Teck

NI 43-101 Technical Report
Red Dog Mine
Alaska, USA

Report prepared for Teck Resources Limited

Effective Date: 31 December 2016
Report Date: 21 February 2017

Qualified Persons:
Thomas Krolak, RM SME
Kevin Palmer, P.Geo.
Brigitte Lacouture, PE
Norman Paley, PE

Certificate of Qualified Person

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I, Thomas Krolak, RM SME, am employed as the Principal Geologist, Reserves for Teck Alaska Incorporated, a subsidiary of Teck Resources Limited ("Teck") at the Red Dog Mine.

This certificate applies to the report titled "NI 43-101 Technical Report, Red Dog Mine, Alaska, USA" with an effective date of 31 December, 2016 (the "Report").

I graduated from the University of Missouri at Rolla with a Bachelor of Science (B.S.) degree in Geology in 1985. I am a Registered Member in good standing of the Society for Mining, Metallurgy and Exploration (RM SME; #4170226) and a Registered Geologist in the State of Missouri (#643).

Since 1987 I have been employed in the United States as a geologist at zinc and lead mining operations. I have been responsible for reporting reserves and resources for the Red Dog Mine since 2001.

I have worked at the Red Dog Mine since 1991, and this familiarity with the operations serves as my scope of personal inspection. As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43-101 *Standards of Disclosure for Mineral Projects* ("NI 43-101").

I am responsible for items 1.1-1.7, 1.9, 1.15, 2, 4, 5, 6, 7.1, 7.2, 7.4, 7.5, 8, 9, 10, 11, 12, 14.1-14.4, 14.6-14.10, 15, 23, 24, 25.1, 25.2, 25.4, 25.5, 25.7, 25.8, 26, and 27.

I am not independent of the issuer, Teck, as described in section 1.5 of NI 43-101.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As at the effective date of the Report, to the best of my knowledge, information, and belief, the sections of the Report that I am responsible for contain all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated: 21 February 2017

"signed and stamped"
Thomas Krolak, RM SME

Certificate of Qualified Person

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I, Kevin Palmer am employed as a Principal Geostatistician for Teck Resources Limited (“Teck”).

This certificate applies to the report titled “NI 43-101 Technical Report, Teck Resources Limited, Red Dog Mine 2016 Update (the “Report”) with an effective date of 31 December, 2016 (the “Report”).

I graduated from the University of the Witwatersrand, Johannesburg, South Africa in 1984 with a Bachelor of Science Honours (B.Sc. (Hons)) degree in Geology. I am a member of the Association of Professional Engineers and Geoscientists of British Columbia, member # 30020.

I have worked in underground and open pit base metal mines for 14 years and have been performing mineral resource estimates for 12 years. These estimates have included zinc deposits in Peru and Alaska, USA.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I have visited the Red Dog Mine site on a regular basis since 2012. My most recent visit was from the 27th July until the 3rd August 2016.

I am responsible for items 1.9, 1.15, 2, 3, 7.3, 14.1-14.4, 14.6-14.10, 25.1, 25.7, 26, and 27.

I am not independent of the issuer, Teck, as described in section 1.5 of NI 43-101.

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Dated: 21 February 2017

”signed and sealed”
Kevin Palmer, P.Geo.

Certificate of Qualified Person

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I, Brigitte Lacouture, PE, am employed as Operating Superintendent, Mill with Teck Alaska Incorporated, a subsidiary of Teck Resources Limited ("Teck").

This certificate applies to the report titled "NI 43-101 Technical Report, Red Dog Mine, Alaska USA" that has an effective date of 31 December, 2016 (the "Report").

I graduated with a Bachelor of Engineering (B. Eng.) degree from McGill University in 1987 and a Master of Engineering Science (M.EngSc.) degree from the University of Queensland in 1989. I am a registered professional engineer in the mining and mineral processing discipline in the state of Alaska. My license number is EM13665.

I have worked as a mineral processing engineer for over 25 years mostly in base metal mineral processing. I have practiced my profession since 1989. I have been directly involved in geo-metallurgy and flow sheet design of Pb/Zn concentrators at both Mt Isa Mines and the Red Dog Mine. I have obtained operational metallurgical experience with increasingly senior and supervisory roles at both these sites.

I have worked at the Red Dog Mine since 1996, and this familiarity with the operations serves as my scope of personal inspection. As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* ("NI 43–101").

I am responsible for items in sections 1.8, 1.11, 1.15, 2, 13, 17, 25.1, 25.6, 25.10, 26, and 27.

I am not independent of the issuer, Teck, as described in section 1.5 of NI 43-101.

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As at the effective date of the Report, to the best of my knowledge, information, and belief, the parts of the Report that I am responsible for contain all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated: 21 February 2017

"signed and sealed"

Brigitte Lacouture, PE

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I, Norman Paley, PE, am employed as Principal Engineer, Long Range Planning for Teck Alaska Incorporated, a subsidiary of Teck Resources Limited ("Teck").

This certificate applies to the report titled "NI 43-101 Technical Report, Red Dog Mine, Alaska, USA" that has an effective date of 31 December, 2016 (the "Report").

I graduated with a Bachelor of Engineering (B. Eng) degree from McGill University in 1987 and a Master of Engineering Science (M.EngSc.) degree from the University of Queensland in 1989. I am a registered professional engineer in the mining and mineral processing discipline in the state of Alaska. My license number is EM14068.

I have worked as a mining engineer for over 25 years mostly in base metal open pit and underground mines. I have practiced my profession since 1989. I have been directly involved in both Mineral Resource and Mineral Reserve estimation, life of mine planning, pit optimization, open pit geotechnical investigations, mining operations feasibility studies, and mining capital and operating cost estimation.

I have worked at the Red Dog Mine since 1996, and this familiarity with the operations serves as my scope of personal inspection. As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* ("NI 43–101").

I am responsible for items in sections 1.9-1.10, 1.12-1.15, 2, 14.5, 14.8, 15, 16, 18, 19, 20, 21, 22, 25.1, 25.3, 25.7-25.9, 25.11-25.14, 26, and 27.

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I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As at the effective date of the Report, to the best of my knowledge, information, and belief, the parts of the Report that I am responsible for contain all scientific and technical information that is required to be disclosed to make the Report not misleading.

Dated: 21 February 2017

"signed and sealed"

Norman Paley, PE

Cautionary Statement on Forward Looking Information

This Report includes forward-looking statements. All statements other than of historical fact regarding Teck or Red Dog are forward-looking statements. The forward-looking statements in this Report include statements with respect to projected capital and operating costs, mine life and production rates, potential mineralization and metal or mineral recoveries, mineral reserve and mineral resources, availability of infrastructure, statements that there are no metallurgical, environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant issues not discussed in the Report that may affect the mineral resource or mineral reserve estimates, statements with respect to future metal prices, exchange rates, and concentrate sales contracts; royalty terms; assumed mining and metallurgical recovery factors; he timing and amount of estimated future production, costs of production relevant to a remote mining operation in Alaska; timing of the development of new open pit pushbacks; technological changes to the mining, processing and waste disposal activities outlined; permitting time lines for tailings dam lifts; statements regarding the development of the mine and deposits; government regulation of mining operations; environmental risks; and ability to retain social licence for operations.

All forward-looking statements are based on opinions, assumptions and estimates and are subject to risks and uncertainties. Inherent in forward-looking statements are risks and uncertainties beyond our ability to predict or control, including risks that may affect our operating or capital plans; risks generally encountered in the permitting and development of mineral properties such as unusual or unexpected geological formations, unanticipated metallurgical difficulties, delays associated with permit appeals or other regulatory processes, ground control problems, adverse weather conditions, process upsets and equipment malfunctions; risks associated with labour disturbances and availability of skilled labour; risks associated with fluctuations in the market prices of our principal commodities, which are cyclical and subject to substantial price fluctuations; risks created through competition for mining and oil and gas properties; risks associated with lack of access to markets; risks associated with mineral resource and reserve estimates; risks posed by fluctuations in exchange rates and interest rates, as well as general economic conditions; risks associated with access to capital; risks associated with environmental compliance, changes in environmental legislation and regulation; risks associated with our dependence on third parties for the provision of transportation and other critical services; risks associated with non-performance by contractual counterparties.

Actual results and developments may differ materially, from those expressed or implied by the forward-looking statements contained in this Report. Such statements are based on a number of assumptions which may prove to be incorrect, including, but not limited to, assumptions about commodity prices, grades, our ability to obtain, comply with and renew permits in a timely manner; the accuracy of our reserve and resource estimates (including, with respect to size, grade and recoverability) and the geological, operational and price assumptions on which these are based; our ability to procure equipment and operating supplies in sufficient quantities and on a timely basis; the availability of qualified employees and contractors for Red Dog, including our new developments.

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1 SUMMARY

1.1 Introduction

A technical report (the Report) has been prepared for Teck Resources Limited in compliance with National Instrument 43-101 “Standards of Disclosure for Mineral Projects” (NI 43-101) on the Red Dog mining operation (the Red Dog Mine or the Project), located in Alaska. As used in this report, “Teck” refers to Teck Resources Limited or its wholly owned subsidiaries, as applicable.

The Report is used in support of Teck’s annual information form (AIF) filing and in support of updated Mineral Resource and Mineral Reserve estimates for the operation.

1.2 Property Description, Location, and Access

The Red Dog Mine is situated about 1,000 km north of Anchorage, 144 km north of Kotzebue and 140 km north of the Arctic Circle at an approximate latitude of 68°4′30″N and longitude of 162°49′44″W. The mine is 84 km inland from a shallow tidewater port on the Chukchi Sea, which is only open to shipping 100 days per year. A paved airstrip 5.5 km southwest of the mine supports jet access from Anchorage and Kotzebue.

The mine site is located on a ridge between the Middle and South Forks of Red Dog Creek, in the DeLong Mountains of the Western Brooks Range. The topography is moderately sloping, with elevations ranging from 260 m to 1,200 m above sea level. Permafrost has developed to depths more than 90 m. Vegetation is classified as woody tundra.

The Arctic climate is cold to very cold, with temperatures fluctuating seasonally from a low of about -41ºC to summer peaks of 16ºC. Precipitation is concentrated mainly in the summer months, increasing in June and reaching a peak during late August. Mining activities are conducted year-round.

The property consists of (i) a mining lease on land owned by the NANA Regional Corporation (NANA) and (ii) 2,479 Alaska state mining claims held in three separate claim blocks: Noatak, JAH and GOS. Seven deposits have been identified: Qanaiyaq, Main, Aqqaluk, Paalaaq, Aŋarraaq, Su and Aktigiruq. The Aqqaluk, Main, Qanaiyaq and Paalaaq deposits are situated within the NANA-TAK mining lease. The Aŋarraaq, Su and Aktigiruq deposits are within the Noatak block of state mining claims. The mine plan assumes mining of the Aqqaluk and Qanaiyaq deposits. The Main deposit is mined out; Mineral Resources are estimated currently at the Paalaaq and Aŋarraaq deposits.

