet been completed. A METSIM™ simulation of the sequential flotation flowsheet has projected recoveries to the respective concentrates of 83.0% copper, 84.3% lead and 87.2% zinc, and these preliminary recoveries have been applied to the resource model in this Study. Continued development of the sequential flotation flowsheet with locked cycle testing is warranted to confirm the metallurgical performance.

The current Mineral Resource Estimate, effective February 28, 2019, includes In-pit Indicated Mineral Resources of 16,790,000 tonnes grading 1.53% Zn, 0.64% Pb, 0.42% Cu, 5.69 g/t Ag and 0.07 g/t Au (3.38% ZnEq) and In-pit Inferred Mineral Resources total 380,000 tonnes grading 2.03% Zn, 1.01% Pb, 0.36% Cu, 22.35 g/t Ag and 0.31 g/t Au (4.46% ZnEq) reported at a cut-off grade of \$20 US/t NSR within an optimized pit shell. It is considered to reflect reasonable prospects for economic extraction in the foreseeable future using conventional open-pit mining methods. The current Mineral Resource Estimate was prepared by incorporating 21,203 m of drilling by Buchans in 144 surface drill holes, including 91 holes totaling 13,145 m drilled since the 2011 PEA, and including 17 holes totaling 2,205 m drilled in 2018. In addition, the current Mineral Resource Estimate incorporates information collected through systematic relogging of approximately 28,000 m of core from 280 archived surface and underground drill holes from the former Lucky Strike mine. In total, the Lundberg Deposit is defined by 7,972 core samples from 263 diamond drill holes within the limits of the current Mineral Resource Estimate.

Based on the results of the Mineral Resource Estimate summarized in this Report, Mercator has concluded that the current Mineral Resource Estimate represents a substantial upgrade in deposit definition confidence that is exemplified by its large inventory of Indicated category Mineral Resources.

Through completion of a large amount of additional infill core drilling, relogging of archived drill core, database upgrading and detailed deposit model studies in the intervening years, the current Mineral Resource Estimate reflects a ~97.8% conversion of 2011 PEA Ultimate Pit Design Inferred Mineral Resources to Indicated Mineral Resources at comparable grades and a slightly lower strip ratio.

The net effect of optimized pit shell application for the 2019 Mineral Resource Estimate is to define reasonable prospects for economic extraction in the foreseeable future using conventional open-pit mining methods and therefore to not include certain portions of the

Lundberg mineral deposit that do not fall within the optimized shell volume. The material falling within the pit shell that meets the \$20 US/t NSR value defines the current Mineral Resource Estimate presented previously in Table 1-3 and Table 14-10 of this report. While the optimized pit for the 2019 Mineral Resource Estimate excludes significant volumes of mineralization within the Lundberg deposit occurring largely beneath the current pit shell bottom from classification as current Mineral Resources, pit optimization associated with future economic studies that reflect changes in metal prices or other parameters has the potential to include such mineralization in a future Mineral Resource Estimate

The current Mineral Resource Estimate upgraded the Lundberg deposit to a more robust, pit-constrained Mineral Resource, with 98.7% of the Mineral Resources in the Indicated category. The current Mineral Resource Estimate demonstrates that Lundberg's in-pit Mineral Resources contain more than 1.25 billion pounds zinc equivalent in the Indicated category. It is considered a potential open pit mine development project that is optimally situated on a brownfields site, with excellent infrastructure and a low strip ratio.

The Mineral Resource Estimate sensitivity assessment presented previously in Section 14 demonstrates that a high proportion of the contained metal is retained at higher cut-off thresholds (to \$50 US/t) and indicates that both lower grade - higher tonnage and higher grade - lower tonnage mining scenarios should be assessed in future economic studies. Potential also exists for future enhancement of Mineral Resources through refinement of pit optimization parameters, continued metallurgical studies, and future economic analysis.