Teck’s subsidiary, Teck Alaska Incorporated (TAK) operates the Red Dog Mine under the terms of a Mining Lease and Development and Operating Agreement with NANA. Under the agreement, TAK leases the property from NANA, operates the mine, and markets the concentrate produced. TAK pays NANA royalties on production from the Project. In addition to the royalties payable to NANA, the operation is subject to state and federal income taxes, and Alaskan mining taxes.

1.3 History

Cominco Ltd., now a subsidiary of Teck, acquired the Red Dog Mine area in 1978. Prior to commencement of mining activities in 1989, work completed had included geological mapping, geochemical sampling (rock chip, soil, stream sediment) ground and airborne geophysical surveys (gravity, downhole radial induced polarization (IP)), metallurgical testwork and mining studies.

Production commenced from the Main deposit in 1989 and was completed in 2012; production from Aqqaluk began in 2010 and the pit continues being mined. Pre-stripping started in Qanaiyaq in 2016. Production from the Red Dog Mine through 2016 has been 78,257,035 t milled, yielding 22,650,468 t of zinc concentrate, 4,324,691 t of lead concentrate and 201,173 t of Imperial Smelter Feed (ISF) concentrate.

1.4 Geological Setting, Mineralization, and Deposit Types

The Red Dog deposits are considered examples of clastic-dominated sediment hosted lead–zinc deposits.

The Red Dog district deposits are found in the basal allochthon, the Endicott Mountains allochthon, of the seven allochthons that make up the western Brooks Range. The structurally higher allochthons were emplaced prior to the emplacement of the lower ones. Each consists of subhorizontal sheets that are characterized by complex internal imbrication, duplex structures, and antiformal stacks, all of which are cut by late strike–slip and extensional faults. The Endicott Mountains allochthon consists of three tectonostratigraphically coherent and distinct thrust plates: the Wolverine Creek, Red Dog, and Key Creek plates. The Red Dog plate is detached in incompetent shales of the Kuna Formation and structurally overlies the Wolverine Creek plate and underlies the Key Creek plate. Mineralization in the mine area was broadly contemporaneous with deposition of the Kuna Formation.

The Red Dog mine area deposits consist of four stacked and complexly-deformed mineralized bodies that are contained in the Red Dog thrust plate. They have been structurally detached from their original footwalls and are imbricated in separate thrust sheets, positioned from highest to lowest and south to north: Qanaiyaq, Main, Aqqaluk and Paalaaq. Aŋarraaq is located about 10 km northwest of the Red Dog Mine at depths of 600–700 m, and situated within a shallowly southwesterly-dipping thrust panel of Red Dog stratigraphy. The Aktigiruq deposit is situated directly to the north of the Aŋarraaq deposit and roughly 12 km to the northwest of the Red Dog Mine. The Su deposit is located 22 km northwest of the Red Dog Mine.

The Red Dog deposits have similar host rock lithologies, mineral assemblages, and degrees of silicification, but differ in thicknesses, proportions of mineralization types and styles, and average grades. From base to top, the mine deposits are generally characterized by sulphide veins and breccias, massive sulphide, silica rock or silicified barite, sulphide-bearing barite and sulphide-poor barite. Brief deposit descriptions follow for those deposits where Mineral Resources and Mineral Reserves have been estimated:

- Aqqaluk: lies directly to the north of the Main deposit, demarcation of the deposit is arbitrary and defined as any mineralization that is potentially mineable by open pit methods, which lies north of the roughly east–west line made by Shelly Creek and Red Dog Creek; dimensions of 700 m east–west, 600 m north–south and up to 150 m thick;
- Paalaaq: arcuate-shaped mineralized zone lying to the north of the Aqqaluk deposit; dimensions of 1,200 m long in a north–south direction, is 100 m to 200 m wide from east to west and up to 60 m thick;
- Qanaiyaq: 600 m to the south of the Main deposit; contained within a 600 m x 850 m klippe. Has elevated zinc and lead grades compared to the other mine-area deposits;
- Aŋarraaq: elongate lens-shaped massive sulphide body; dimensions of 1,000 m long, 500 m wide and up to 80 m thick.

Most of the Aqqaluk and Qanaiyaq mineralization is massive and unbedded, consisting of abundant sulphide grains and aggregates disseminated in a dense silica matrix. There is an apparent geochemical zoning, with Qanaiyaq and the Main deposit having higher average lead and zinc grades than Aqqaluk and Paalaaq. Vertical geochemical zoning, based on Zn:Fe and Zn:Pb ratios, is also evident. Mineralization at Aŋarraaq and Aktigiruq ranges from laminated or banded to brecciated. Sulphide mineralization consists of semi-massive to massive sphalerite, pyrite, marcasite and galena. Textures include massive, fragmental and veined types. Sedimentary layering within the sulphide zones is rare.

1.5 Exploration

Since 2004, Teck has focused exploration in the Red Dog area into a systematic pipeline approach that has included detailed mapping, soil and stream sampling and various airborne and ground geophysical techniques to identify prospects that could be tested via core drilling. Beyond those deposits discussed in this report, exploration to date has not identified any additional economic mineralization. Teck continues to identify, define, and test additional targets throughout the district.

1.6 Drilling

Since 1977 Teck, and its predecessor entities, has drilled 394,244.7 m in 2,019 holes in the Red Dog district. This drilling consists of 150,763 m (359 holes) of exploration and 243,482 m (1,660 holes) for definition purposes. Drilling has been primarily core, with reverse circulation drilling (RC) used in some of the early delineation programs from 1991 to 1997. In general, most core holes were collared using HQ (62.3 mm core diameter) and reduced to NQ (48 mm) at depth. Drill hole orientations are typically vertical, and intersect the mineralization at an angle. Drilled width for mineralization is typically greater than the mineralization true width.

Core recoveries have been recorded, and are generally good, except in localized areas of faulting or fracturing, or in surface oxidized rock. RC chip and core sample collection and sample handling has been undertaken in accordance with normal industry practices. Core is photographed. Core and RC chips are logged for geological parameters and core is also geotechnically logged.

Drill collars are surveyed in the mine area; the mine's surveyors, with the exception of some of the more remote and pre-1985 holes, have surveyed the collar locations of most of the exploration holes outside the mine area. Since 1997, all holes that are 150 m or greater in depth have been surveyed with a down hole instrument.

1.7 Sampling, Analysis, and Data Verification

Sampling for resource estimation has been conducted on drill core and RC chips obtained from holes drilled between 1980 and 2016. RC chips were collected on 1.5 m intervals. Core samples are selected based on the visual presence of trace mineralization, and sampling extends approximately 7.6 m above and below mineralization. Prior to 2014, a pneumatic splitter was used to split samples. Since 2014, samples have been cut using an automatic circular saw, in which core is fed through the saw using plastic trays and an automatic core feeding system. One half of the core is sent for sampling and the other half remains in the core box as a permanent record. Some core may be fully consumed if required for metallurgical testwork purposes. Grade control samples are taken from every other hole in a blast pattern using a pipe sampler that is closed at the base.

A combination of independent and non-independent laboratories have been used for sample preparation and analysis. Non-independent and non-certified primary laboratories include Cominco Ltd.'s Vancouver Exploration Research Laboratory (ERL; pre-mine startup), and the Red Dog Mine assay laboratory (RDM-AL; sample preparation and analysis from 1990 to date). Independent certified primary laboratories used have included Acme Commodities Canada Ltd (Acme; check analysis from 2010–2011) and Bureau Veritas Commodities Canada Ltd (BV, formerly Acme; sample preparation and sample analysis from 2013 to date). Acme and BV held either ISO 9001 and/or ISO/IEC 17025 accreditations for specific methods at the time. The RDM-AL and ALS Vancouver both serve as check assay laboratories for BV for exploration samples. ALS Vancouver holds ISO/IEC 17025 accreditations for specific analytical methods.

At present, no drill core is sent to the RDM-AL. The RDM-AL routinely processes production blasthole, mill, concentrate and environmental samples. Sample preparation methods included drying, crushing to 90% passing 2 mm and pulverizing to 90% passing -125 mesh. Analysis is performed using atomic absorption (AA), X-ray fluorescence (XRF) or Leco methods. Elements analyzed for include zinc, lead, iron, barium, silica, silver, cadmium (concentrates only), copper, elemental sulphur, and total organic carbon. The laboratory uses a quality assurance and quality control (QA/QC) procedure that includes blank, duplicate, and standard reference (SRM) materials.

The BV protocol is to dry the samples, crush to 80% passing 10 mesh, and pulverize to 85% passing 200 mesh. Analysis uses AA and XRF methods, depending on the element. BV reports analytical values for lead, zinc and copper, and a multi-element suite that includes Ag and Au. Teck submits blank, duplicate and SRM materials in each batch of samples for analysis.

Density values are determined by Teck personnel, using tonnage-factoring formulae. A selected number of core samples are sent to BV for routine determination of density to compare against the formula-derived tonnage factor for QA/QC purposes.

Methods and procedures used in sampling and analysis are consistent with industry standard practices and are considered to produce sufficiently accurate and precise data that are suitable for use in Mineral Resource and Mineral Reserve estimation.

Regular data verification is undertaken on the Project database by Teck personnel. In addition, regular data verification programs have also been undertaken by third-party consultants. The Red Dog Mine has been in operation for 26 years, and has acceptable reconciliation data.

The results of these work programs indicate that the data collected from the Project acceptably support the geological interpretations and the database quality, and therefore support the use of the data in Mineral Resource and Mineral Reserve estimation, and in mine planning.

1.8 Mineral Processing and Metallurgical Testing

Metallurgical testwork completed in support of the initial mill design included mineralogical analysis, and comminution, locked and open cycle, flotation, and thickening tests. A number of modifications and improvements have been made to the plant over the 26-year operational history. The majority of the initial testwork was conducted over the Main deposit. The mill feed material for the remaining mine life is to be sourced from the Aqqaluk and Qanaiyaq deposits.

Metallurgical testing of both Aqqaluk and Qanaiyaq deposits have been performed using a multi-phase approach. Completed testwork has included comminution, open and locked cycle tests, and geo-metallurgical evaluations. The impact of blending ores from the two deposits was also reviewed.

Universal recovery formulae were developed from the testwork; a regular model and a specific model for rock with high barium and low zinc and low iron for Aqqaluk; a regular model that incorporates the degree of weathering, measured by the ratio of non-sulphide lead to total lead, and the copper grade, and a specific model that covers more highly weathered ore, but with low copper grades at Qanaiyaq. In Aqqaluk, concentrate grades are 55% zinc in zinc concentrate and 54% lead in lead concentrate except in a small zone of intersection between the Paalaaq structural plate and the Aqqaluk pit. In this area the concentrate grades are 60% and 48.8% respectively for veined ore, 49.6% and 48.6% respectively for siliceous ore, and 55% and 54%, respectively for baritic ore. In Qanaiyaq, concentrate grades are 50% for both zinc in zinc and lead in lead concentrates.

Iron as pyrite is the primary deleterious element with regards to metallurgical recovery with high absolute amounts or high ratios of iron as pyrite to zinc or to lead having an adverse effect. Silica is the primary deleterious element with regards to metallurgical throughput with high absolute amounts having an adverse effect. Weathering is also a deleterious process which impacts both lead and zinc metallurgy.

1.9 Mineral Resource and Mineral Reserve Estimates

Mineral Resource and Mineral Reserve estimates were performed by Teck personnel.

1.9.1 Mineral Resources

Mineral Resources are estimated for the Aqqaluk, Qanaiyaq, Paalaaq and Aŋarraaq deposits. A conventional estimation methodology is used. Initially, geological domains were modelled. Depending on the deposit, consideration of structural and waste domains may be incorporated. Drill data were subject to exploratory data analysis to determine data relationships and domain boundaries to be used during modelling. Aqqaluk, Qanaiyaq, and Paalaaq drill holes were composited to 3.8 m lengths, whereas the Aŋarraaq composites were 1.5 m lengths. A review of grade outliers was conducted, and higher-grades capped where warranted. Experimental variography was conducted for zinc, lead, iron, barium, silver, non-sulphide lead, elemental sulphur, total organic carbon and, for Qanaiyaq only, copper. Block sizes within the block models were variable by deposit, ranging from 7.6 m x 7.6 m x 7.6 m at Aqqaluk and Qanaiyaq, to 30.5 m x 30.5 m x 3.8 m at Paalaaq, and 30.5 m x 30.5 m x 1.5 m at Aŋarraaq. Sub-blocking to 1.5 m x 1.5 m x 0.8 m was used at Paalaaq and Aŋarraaq to better define the mineralization shapes.

Metal grades for all four deposits were estimated with a three-pass interpolation methodology using drill hole composites that respect lithological and/or grade domains. At Aqqaluk, Qanaiyaq and Paalaaq, zinc, lead, iron, barium, silver, non-sulphide lead, elemental sulphur and total organic carbon are interpolated using ordinary kriging (OK). At Aŋarraaq zinc, lead, iron, barium and silver are interpolated using ordinary kriging (OK). The same search criteria are used for each variable in each domain for Aqqaluk and Qanaiyaq. In contrast, the elemental suite at Paalaaq and Aŋarraaq used search criteria that varied by variable and domain. Limits were placed on the minimum and maximum numbers of composites required for interpolation, and the number of composites that could come from a single drill hole. Bulk density was estimated for each block based on a formula that was applied to the estimated assays. The estimates were validated using inverse distance squared (ID) and nearest neighbour (NN) methods, visual inspection, global statistical comparisons, and swath and volume–variance plots. No significant biases were observed from the checks.

Indicated and Inferred confidence classifications were assigned to the model blocks based on distance to the nearest drill hole criteria that varied by deposit. No Measured Mineral Resources are reported. Reasonable prospects for eventual economic extraction were assessed by applying constraining pit shells to the mineralization considered amenable to open pit mining methods at Aqqaluk and Qanaiyaq, and conceptual long-hole stopes to the mineralization considered amenable to underground mining methods at Paalaaq and Aŋarraaq.

Mineral Resources in Table 1-1 are reported using the 2014 Canadian Institute of Mining, Metallurgy and Petroleum (CIM) *Definition Standards for Mineral Resources and Mineral Reserves* (2014 CIM Definition Standards). The estimates have an effective date of 31 December, 2016, and are reported exclusive of Mineral Reserves. The Qualified Person (QP) for the Aqqaluk, Qanaiyaq and Paalaaq Mineral Resource estimate is Mr. Thomas Krolak RM SME, Principal Geologist at Red Dog Mine and a TAK employee. The QP for the Aŋarraaq estimate is Mr. Kevin Palmer P. Geo., Principal Geostatistician at Teck in Vancouver, BC.

Table 1-1: Red Dog Indicated and Inferred Mineral Resources as at December 31, 2016

Resource Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Indicated	Aqqaluk Indicated – Mill Feed	9,770	7.1	2.2	38
	Aqqaluk Indicated – LG Stockpile	3,200	4.3	2.4	38
	Qanaiyaq Indicated – Mill Feed	480	14.4	5.4	118
	Qanaiyaq Indicated – LG Stockpile	50	8.1	2.7	52
	Paalaaq Indicated – Mill Feed	2,910	12.3	4.2	91
Indicated Resource Total		***16,410***	***7.7***	***2.7***	***50***

Resource Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Inferred	Aqqaluk Inferred – Mill Feed	410	9.6	3.1	63
	Aqqaluk Inferred – LG Stockpile	80	3.9	2.8	45
	Paalaaq Inferred – Mill Feed	6,110	12.3	4.7	89
	Aŋarraaq Inferred – Mill Feed	19,440	14.4	4.2	73
Inferred Resource Total		***26,040***	***13.8***	***4.3***	***77***

Note to accompany Mineral Resource Tables

1. Tom Krolak, RM SME, Principal Geologist at Red Dog Mine is the Qualified Person responsible for the Aqqaluk, Qanaiyaq, and Paalaaq Mineral Resource estimates.
2. Kevin Palmer, P.Geo., Principal Geostatistician at Teck Resources Limited, is the Qualified Person responsible for the Aŋarraaq Mineral Resource estimate.
3. Mineral Resources have the following reporting dates: Aqqaluk and Qanaiyaq, 31 December 2016; Paalaaq, 17 December 2016; and Aŋarraaq, 19 August 2016.
4. Aqqaluk and Qanaiyaq are being mined using open pit mining methods. Metal prices used for NSR calculation were $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag. The reported numbers for mill feed are at cutoffs of $4.60 per second milled, pre-VIP2, and $3.60 per second milled, post-VIP2, and represents mill feed that is to be mined and directly processed. The VIP2 project is planned to include modifications to the grinding and flotation circuits. Metallurgical recoveries for mill feed for Aqqaluk are variable based on grade and rock type and average 81.5% for Zn, 40.4% for Pb, and 58.1% for Ag. Metallurgical recoveries for mill feed for Qanaiyaq are variable based on grade and rock type and average 39.0% for Zn, 18.9% for Pb, and 32.2% for Ag. The reported numbers for LG stockpile are at a cutoff of $0.00 per second milled; this material will be fed to the mill at the end of mine life. Metallurgical recoveries for LG stockpile for Aqqaluk are variable based on grade and rock type and average 72.2% for Zn, 53.4% for Pb, and 47.4% for Ag. Metallurgical recoveries for the LG stockpile for Qanaiyaq are variable based on grade and rock type and average 54.8% for Zn, 53.2% for Pb, and 45.4% for Ag.
5. No allowances for mining recovery and external dilution have been applied. Contact dilution between the 7.6 m x 7.6 m x 7.6 m blocks was applied.
6. The pit shell constraining the Aqqaluk estimate used the following assumptions: metal prices of US$0.75/lb Zn, US$0.68/lb Pb, and US$15.00/oz Ag; site costs of $2.78/t waste mining and $2.86/t mill feed mining, plus a vertical component per bench of US$0.0182/t (± 875 ft elevation) and $57.71/t mill feed process and G&A; and inter-ramp pit slope angles that ranged from 41–47°. The pit shell constraining the Qanaiyaq estimate used the following assumptions: metal prices of US$1.00/lb Zn, US$0.90/lb Pb, and US$20.00/oz Ag, site costs of $2.02/t waste mining and $2.37/t mill feed mining plus a vertical component per bench of US$0.0182/t (± 1325 ft elevation) and $57.93/t mill feed process and G&A; and inter-ramp pit slope angles that ranged from 26–37°.
7. Paalaaq and Aŋarraaq are expected to be mined using an underground mining method. The reported numbers are those from open stope shapes with a maximum size of 15 m x 30 m x 50 m generated in Vulcan Stope Optimizer using $100 NSR as a cutoff. Isolated stope shapes were ignored. Metallurgical recoveries for Paalaaq are based on rock type and average 55.1% for Zn, 54.2% for Pb and 65.0% for Ag. At Aŋarraaq a standard recovery was used for all domains and

this was 80.0% for Zn, 53.0% for Pb and 65.0% for Ag. Metal prices used for the NSR calculation were $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag. No dilution factor has been applied.

8. Numbers have been rounded for the individual entries so totals and weighted averages for the variables may vary slightly.
9. Mineral Resources are reported exclusive of Mineral Reserves and do not have demonstrated economic viability.
10. Reporting units are metric: Tonnes, dry metric tonnes; Zn and Pb percent (%); and Ag gram per tonne (g/t).

1.9.2 Mineral Reserves

Mineral Reserves were estimated for the Aqqaluk and Qanaiyaq deposits, and are confined within designed pits. Ultimate pit geometries were developed for the two deposits using a Lerchs-Grossmann pit optimization algorithm. Pit shell outputs from this program were ranked to optimize net present value (NPV), and constraints such as minimum mining width and access points were considered. The various pit shells were then scheduled to produce an operating plan that limits annual flotation capacity to 1.10 and 0.25 Mt for zinc and lead concentrate, respectively.

The estimates in Table 1-2 are reported using the 2014 CIM Definition Standards, and have an effective date of 31 December 2016. The QP for the estimate is Mr Norman Paley, PE, Principal Engineer at Red Dog Mine and a Teck employee.