## 26.0 RECOMMENDATIONS

### 26.1 Recommendations

#### 26.1.1 Mineral Resource Estimate and Economic Analysis Programs

Based on work carried out for the current Mineral Resource estimation project, Mercator is of the opinion that the Lundberg Deposit has been sufficiently delineated by drilling to support Pre-feasibility (PFS) of Feasibility level studies, and that additional infill resource delineation drilling is not required for this purpose.

The primary recommendation arising from the current Mineral Resource Estimate program is that an updated assessment of the Lundberg Deposit's economic potential be completed as the next phase of project evaluation. This could take the form of a new Preliminary Economic Assessment (PEA) or an internal economic study leading to a decision to proceed directly to a PFS assessment of Lundberg Deposit economics.

A recommended two phase estimated budget for such work is presented below in Table 26-1. PEA level studies are covered in Phase I, and Phase II constitutes a subsequent PFS level assessment. Commitment to Phase II program components is strongly dependent on substantively positive results being obtained from Phase I programs, but, Buchans may decide to proceed directly to Phase II before completion of Phase I.

As detailed below, additional metallurgical testing would be required to support a future PEA or PFS.

#### 26.1.2 Metallurgical Programs

Pre-concentration using dense media separation or ore sorting will improve mill feed grades, reduce the size of the milling facility or reduce mill feed transportation requirements should an off-site milling facility be considered. Future economic studies are therefore recommended to determine any potential savings with pre-concentration versus metal loss from the upgrading process.

With favorable open circuit test results and simulation results, the sequential flotation flowsheet is expected to produce improved results compared to the bulk Cu/Pb flowsheet. Therefore, continued development of the sequential flotation flowsheet for the Lundberg and Engine House

deposits is recommended to confirm the metallurgical performance. Testing for a PEA should include at minimum one composite sample, with open-circuit tests to better define reagent dosages, grind sizes and regrind sizes, followed by locked cycle flotation testing.

If testing of the sequential flowsheet is conducted for a Pre-Feasibility Study open circuit and locked cycle flotation testing on up to three composite samples is recommended. Final locked cycle flotation tailings solids should be characterized for acid generation and metals leachability, and liquid effluent should be subjected to a detailed analysis with respect to environmental discharge criteria. Additional concentrate dewatering tests are also recommended.

Phase I includes a budget to complete sequential flowsheet batch flotation testing and locked cycle flotation testing on one composite sample and Phase II includes a budget to complete sequential flowsheet batch flotation testing and locked cycle flotation testing on three distinct composite samples, tailings characterization, and concentrate dewatering tests. The following budgets assume existing metallurgical samples in freezer storage would be used for future testing and therefore costs to acquire additional new drill core samples are not included.

The potential benefits to the project of pre-concentration using dense media separation or ore sorting should also be determined in future economic studies

## **26.2 Estimated Budget for Recommended Work Programs**

Completion of the recommended work programs, excluding optional activities as set out above are estimated to require expenditure of \$2,105,000 (CAN) if completed under contract service conditions existing at the effective date of this report. Table 26-1 below presents a summary of anticipated costs.

**Table 26-1: Estimated Budget for Recommended Work Programs**

<b>Phase I</b>	<b>Estimated Cost (\$CAN)</b>
Recommended Preliminary Economic Assessment metallurgical testing	\$160,000
Completion of Preliminary Economic Assessment	\$125,000
<b>Sub-Total</b>	<b>\$285,000</b>
<b>Phase II</b>	
Recommend Pre-Feasibility metallurgical testing	\$370,000
Environmental, community, and claims management programs	\$250,000
Geotechnical and engineering studies	\$200,000
Completion of Pre-Feasibility Study	\$100,000
<b>Sub-Total</b>	<b>\$1,820,000</b>
<b>Completion of Phase I and II Total</b>	<b>\$2,105,000</b>

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Royal Roads Corp PR #09-08 May 30, 2008

Buchans River Ltd. PR #12-08 May 30, 2008

Buchans River Ltd. PR #14-07 Sept 10, 2007

**28.0 AUTHOR CERTIFICATES****Certificate of Qualified Person  
Matthew D. Harrington, P. Geo.**

I, Matthew D. Harrington, P. Geo., do hereby certify that:

1. I reside at 10 Commodore Road in Lewis Lake, Nova Scotia, Canada
2. I am currently employed as a Senior Resource Geologist with Mercator Geological Services Limited of 65 Queen St Dartmouth, Nova Scotia, Canada B2Y 1G4
3. I received a Bachelor of Science degree (Honours, Geology) in 2004 from Dalhousie University.
4. I am a registered member in good standing of the following professional associations: (1) Association of Professional Geoscientists of Nova Scotia, registration number 0254, and (2) Professional Engineers and Geologists of Newfoundland and Labrador, registration number 09541.
5. I have worked as a geologist in Canada since graduation.
6. I have read the definition of “Qualified Person” set out in National Instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “Qualified Person” for the purposes of NI 43-101.
7. I am one of the Qualified Persons responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019” and dated April 15, 2019.

I am responsible for Technical Report Items (Sections) 12, 14 and parts of Items 1, 25, and 26; and I have reviewed all Items of the Technical Report.

8. My relevant experience with respect to this project includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Atlantic provinces and elsewhere.
  9. I have no past involvement with the property that is the subject of this Technical Report.
-

10. I last visited the Lundberg Project between November 19<sup>th</sup> and November 21<sup>st</sup> of 2018 to carry out the site visit described in this Technical report. I was accompanied at that time by Paul Moore, P. Geo., Vice President of Exploration, with Buchans Resources Ltd..
11. I am independent of Buchans Resources Ltd., applying all of the tests in section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3
12. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
13. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

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Matthew D. Harrington, P. Geo.  
Senior Resource Geologist  
Mercator Geological Services Limited

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**Certificate of Qualified Person****Michael P. Cullen, P. Geo.**

I, Michael P. Cullen, P. Geo., do hereby certify that:

1. I reside at 2071 Poplar St. in Halifax, Nova Scotia, Canada
  2. I am currently employed as a Chief Geologist with Mercator Geological Services Limited, 65 Queen St., Dartmouth, Nova Scotia, Canada B2Y 1G4
  3. I received a Master of Science Degree (Geology) from Dalhousie University in 1984 and a Bachelor of Science Degree (Honours, Geology) in 1980 from Mount Allison University.
  4. I am a registered member in good standing of the Association of Professional Geoscientists of Nova Scotia (Registration Number 064), Newfoundland and Labrador Professional Engineers and Geoscientists (Member Number 05058) and Association of Professional Engineers and Geoscientists of New Brunswick, (Registration Number L4333).
  5. I have worked as a geologist in Canada and internationally since graduation.
  6. I have read the definition of “Qualified Person” set out in National Instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “Qualified Person” for the purposes of NI 43-101.
  7. I am one of the Qualified Persons responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019” and dated April 15, 2019  
  
I am responsible for parts of Technical Report Items (Sections) 1, 12, 14, 25, and 26; and I have reviewed all Items of the Technical Report
  8. My relevant experience with respect to this project includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Atlantic provinces and elsewhere.
  9. My past involvement with the property is that of a contributing author of the Technical Report titled “Mineral Resource Estimate Technical Report on the Lundberg Deposit, Buchans Area, Newfoundland, Canada, Effective Date: February 22<sup>nd</sup>, 2013”.
  10. I have visited the Buchans district many times. The most recent being October of 2017.
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11. I am independent of Buchans Resources Ltd., applying all of the tests in section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3.
12. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
13. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

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Michael P. Cullen, P. Geo.  
Chief Geologist  
Mercator Geological Services Limited

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**Certificate of Qualified Person**  
**Shaun D. O'Connor, P. Geo.**

I, Shaun D. O'Connor, P. Geo., do hereby certify that:

1. I reside at 146 High Street in Bedford, Nova Scotia, Canada
  2. I am currently employed as a Resource Geologist with Mercator Geological Services Limited of 65 Queen St Dartmouth, Nova Scotia, Canada B2Y 1G4
  3. I am a graduate of Carleton University, from which I received a Bachelor of Science degree( Hons.) in Earth Sciences in 2010, and Queen's University, from which I received a Master of Science degree in Geological Science in 2015.
  4. I am a registered member in good standing of the Association of Professional Geoscientists of Nova Scotia, Registration Number 0261, and Newfoundland and Labrador Professional Engineers and Geoscientists, Registration Number 09711.
  5. I have actively worked as a geologist since 2010 in the Yukon, Ontario, Quebec, and Nova Scotia
  6. I have read the definition of "Qualified Person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for the purposes of NI 43-101.
  7. I am one of the Qualified Persons responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019" and dated April 15, 2019.
    - I am responsible for parts of Technical Report Items (Sections) 1, 14, 25, and 26, and I have reviewed all Items of the Technical Report
  8. My relevant experience with respect to this project includes extensive professional experience with respect to data management, exploration activities, and deposit modelling in varied geological environments across Canada
  9. I have no past involvement with the property that is the subject of this Technical Report.
  10. I am independent of Buchans Resources Ltd., applying all of the tests in section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3
-

11. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
12. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

---

Shaun O’Connor, P. Geo.  
Resource Geologist  
Mercator Geological Services Limited

**Certificate of Qualified Person**  
**Timothy McKeen, P. Eng.**

I, Timothy McKeen, P. Eng., do hereby certify that:

1. I reside at 45 Lyndsay Lane in New Market, New Brunswick, Canada
2. I am currently employed as a Senior Process Engineer with Stantec Consulting Ltd., of Fredericton, New Brunswick, Canada.
3. I received a Bachelor of science degree in chemical engineering from University of New Brunswick in 2000, and a Master of science degree in chemical engineering from University of Saskatchewan in 2003.
4. I am a registered member in good standing of the following professional associations: (1) Engineers and Geoscientists New Brunswick, registration number M6082, and (2) Professional Engineers and Geoscientists of Newfoundland and Labrador, registration number 04709.
5. I have worked as a Professional Engineer in Canada since 2005.
6. I have read the definition of “Qualified Person” set out in National Instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “Qualified Person” for the purposes of NI 43-101.
7. I am one of the Qualified Persons responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019” and dated April 15, 2019.

I am responsible for Technical Report Item (Section) 13, and parts of Items 1, 14, 25 and 26.

8. My relevant experience with respect to this project includes extensive professional experience in mineral processing, metallurgical testing, process design and plant design for projects in Newfoundland and elsewhere.
  9. My past involvement with the Lundberg Deposit is as a co-author of the Report “Centralized Milling of Newfoundland Base Metal Deposits - Bench Scale DMS and Flotation Test Program” dated 2017.
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10. I am independent of Buchans Resources Ltd., applying all of the tests in section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3.
11. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
12. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

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Timothy McKeen, P. Eng.  
Senior Process Engineer  
Stantec Consulting Ltd.

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**Certificate of Qualified Person**  
**Wm Douglas Roy, M.A.Sc., P.Eng.**

I, Douglas Roy, P. Eng., do hereby certify that:

1. I reside at 35 Colindale St in Halifax, Nova Scotia, Canada
2. I am currently employed as a Mining Engineer with MineTech International Limited, located at 1161 Hollis St, Halifax, Nova Scotia, Canada B3H 2P6.
3. I graduated with a bachelor's degree in Mining Engineering from the Technical University of Nova Scotia, now Dalhousie University, in 1997. In addition, I graduated with a Master of Applied Science in Mining Engineering from DalTech, now Dalhousie University, in 2000.
4. I am a member of the Association of Professional Engineers of Nova Scotia (APENS), Registration Number 11701.
5. I have worked as an Engineer in Canada for over twenty years.
6. I am one of the Qualified Persons responsible for preparation of the Technical Report titled "NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019" and dated April 15, 2019.

I am responsible for parts of Technical Report Items (Sections) 1, 14, and 25.