Table 1-2: Red Dog Probable Mineral Reserves as at December 31, 2016

Reserve Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Probable	Aqqaluk – Mill Feed	43,410	13.4	3.7	66
	Qanaiyaq – Mill Feed	7,480	24.7	6.9	138
Probable Reserve Total		***50,890***	***15.0***	***4.2***	***76***

Note to accompany Mineral Reserve Table

1. Norman Paley, PE, Principal Engineer at Red Dog Mine is the Qualified Person responsible for the Aqqaluk and Qanaiyaq Mineral Reserve estimates.
2. Mineral Reserves for Aqqaluk and Qanaiyaq have reporting date as of 31 December 2016.
3. Mineral Reserves are reported within the open pit designs based on metal prices of $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag and cutoffs of $4.60 per second milled, pre-VIP2, and $3.60 per second milled, post-VIP2, and represents ore that is to be mined and directly processed. The VIP2 project is planned to include modifications to the grinding and flotation circuits. Metallurgical recoveries for Aqqaluk are variable based on grade and rock type and average 85.5% for Zn, 58.1% for Pb, and 66.8% for Ag. Metallurgical recoveries for Qanaiyaq are variable based on grade and rock type and average 73.9% for Zn, 32.2% for Pb, and 50.6% for Ag.
4. No allowances for mining recovery and external dilution have been applied. Contact dilution between the 7.6 m x 7.6 m x 7.6 m blocks was applied. Aqqaluk inter-ramp pit slope angles range from 41–47° and Qanaiyaq inter-ramp pit slope angles range from 26–37°.
5. Numbers have been rounded for the individual entries so totals and weighted averages for the variables may vary slightly.
6. Mineral Reserves are reported exclusive of Mineral Resources.
7. Reporting units are metric: Tonnes, dry metric tonnes; Zn and Pb percent (%); and Ag gram per tonne (g/t).

There are no metallurgical, environmental, permitting, legal, title, taxation, socio-economic, marketing, political, and other relevant issues that are not discussed in this Report that may affect the Mineral Resource or Mineral Reserve estimates.

1.10 Mining Operations

The Red Dog mine currently operates two open pits at Aqqaluk and Qanaiyaq using conventional open pit drill and blast and truck and loader technology. The pits are mined with a TAK-owned and maintained fleet of equipment. Generally, the pit equipment operates at low utilization rates as the mine easily supplies the necessary feed for the mill and concentrator.

Open pit designs use geotechnical structural analysis, structural domains based on rock types, and rock mass quality ratings for the principal lithologies. Golder Associates are the engineer of record for the Project and have approved the pit designs. Water inflows that must be managed are as the result of seepage in the Aqqaluk pit, and for both pits, the results of the freshet (spring melt).

Three of the four phases in the Aqqaluk pit remain to be mined and mining of the first of the two phases in the Qanaiyaq pit started in 2016. The Qanaiyaq pit is planned to operate until 2027 and the Aqqaluk pit until 2031. The final year will also treat the low-grade ore stockpile. The waste to mill feed strip ratio over the life of the Aqqaluk pit is 0.87:1. The waste to mill feed strip ratio over the life of the Qanaiyaq pit is 2.18:1. Waste rock from the Aqqaluk and Qanaiyaq pits will be used to completely backfill the mined-out Main and Qanaiyaq pits.

The Mine Operations department at Red Dog is responsible for building pre-blended stockpiles, or batch piles, to supply approximately two weeks of concentrator feed. These stockpiles are built in thin lifts from various ore sources within the pit to conform to metal grade and metallurgical constituent constraints.

1.11 Processing and Recovery Operations

Design assumptions were based on the metallurgical testwork described in Section 1.8.

The Red Dog flow sheet uses three stages of grinding and froth flotation technology to recover sphalerite and galena to the zinc and lead concentrates respectively. Following crushing and grinding, slurry reports to a pre-flotation circuit to remove elemental sulphur and naturally occurring organic material. The pre-flotation section consists of both a rougher and a cleaner stage. The lead flotation circuit consists of a rougher circuit in closed circuit with cleaner columns. Typical lead recovery to the lead concentrate varies between 55–65% depending on ore type. The final lead concentrate is thickened and filtered. Silver is present in the lead concentrate and contributes to the lead concentrate revenue stream. The lead flotation tailings reports to the zinc circuit. The zinc flotation circuit consists of a rougher circuit followed by three stages of cleaning and a retreat circuit. The final zinc concentrate is thickened and filtered. Concentrate is stored on site then hauled by truck to the port site facility on the Chukchi Sea. The concentrates are stored at the port and then shipped to the contracted smelting facilities during the shipping season between early July and early October.

A mill improvement project is underway. If approved, the VIP2 project will include modifications of the grinding circuit, the addition of one M15000 IsaMill, and modifications to the flotation circuit.

Currently more than 90% of the zinc concentrates and 50% of the lead concentrates are under long-term contracts, while the remainder are sold annually. Contracts for concentrate sales are consistent with industry practice in marketing base metal concentrates. Treatment charges are in line with other base metal operations in North America and worldwide. Distribution costs are reasonable given the overland transport in Arctic conditions and seasonal port operations.

Tailings slurry from both the zinc rougher and the zinc retreat circuits are combined with the pre-flotation concentrate to form the final tailings. The final tailings are pumped to the tailings storage facility, where water is decanted and re-used in the milling circuit.

Average daily power draw is in the order of 23.1 MW peaking at 27.0 MW. The mill consumes approximately 92% of the power generated. Process water is sourced from tailings water reclamation. Flotation reagents, grinding media, and other process materials as well as spare parts for the plant are shipped to site during the summer shipping season.

1.12 Infrastructure, Permitting, and Compliance Activities

The Red Dog Mine is operational, and required power, crushing and conveying facilities, milling and processing infrastructure, waste rock facilities, tailings storage facility (TSF), dams, maintenance facilities, roads, airstrip, and port facilities are in place. Outstanding infrastructure required to be built to support the remaining mine life as described in this Report is the VIP2 expansion to the mill and the final two staged lifts of the tailings dams. Personnel are transported to site via aircraft, and supplies are shipped in during the summer season. Power for the project is sourced from diesel generators; the generative capacity is sufficient for present and projected power requirements. Potable water is sourced from Bons Creek and process water is reclaimed from the TSF. Both sources are sufficient for the life-of-mine plan.

The TSF collects all mill tailing discharge as well as waste rock seepage, pit dewatering and site runoff. The facility has a current capacity of 15.9 ML (4.2 M US gallons) of water. Two dam raises are planned to support the life-of-mine (LOM) plan (LOMP) storage requirements. Three water treatment plants are used to treat the various tailings pond water streams: recycle water to the milling process, discharge water to the environment, and pre-treatment of waste dump seepage water.

Surface rights held by TAK under the provisions of the NANA lease are sufficient to accommodate mining, processing and infrastructure needs for the Aqqaluk and Qanaiyaq pits. Mine operations are licensed through a State of Alaska Mining License. The port facilities and road are operated and maintained by TAK under an agreement with the Alaska Industrial Development and Export Authority as the DeLong Mountain Transportation System.

Four key permits are required for mining operations: Alaska Pollution Discharge and Elimination System (APDES) permit, Alaska Title V Air Permit, Alaska Closure and Reclamation Plan Approval, and Alaska Waste Management Permit. The port operations require two permits: an APDES permit and the Title V Air Permit. All of these permits are in good standing as at the Report effective date. Operations also require approximately 45 minor permits; these are renewed as applicable.

Red Dog employs an environmental department that is located at the mine site and is responsible for compliance monitoring, administering environmental permits, interfacing with regulators, and maintaining an environmental management system that is ISO 14001 compliant.

NANA and Teck partnered to develop the Red Dog mine under an innovative operating agreement in 1982. Under this Agreement, Teck runs the mining operations, while NANA is the land and resource owner and contributes Iñupiat business values. The mine is managed to protect the region's natural resources for future generations and not infringe upon Iñupiat culture and lifeways.

Closure requirements are established under the Closure and Reclamation Plan Approval and Waste Management Permit, which set out Teck's obligations for reclamation, closure and long-term monitoring of the property following closure. To ensure the proper closure and reclamation of the property should TAK be unable to meet the obligations a Financial Assurance Obligation has been filed with the State of Alaska for approximately $558 million.

1.13 Capital and Operating Costs

Capital cost estimates were prepared for expenditures required to maintain production which include funding for infrastructure, mobile equipment replacement, and development. Infrastructure requirements include tailings dam construction to maintain capacity and grinding and flotation circuit upgrades to the mill. Mobile equipment is scheduled for replacement when operating hours reach threshold limits; most major mobile equipment is considered a sustaining cost and is included within the operating costs.

Capital cost estimates are based on quotes, forecast budgets, and previous experience. Over the remaining life of the open pit mines, the following are projected, by key area:

- Mining: $44 million;
- Milling: $221 million;
- Water management: $168 million;
- Other (G&A, Port facilities, Closure): $126 million;
- Contingency: $30 million.

The costs equate to an overall LOM average cost per tonne milled of $9.30.

Operating costs were developed based on a combination of fixed and variable cost standards applied to mine, mill, and general and administrative aspects to forecast total mine site operating costs. Estimates were based on historical consumption rates, historical productivity, and forecast budgets.

Over the remaining life of the open pit mines, the following operating costs are projected in dry metric tonne units, by key area:

- Waste mining: $3.00/dmt;
- Ore Mining: $3.15/dmt;

- Milling: $29.11/dmt;
- Indirect: $7.01/dmt;
- G&A: $17.66/dmt.

1.14 Economic Analysis

Teck is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no major expansion is planned. An economic analysis to support presentation of Mineral Reserves was conducted. Under the assumptions presented in this Report, the operations show a positive cash flow, and can support Mineral Reserve estimation.

1.15 Recommendations

A two-phase work program is recommended. The first phase should consist of mine site based activities that will result in workflow improvements, and reviews to provide a better understanding of some of the current Project data. The second phase should include additional metallurgical test work, supporting mining studies and exploration activities. The total program is estimated at $310,000.

2 INTRODUCTION

2.1 Terms of Reference

A technical report (the Report) has been prepared for Teck in compliance with National Instrument 43-101 “Standards of Disclosure for Mineral Projects” (NI 43-101) on the Red Dog mining operation (the Red Dog Mine or the Project), located in Alaska. The Report will be used in support of Teck’s annual information form (AIF) filing and in support of updated Mineral Resource and Mineral Reserve estimates for the operation.

Teck’s subsidiary, Teck Alaska Incorporated (TAK), is the operating entity for the Red Dog Mine.

All measurement units employed in this Report are metric; however, where data have been derived from US Government departments or other American statutory authorities, US standard units may be used.

Currency is expressed in US dollars unless stated otherwise.

2.2 Qualified Persons

The following people served as the Qualified Persons (QPs) responsible for preparing the Report:

- Thomas Krolak, RM SME, Principal Geologist, Reserves, TAK – Red Dog Operations;
- Kevin Palmer, P. Geo., Principal Geostatistician, Exploration, Teck – Vancouver;
- Brigitte Lacouture, PE, Operating Superintendent, Mill, TAK– Red Dog Operations;
- Norman Paley, PE, Principal Engineer, Long Range Planning, TAK – Red Dog Operations.