7. My relevant experience with respect to this project includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Atlantic provinces and elsewhere.
  8. I have no past involvement with the property that is the subject of this Technical Report.
  9. I am independent of Buchans Resources Ltd., applying all of the tests in section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3
  10. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
  11. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.
-

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

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Wm Douglas Roy, M.A.Sc., P.Eng.  
Mining Engineer  
MineTech International Limited

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**Certificate of Qualified Person****Paul Moore, P. Geo.**

I, Paul Moore, P. Geo., do hereby certify that:

1. I reside at 25 Fagan Drive in St. John's, Newfoundland and Labrador, Canada
2. I am currently employed as Vice President of Exploration with Buchans Resources Limited, Suite 320, 44 Torbay Road, St. John's, Newfoundland and Labrador, Canada A1A 2G4.
3. I received a Master of Science degree in Earth Sciences from Memorial University in 1990.
4. I am a registered member in good standing of the following professional associations: Professional Engineers and Geologists of Newfoundland and Labrador, registration number 03884.
5. I have worked as a geologist in Canada since graduation.
6. I have read the definition of "Qualified Person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for the purposes of NI 43-101.
7. I am one of the Qualified Person responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019" and dated April 15, 2019.

I am responsible for Technical Report Items (Sections) 2-11, 15-24, and parts of Items 1 and 12; and I have reviewed all Items of the Technical Report

8. My relevant experience with respect to this project includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Atlantic provinces and elsewhere.
  9. I last visited the Lundberg Project between November 19<sup>th</sup> and November 22<sup>nd</sup> to carry out the site visit described in this Technical Report
  10. I am an employee of Buchans Resources Limited, applying all of the tests in Section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3
-



11. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
12. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

---

Paul Moore, P. Geo.  
Vice President of Exploration  
Buchans Resources Limited

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**Certificate of Qualified Person**  
**David Butler, P. Geo**

I, David Butler, P. Geo., do hereby certify that:

1. I reside at 68 Regent Street in St. John's, Newfoundland and Labrador, Canada
2. I am currently employed as Exploration Manager with Buchans Resources Limited, of Suite 320, 44 Torbay Road, St. John's, Newfoundland and Labrador, Canada A1A 2G4.
3. I received a Bachelor of Science degree in Earth Sciences from Memorial University in 1987.
4. I am a registered member in good standing of the following professional associations: Professional Engineers and Geologists of Newfoundland and Labrador, registration number 03045.
5. I have worked as a geologist in Canada since graduation.
6. I have read the definition of "Qualified Person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for the purposes of NI 43-101.
7. I am one of the Qualified Person responsible for preparation of the Technical Report titled NI 43-101 TECHNICAL REPORT AND MINERAL RESOURCE ESTIMATE ON THE LUNDBERG DEPOSIT, BUCHANS AREA, NEWFOUNDLAND, CANADA, Effective Date: February 28, 2019" and dated April 15, 2019.

I am responsible for Technical Report Items (Sections) 2-11, 15-24, and parts of Items 1 and 12; and I have reviewed all Items of the Technical Report.

8. My relevant experience with respect to this project includes extensive professional experience with respect to geology, mineral deposits and exploration activities in the Atlantic provinces and elsewhere.
  9. I last visited the Lundberg Project between November 19<sup>th</sup> and November 22<sup>nd</sup> to carry out the site visit described in this Technical Report.
  10. I am an employee of Buchans Resources Limited, applying all of the tests in Section 1.5 of National Instrument 43-101 and National Instrument 43-101 Companion Policy Section 5.3
-

11. I have read National Instrument 43-101, Form 43-101F1 and the Companion Policy and believe that this Technical Report has been prepared in compliance with that Instrument and Form.
12. As of the date of this certificate, to the best of my knowledge, information and belief, this Technical Report contains all scientific and technical information that is required to be disclosed to make this Report not misleading.