2.3 Site Visits and Scope of Personal Inspection

Mr. Thomas Krolak has worked at the Red Dog Mine since 1991, and was working at the site at the Report effective date. In his role as Principal Geologist, Reserves, he has responsibility for constructing Aqqaluk and Qanaiyaq block models and reporting Mineral Resource estimates from those models. He is directly involved in core drill program planning and Mineral Reserve estimation.

Mr. Kevin Palmer has visited the property on a regular basis from 2012, with the most recent visit being from 27 July to 3 August 2016. During that visit, he reviewed the Aqqaluk Mineral Resource estimate and presented the Anarraaq Mineral Resource estimate.

Ms. Brigitte Lacouture has worked at the Red Dog Mine since 1996, and was working at the site at the Report effective date. In her role as Operating Superintendent, Mill, she has been directly involved in geo-metallurgy and flow sheet design of Pb/Zn concentrators and participated directly in all aspects associated with the execution of annual business plans and performed detailed reviews of operational performance, mill processes, and financial performance.

Mr. Norman Paley has worked at the Red Dog Mine since 1996, and was working at the site at the Report effective date. In his role as Principal Engineer, Long Range Planning, he has been directly involved in both Mineral Resource and Mineral Reserve estimation, life-of-mine (LOM) planning, pit optimization, open pit geotechnical investigations, mining operations feasibility studies, and mining capital and operating cost estimation.

2.4 Effective Dates

The Report has a number of associated dates as follows:

- Mineral Resources have the following reporting dates: Aqqaluk and Qanaiyaq, 31 December 2016; Paalaaq, 17 December 2016; and Anarraaq, 19 August 2016;
- Mineral Reserves have the following reporting date: Aqqaluk and Qanaiyaq, 31 December 2016.

The overall Report effective date is taken to be the date of the Mineral Reserves, which is the 31 December 2016.

2.5 Sources of Information and Data

In preparing this Report the QPs relied on the information listed in the References section of this report. Specialist input from Teck employees in other disciplines, including legal, process, geology, geotechnical, hydrological and financial, was sought to support the preparation of the Report. Unless otherwise noted, all figures and images were prepared by Teck.

Information used to support this Report is also partly derived from previous technical reports on the Project:

- Cinits, R., Kirkland, K., Kuhl, T., and Kozak, A., 2007: Red Dog Mine Review, Alaska, NI 43-101 Technical Report: report prepared for Teck Cominco Limited by AMEC Americas Ltd., effective date 9 March, 2007;
- Juras, S., 2001: Technical Report, Red Dog Mine Review Alaska: report prepared for Cominco Ltd. by Mineral Resources Development Limited (MRDI) report L458A, May 31, 2001.

3 RELIANCE ON OTHER EXPERTS

Not applicable.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Location

The Red Dog Project is located in the DeLong Mountains of the western Brooks Range of Alaska, about 1,000 km north of Anchorage, 144 km north of Kotzebue and 140 km north of the Arctic Circle. The properties controlled by Teck are in parts of both the Northwest Arctic Borough and the North Slope Borough.

The Red Dog Mine, located within in the Delong Mountains AMS 2° quadrangle, is centred at approximately:

- WGS 84: Latitude 68°4'30.761" N, Longitude 162°49' 44.094" W;
- NAD27 Alaska State Plane Zone 7: N 5145869.66257068, E 586643.590709441.

The mine is located approximately 84 km inland from the concentrate loading port site situated at shallow tidewater on the Chukchi Sea (Figure 4-1).

There are seven known mineral deposits (Figure 4-2), within the Red Dog district: Qanaiyaq, Main, Aqqaluk, Paalaaq, Aŋarraaq, Su, and Aktigiruq. The first four deposits are aligned from south to north, collectively span a distance of about 3.5 km, and occur at an average elevation of approximately 300 masl. The Aŋarraaq deposit is approximately 10 km to the northwest of the Paalaaq deposit; Su is 20 km northwest of the Main deposit and Aktigiruq is 2.3 km north of Aŋarraaq. The surface above these deposits occurs at an average elevation of approximately 460 masl.

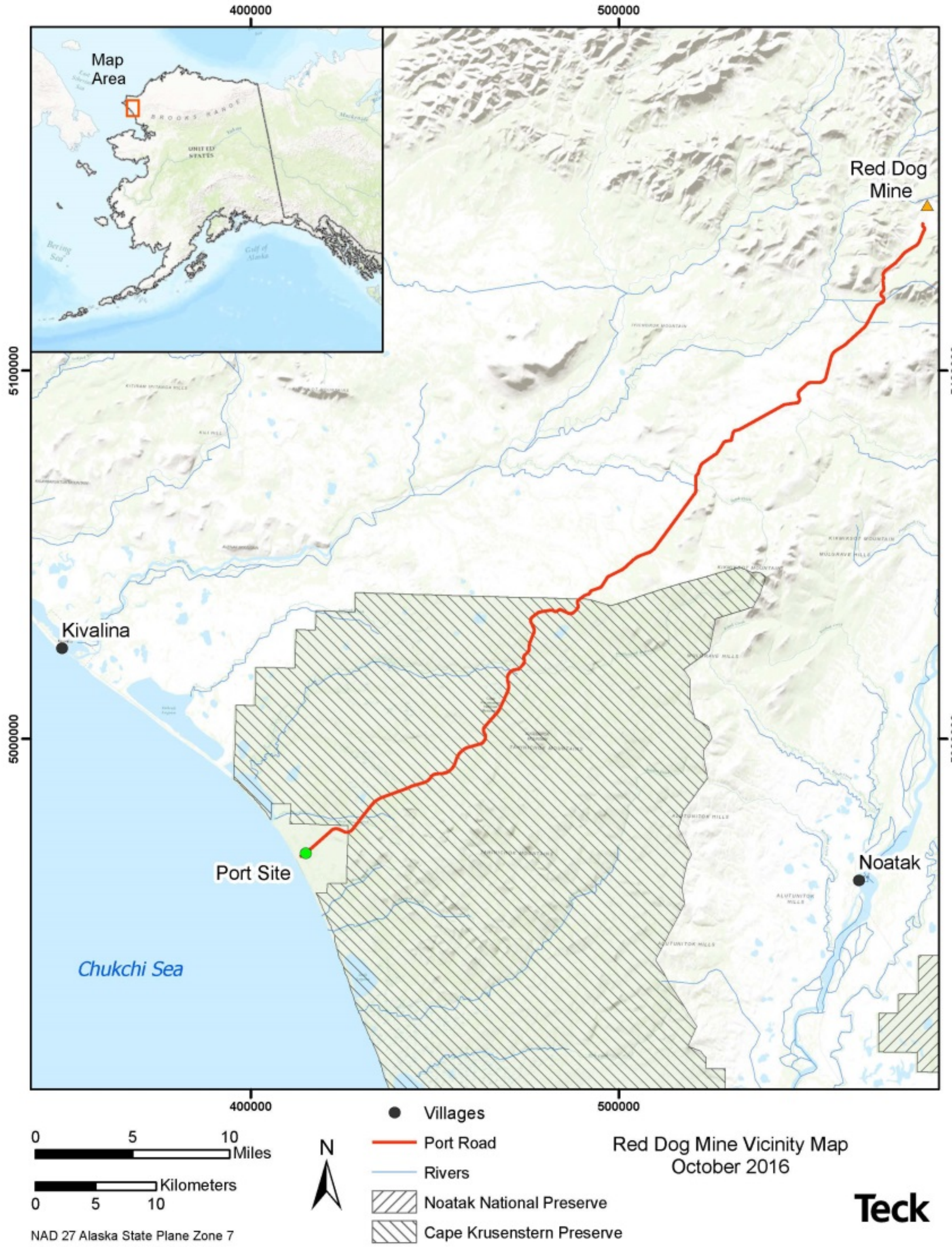

Figure 4-1: Regional Location Plan

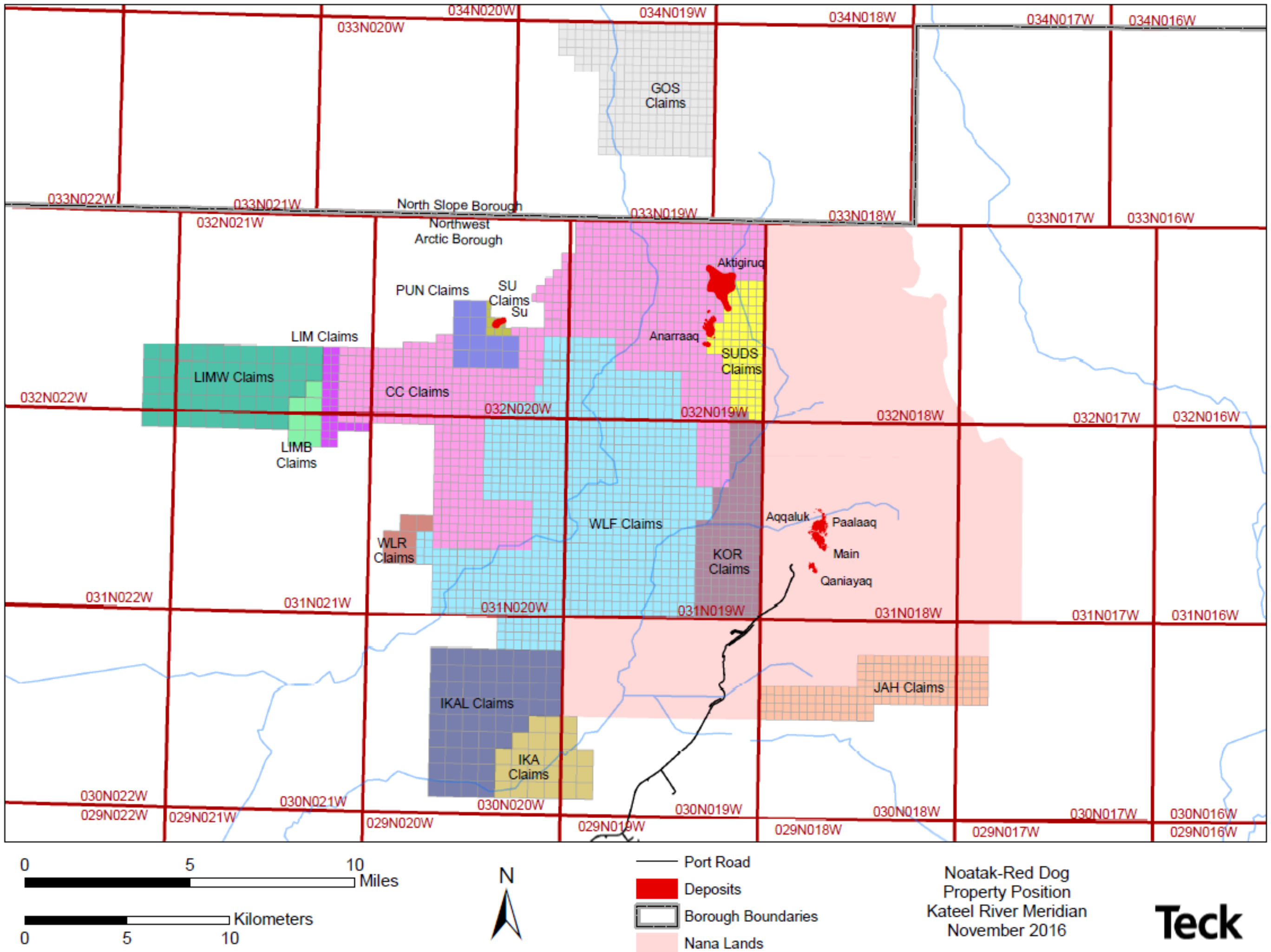

Figure 4-2: Mineral Tenure Overview Plan

4.2 Mineral Tenure

The property consists of (i) a mining lease on land owned by the NANA Regional Corporation (NANA) and (ii) 2,479 Alaska state mining claims held in three separate claim blocks: Noatak, JAH and GOS (refer to Figure 4-2). The mining lease is held by NANA and TAK; with Teck American Incorporated (TAI) holding the mining claims. A detailed description of the locations and claims is provided in Appendix A.

The Aqqaluk, Main, Qanaiyaq and Paalaaq deposits are situated within the NANA–TAK mining lease, and the Aŋarraaq and Aktigiruq deposits are within a group of state mining claims known as the Noatak Block. The Su deposit is situated on the Su claims, also part of the Noatak Block.

4.2.1 The NANA Lease and Development and Operating Agreement

Cominco American Incorporated (CAI), a wholly-owned subsidiary of Cominco Ltd., entered into the Development and Operating Agreement (the Agreement) with NANA on October 11, 1982. Before development, CAI assigned its rights and obligations under the Agreement to its wholly-owned subsidiary Cominco Alaska Incorporated. On July 20, 2001, Teck Corporation merged with Cominco Ltd. by acquiring all of the issued and outstanding share capital of Cominco Ltd. Currently, after a series of names changes, the operator of the mine is Teck Alaska Incorporated (TAK), an Alaska corporation, and the owner and operator of activity on the state mining claims, outside the NANA lease, is Teck American Incorporated (TAI), a Washington corporation. TAK is 100% owned by TAI, which is an indirect wholly-owned subsidiary of Teck Resources Limited, the successor to Teck Corporation.

TAK operates the Project pursuant to the Agreement, which controls activity on the NANA lease. Collectively, the Aqqaluk, Main, Qanaiyaq and Paalaaq deposits comprise the Red Dog Mine. In total, the leased land covers approximately 26,143 ha as detailed in Appendix A. Under the terms of the Agreement, TAK leases the mine and concentrator properties and other adjacent lands from NANA, operates the mine, and markets the concentrate produced. An initial lease rental payment of $1 per acre on the execution of the Agreement was completed and annual payments of $1 per acre on undisturbed land and $100 per acre of disturbed land, plus an annual escalator for both, continue to be payable. Annual lease maintenance costs (exclusive of the royalty payments) have been paid as required.

The Agreement required an initial royalty payment of $1.5 million, which was paid upon the agreement being signed. To date, the following royalty provisions have applied:

> *Under the terms of the agreement with NANA, the Company paid advance royalties from 1983 to 1989 of $7,595,000. On commencement of commercial operations, which occurred in 1990, the required advance royalty became the greater of $1,000,000 per annum, escalated from 1983 as defined in the agreement, and a 4.5% net smelter royalty. After payback of certain capital expenditures including interest and advance royalties which occurred in 2007, the royalty became 25% of the net proceeds from production, increasing in increments of 5% at five-year intervals to a maximum of 50%. The*

percentage of net proceeds from production changed to 30% in the fourth quarter of 2012.

TAK's royalty payment in 2016 was 30%; the next escalations will be to 35% in the fourth quarter of 2017, to 40% the fourth quarter of 2022, to 45% in the fourth quarter of 2027, and to 50% in the fourth quarter of 2032. In addition to the royalties payable to NANA, the operation is subject to State and Federal income taxes, and payments to the Northwest Arctic Borough.

The exterior boundary of the NANA Lease has not been surveyed, but is defined by Township aliquot parts described in Exhibit A of the 1982 Operating Agreement. At its closest point, the preserve is approximately 9 km northeast of the mining operation.

Additional terms imposed on the operations under the Agreement are discussed in Section 20.4.

4.2.2 The State Mining Claims

Exploration on State of Alaska lands adjacent to the NANA lease is conducted on State mining claims covering 42,509 ha in the Northwest Arctic Borough and 4,047 ha in the North Slope Borough of north-west Alaska, all owned and controlled 100% by TAI. The claims are in portions of unsurveyed Townships 30 through 33 North, Ranges 19 through 22 West, Kateel River Meridian.

The individual unpatented claim groups, are CC, IKA, IKAL, KOR, LIM, LIMB, LIMW, PUN, SU, SUDS, WLF, and WLR (collectively the Noatak Group) and the JAH Group within the Northwest Arctic Borough, and the GOS Group, within the North Slope Borough. Details of the claim groups are provided in Appendix A and illustrated in Figure 4-2. The Aŋarraaq deposit is situated on a portion of the CC and Suds claims; Aktigiruq is on the CC claims; and the Su deposit is on the Su claims. Claims within the groups are either 40 acres (approximately 16 ha) or 160 acres (approximately 64 ha) in size.

4.3 Locating and Maintenance of Mining Claims

Alaska recognizes two claim sizes: a 40 acre traditional claim and a 160 acre meridian, township, range, section (MTRS) claim. Claims may be located in either 40-acre units with a maximum length of 1,320 feet, or 160 acre units which conform to existing quarter sections of the rectangular survey system. Locations are determined by placing monuments on the ground at the claim corners. Claims are registered by attaching a location notice to the northeast post, and filing the location certificates in the recording district(s) where the claim is located. All claims in the Project are in the Barrow and/or Kotzebue Recording Districts, and were located and recorded according to the provisions of Alaska statutes AS 38.05.185 - 38.05.275 and regulations 11 AAC 86.100-600.

The State of Alaska requires an annual work expenditure on all active mining claims of $100 per 40 acre claim unit. Claim maintenance is based on labour completed in an exploration year, which ends annually on August 31. This obligation can be met by actual exploration or development work within the labour year, carried forward credits from the previous four years, or payment in lieu of labour (PIL). Any PIL must be paid annually by August 31. Work may be performed anywhere within a contiguous block of claims. Each separate claim block must be calculated separately using annual labour or payment solely from within the contiguous block.

Annual rentals are due by November 30 in escalating amounts based on the duration of tenure since the location date of each claim. Rentals are paid in advance for the next claim year. Rentals begin at $35/year/40 acres and escalate progressively to $170/year/40 acres in year 11. Current rental rates for Teck's claims are shown in Appendix A. An annual rental can be credited against the State production royalty as it accrues for that year.

All claim maintenance labour, PIL and rental obligations for 2016 were current at the Report effective date for all of the Project claims.

4.4 Surface Rights

Surface activities on state mining claims must be permitted through the Alaska Department of Natural Resources, which acts as the lead agency for all state permits. Camps and any structures related to exploration activity also require separate permits. Exploration activity which requires surface disturbance is allowable under the "Annual Hard Rock Exploration Application" process. TAI maintains a multi-year permit, F9339, which is updated annually. Claims within the Northwest Arctic Borough require a land-use planning department, Title 9 authorization, which can be obtained for three-year terms. The North Slope Borough has a similar permit process. If surface activities encroach on streams or wetlands, a US Corps of Engineers permit is also required.

4.5 Permits

Permitting for the Project is discussed in Section 20.

4.6 Environmental Considerations

The environmental setting and environmental considerations for the Project are discussed in Section 20.

4.7 Social License Considerations

Social license considerations for the Project are discussed in Section 20.

4.8 Comments on Property Description and Location

Information from Teck's tenure experts supports that the mining tenure held is valid and is sufficient to support the declaration of Mineral Resources and Mineral Reserves and the LOMP.

Surface rights are sufficient to accommodate mining, processing and infrastructure needs for the life-of-mine (LOM), and to support estimation of Mineral Resources and Mineral Reserves. Surface rights held by TAK under the provisions of the NANA lease are sufficient to accommodate mining, processing and infrastructure needs for the Mineral Reserves contained within the Red Dog operation. Mine operations are licensed through a State of Alaska Mining

License. The port facilities and road are operated and maintained by TAK under an agreement with the Alaska Industrial Development and Export Authority as the DeLong Mountain Transportation System.

To the extent known, there are no other significant factors and risks that may affect access, title, or the right or ability to perform work on the property that have not been discussed in this Report.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Physiography

The mine site is located on a ridge between the Middle and South Forks of Red Dog Creek, in the DeLong Mountains of the Western Brooks Range. The topography is moderately sloping, with elevations ranging from 260 m to 1,200 m above sea level. To the south and southwest, the hills drop off abruptly to a gentle coastal upland, which continues to the Chukchi Sea.

Permafrost has developed to depths more than 90 m. Soil types are mostly derived from glacial moraines and associated fluvial deposits.

Vegetation is classified as woody tundra, consisting of lichens (Northern reindeer Lichen, *Cladina stelaris L*.), tussock grasses (*Parnassia palustris L*. and *Holcus alpinus Sw*.), cotton grasses (*Eriophorum callitrix Cham*.), low and tall deciduous shrubs (dwarf arctic birch, *B. glandulosa L*.), and dwarf evergreen shrubs (*juniperus communis L*.).

5.2 Accessibility

The Red Dog Mine is not directly accessible by road from any other Alaskan communities thus all logistical support is provided by air or water.

An 84 km long gravel service road connects the mine to a port facility on the Chukchi Sea. Because of its northerly location, this port is seasonal, operating from early July to early October.

A paved airstrip, 5.5 km south-west of the mine, allows jet access from Anchorage and Kotzebue. Smaller planes provide service to other native communities in the region. Flight time from Anchorage is approximately 1½ hours.

Additional information on accessibility is included in Section 18.

5.3 Climate

Temperatures in the Brooks Range tend to be very cool to cold; average winter lows are about -31ºC. Temperatures can vary from lower than -41ºC to summer highs of 16ºC. The frost-free season is short, lasting from mid-June to late September or early October.

At Kotzebue, south of the mine, snowfall averages 1,000 mm, with total precipitation of 228 mm per year. Precipitation is most common in the summer months.