Dated this 15<sup>th</sup> day of April, 2019

*“Original signed and stamped by”*

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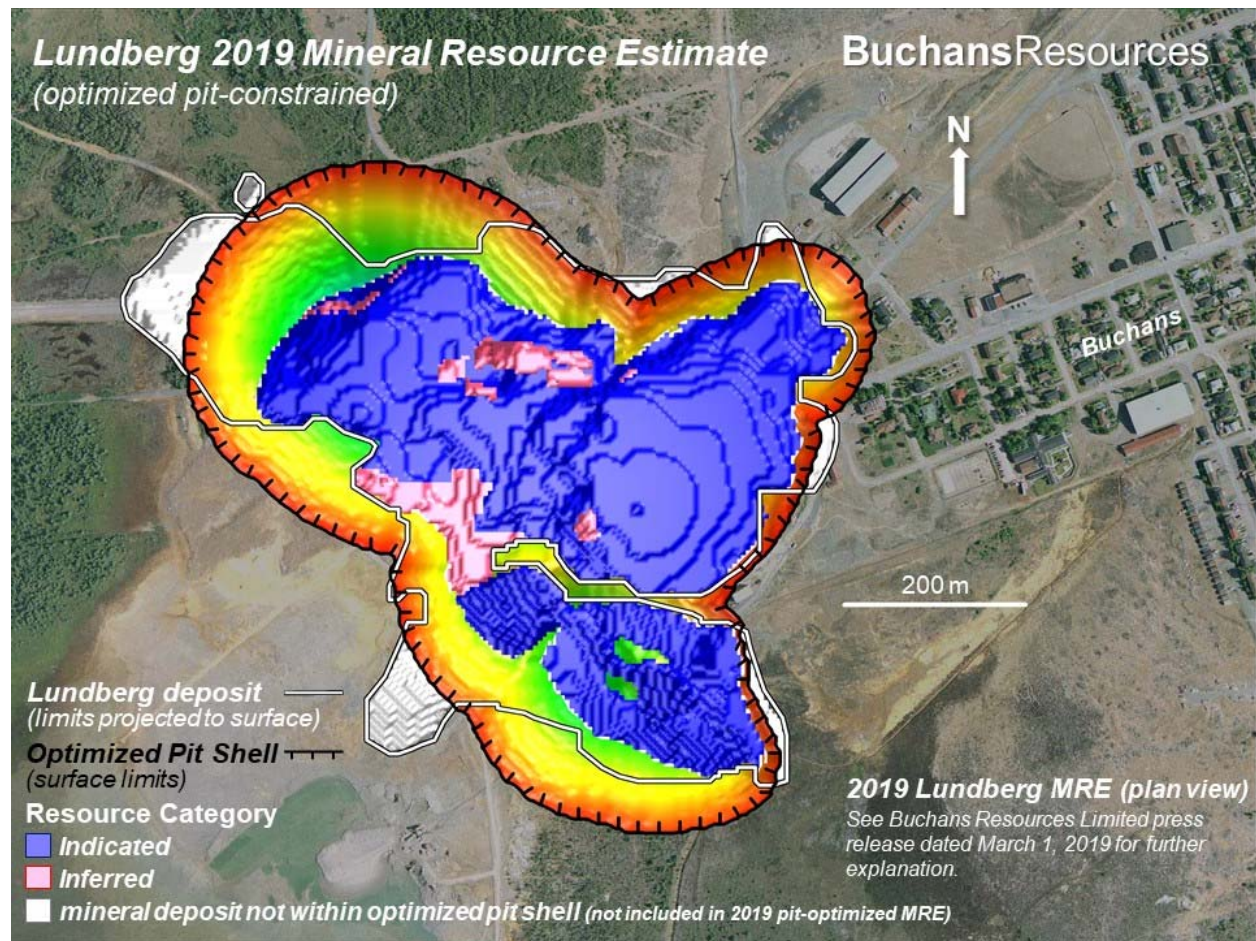
David Butler, P. Geo.  
Exploration Manager,  
Buchans Resources Limited

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**29.0**

**Appendix 1**

March 1<sup>st</sup>, 2019 Buchans Press Release Graphics of Block Model and Optimized Pit



**Lundberg 2019 Mineral Resource Estimate**  
(optimized pit-constrained)

**BuchansResources**