Winds tend to be persistent, peaking at 50–100 km/h during weather storms.

Mining operations are conducted on a year-round basis.

5.4 Local Resources and Infrastructure

There are some small towns and communities in the vicinity of the Red Dog Mine.

The largest is the coastal town of Kotzebue (population c. 3,300), which is located approximately 144 km south of the Red Dog Mine. Facilities at Kotzebue include a regional hospital, hotel accommodations, and a domestic airport with daily jet service to Anchorage.

The closest community to the mine is Noatak (c. 430 people) which is approximately 56 km to the southeast.

The coastal community of Kivalina (population c. 384) is located approximately 26 km northwest of the mine's port facility on the Chukchi Sea.

Additional information on the Project infrastructure and setting is provided in Section 18 and Section 20.

6 HISTORY

6.1 Prior Ownership

Prior ownership is discussed under Section 4.2.1 of the Report.

6.2 Exploration

Key activities in the exploration of the Red Dog Mine area are summarized in Table 6-1.

Table 6-1: Exploration History

Year	Company/Prospector	Activity
Unknown	Irving Tailleur of the United States Geological Survey (USGS)	Identified “mineral staining” in Ferric Creek.
1968	Bob Baker	Additional iron staining noted.
1970	Irving Tailleur	Presence of weathered sulphide-bearing bedrock and stream sediments “containing more than 10% lead” in drainage leading to Wulik River and Ikalukrok Creek.
1982	NANA and Cominco	Agreement signed.
1978–date	Cominco	Staked the Red Dog Mine area. Completed geological mapping, geochemical sampling, geophysical surveys. Discovered the Main deposit in 1980, the Qanaiyaq deposit in 1981, the Aqqaluk and Paalaaq deposits in 1995, and the Aŋarraaq deposit in 1999. Shallow water dock and small staging area built at port site in 1986. Construction of mine and port access road commenced 1987. Construction completed in 1989, with initial mine production commencing in Q4 of 1989. Production increase from 1989 to 1992 to 1.4 Mtpa. Additional increase from 1992 to 1995 to 2.2 Mtpa with additional grinding, flotation capacities and recovery improvements. Production rate increase project initiated in 1995 to take production to 3.2 Mtpa and the zinc concentrate production from 0.59 Mtpa to 0.9 Mtpa by adding a new gyratory crusher, additional comminution capacity, increases to zinc and lead flotation capacity, a zinc filtration press, and upgrading the port and accommodation areas. Value improvement project (1999–2001) increased throughput to 3.9 Mtpa; included expansion in power generation, concentrate thickening, water treatment and flotation areas. Ongoing exploration activities within the district have included mapping, soil and stream sediment sampling, and airborne and ground geophysical surveys. Other than the deposits discussed in this Report, no additional economic mineralization has been identified to date. Exploration around the deposits since 2007 has been confined to core drilling and limited borehole induced polarization (IP) surveys. Drilling has expanded the Resources of the Aqqaluk, Paalaaq, Qanaiyaq, and Aŋarraaq deposits and has demonstrated continuity of mineralization at Aktigiruq. Borehole IP surveys have been limited to Paalaaq, Aŋarraaq, and Aktigiruq and, due to the proximity of mineralization, have not proven to be an effective tool in expanding the extent of mineralization.

6.3 Production History

Mining has occurred from the Main open pit which operated from 1989 until the orebody was exhausted in 2012.

Current mining operations are the Aqqaluk open pit, started in 2010, and the Qanaiyaq open pit, started in 2016.

Production to 31 December 2016, from all sources, totals 78,257,035 t milled, yielding 22,650,468 t of zinc concentrate and 4,324,691 t of lead concentrate and 201,173 t of Imperial Smelter Feed (ISF).

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The following discussion on the regional geology section is primarily abstracted from Slack et al., (2004), De Vera et al., (2004), and Blevings et al., (2013).

Northern Alaska consists of four principal physiographical elements, the most important of which for the Red Dog Mine is the Brooks Range. The Brooks Range is a 950 km long fold-and-thrust belt, formed by the collision of an intra-oceanic southern island arc (Koyukuk and Angayucham terranes) with a northern passive continental margin (Arctic Alaska terrane). Within the fold-and-thrust belt are a series of seven structurally-stacked allochthons (tectonic units) that represent disparate and structurally and tectono-stratigraphically coherent packages. The allochthons are interpreted to represent parts of formerly continuous sedimentary basins that were juxtaposed by multiple stages of thrusting and folding during the Jurassic to Cretaceous age Brookian Orogeny.

The basal tectonic unit, the Endicott Mountains allochthon, contains all of the currently known sediment-hosted massive sulphide (SHMS) deposits in the Brooks Range. Figure 7-1 is a stratigraphic section through the Endicott Mountains allochthon.

The Endicott Mountains allochthon consists of strata of the Endicott (Late Devonian to Early Mississippian), Lisburne (Carboniferous), and Etivluk (Pennsylvanian to Triassic) Groups and the early Cretaceous Okpikruak Formation. The allochthon is exposed in the core of a series of northeast-trending regional antiforms, and consists of three tectono-stratigraphically coherent and distinct thrust plates: the Wolverine Creek, Red Dog, and Key Creek plates (Figure 7-2).

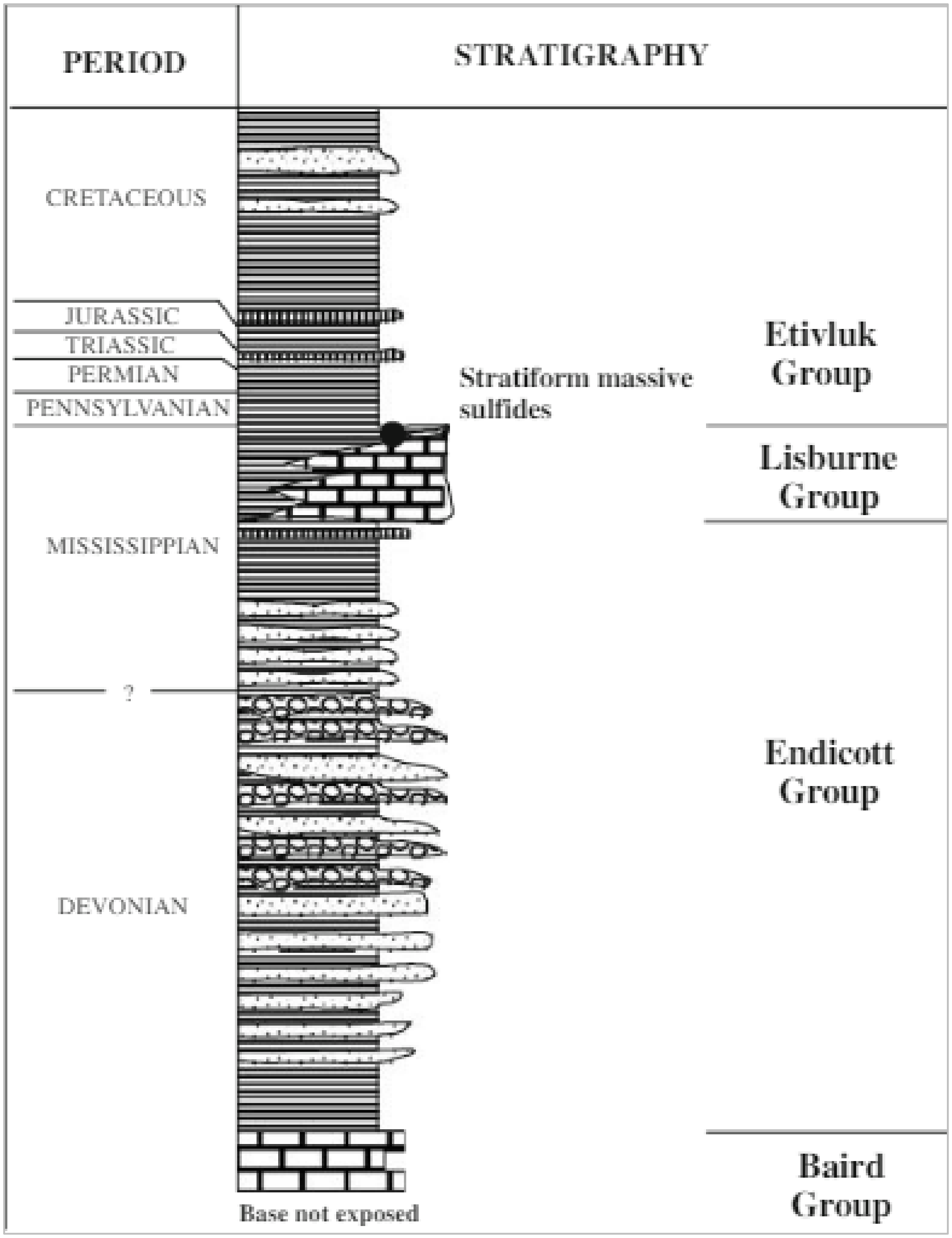

Figure 7-1: Stratigraphic Section

Note: figure from Schardt et al, 2008.

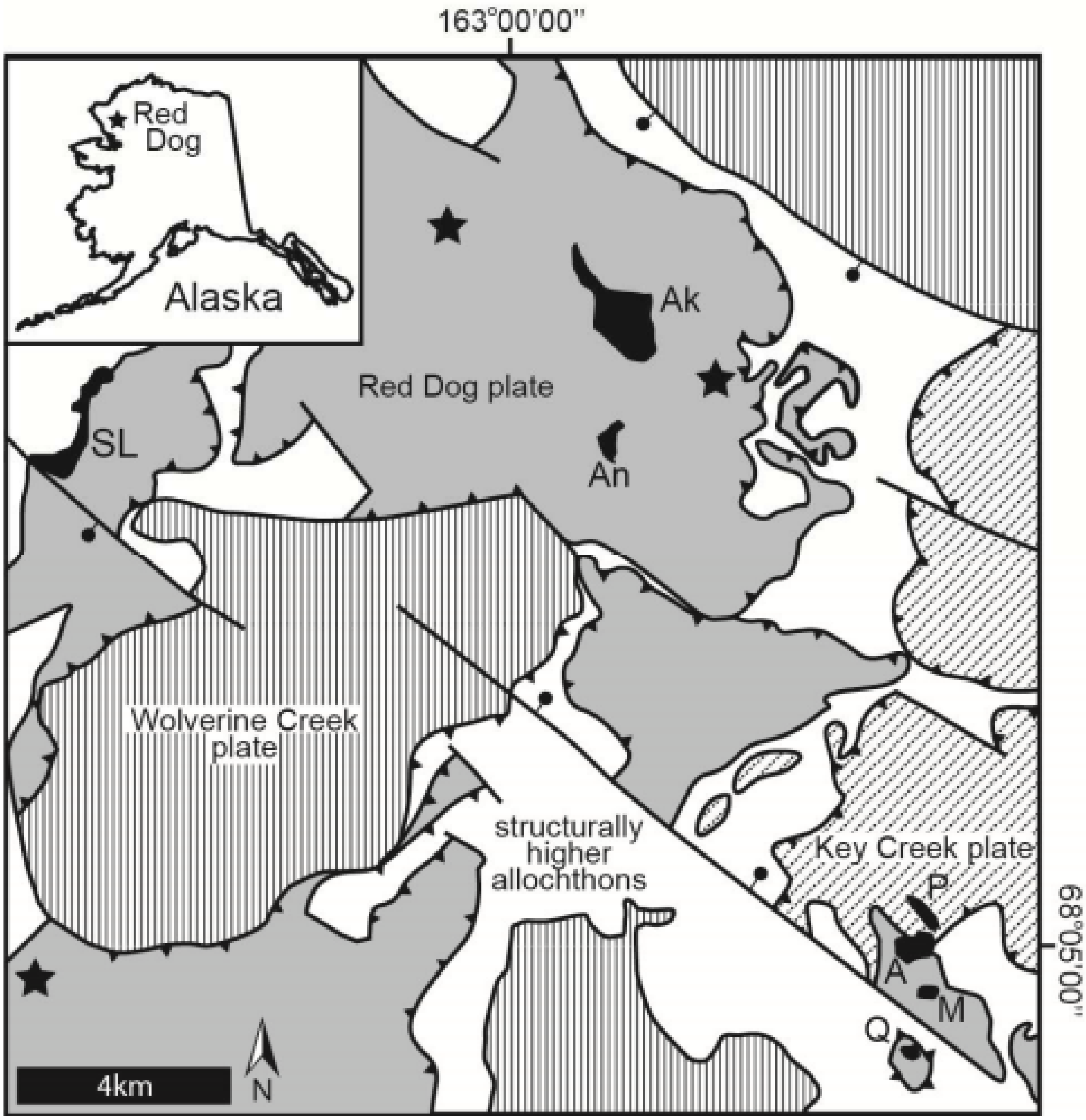

Figure 7-2: Thrust Plates within the Endicott Mountains Allochthon

Note: Figure from Reynolds et al., 2015. The Red Dog District Mine area includes the Main (M), Aqqaluk (A), Paalaaq (P), and Qanaiyaq (Q) deposits. Other known mineralization occurs in the Aŋarraaq (An), SuLik (SL), and Aktigiruq (Ak) deposits and in several other prospects (stars).

The Red Dog plate consists of strata of the Lisburne and Etivluk Groups as well as the Okpikruak Formation. The plate is detached in incompetent shales of the Kuna Formation (part of the Lisburne Group) and structurally overlies the Wolverine Creek plate and underlies the Key Creek plate.

Table 7-1 summarizes the main lithologies in the Red Dog Mine area.

Table 7-1: Mine Area Lithologies

Unit	Description
Otuk Formation	~ 48 m thick unit of shales, cherts and limestone; is in sheared contact with the underlying Siksikpuk Formation.
Siksikpuk Formation	60–100 m thick chert and shale unit. May represents a change to more oxidizing conditions in the basin, as shown by a change in rock colouration from dark to light, and a paucity of carbonaceous rock types.
Kuna Formation	Upper Ikalukrok unit, 30–240 m thick, composed mostly of black shale and black chert with locally abundant carbonate rocks. Includes a lower, laminated, black shale subunit and an upper medium- to thick-bedded black chert subunit. Represents a probable outer shelf, slope, and basin depositional setting. Main host to SHMS deposits.
	Lower Kivalina unit, consisting of alternating limestone and thin-bedded calcareous shale. Interbedded with non-calcareous and concretionary black shale of the Kayak Shale, and represents off-shelf, slope, and basin turbidite facies. Strongly altered mafic sills and/or layered volcanic rocks are locally present in the lower part of this unit.
Kayak Shale	Fine-grained sandstone, black shale, argillaceous limestone, and red limestone, recording a shallow marine tidal-flat setting, and shallow to deeper marine deposits (including pro-delta or slope facies) represented by upper limestone and shale units. Hosts minor both vein-breccia and replacement-type Zn–Pb–Ag occurrences

The Red Dog mine area deposits consist of four stacked and complexly deformed mineralized bodies that are contained in the Red Dog thrust plate. They have been structurally detached from their original footwalls and are imbricated in separate thrust sheets (Figure 7-3). Each thrust sheet consists of strata of the Lisburne and Etivluk Groups, and they are collectively bound by a roof and a floor thrust. In the Red Dog mine area, the roof plate is characterized by incompetent rocks of the Kayak and Kivalina shale units within the Key Creek plate, whereas the basal plate is formed by either rocks of the Kivalina unit or rocks from the Wolverine plate.

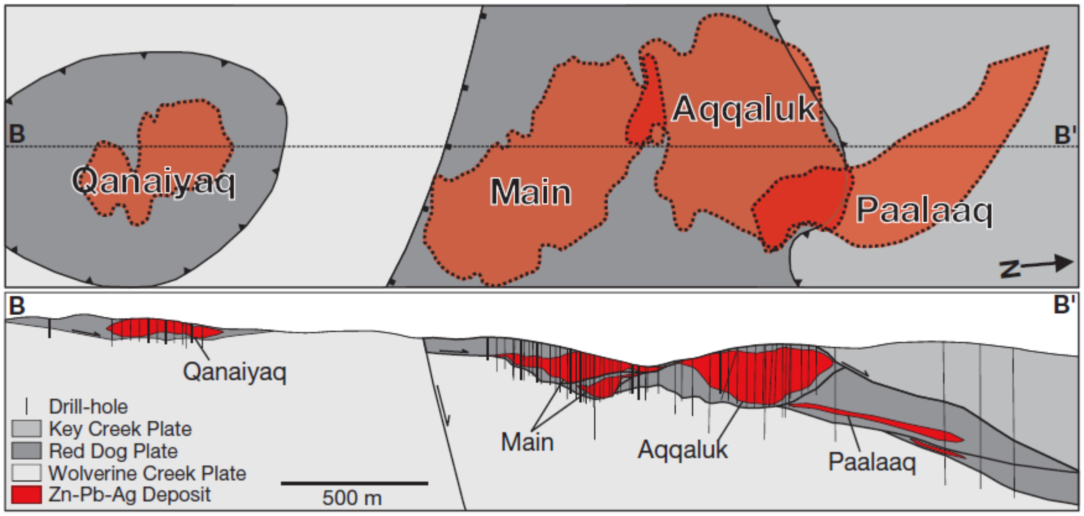

Figure 7-3: Structural Setting, Red Dog Mine Deposits

Note: Figure from Blevings et al., 2013.

Away from the mine area, some variations in host stratigraphy have been noted. More than four additional thrust slices of Red Dog plate stratigraphy are stacked above the mineralized thrust panel that hosts the Aŋarraaq deposit, producing a large apparent thickness of the Siksikpuk and Otuk Formations in that area. In the region where the Aktigiruq and Su deposits are found, the Ikalukrok stratigraphy may contain multiple beds of calcareous turbidites and limestone.

The following subsections describe the main individual deposits.

7.2 Mine Zone Deposits

The general mineralization zonation within the mine deposits (Qanaiyaq, Main, Aqqaluk, and Paalaaq) consists of:

- Barite, commonly the uppermost mineralized unit consisting of disseminated to massive and laminated fine grained pyrite, sphalerite, galena mineralization increasing downward;
- Silica rock, generally underlying barite, is variably mineralized similar to the barite, and represented by secondary crystalline quartz replacing barite and carbonate;
- Massive sulphide, forming the high-grade intervals and consisting of reddish-brown sphalerite, galena, pyrite mineralization with grades varying from 20 to 50% Zn, and high Ag content;
- Sulphide vein and breccia zone, formed by typically symmetric bands of tan sphalerite, red–brown sphalerite, galena and pyrite, commonly present at the base of the deposit. Brecciation caused by dissolution of barite and carbonate, and cross-cutting breccias are common, and may represent multiple phases of sulphide deposition.

Sulphide-bearing barite occurs as two distinct textural types: white to grey, fine-grained (10–50 µm) equigranular grains intergrown with sulphides, and white, coarse-grained (up to 3 cm) crystals with interstitial sulphides. In the Aqqaluk and Paalaaq deposits, base-metal and iron sulphides locally occur as crude interlayers with the barite. Sulphide-poor barite is found at the top of each deposit near or on the contact between the Ikalukrok unit and the Siksikpuk Formation. Sulphide-poor barite is white to light grey, fine-grained, and commonly well bedded.

Massive sulphide is a term used at the Red Dog Mine for material that contains greater than 40 wt% sulphide minerals (sphalerite, galena). Most of the Main, Aqqaluk and Qanaiyaq mineralization is massive and unbedded, consisting of abundant sulphide grains and aggregates disseminated in a baritic, silica, or sulphidic matrix. Fragmental textures also are present in massive sulphide mineralization. Banded sulphides in shale are rare, but have been reported from Aqqaluk and Paalaaq.

Sulphide veins are present in all of the deposits, although they are most abundant and consistently developed at Aqqaluk, where they are found mainly at the base and periphery, and less commonly in the centre of the deposit. At Aqqaluk, the veins typically cut rocks of the Ikalukrok unit and all mineral facies except the sulphide-poor barite. The veins are steeply dipping, trend north–northeast, and vary in width from 1 mm to 1 m. Vein density can be so intense as to constitute bulk ore-grade zones. Vein-style mineralization at Qanaiyaq is uncommon and its distribution at Paalaaq is poorly documented.

7.2.1 Main

The Main deposit has been mined out. It extended 1,600 m in a northwest direction, with a width varying from 150 m to 975 m and up to 135 m thick. To the north and northeast, the Main deposit merges with the Aqqaluk deposit, as the Main and Aqqaluk deposits are actually a single deposit separated for convenience along a line defined by the Red Dog and Shelly creeks.

The Main deposit consisted of two major and one minor mineralized plates and their associated cap rocks. The upper plate was a flat-lying sheet of Kivalina unit limestone and shale, Ikalukrok unit siliceous shale, and sulphide-bearing barite rock. The median plate contained most of the mineralization in the Main zone and consisted of a sequence of massive to semi-massive sulphide rock, sulphide-bearing silica rock, and sulphide-bearing barite rock. The mineralized portion of the median plate was capped with a sequence of shale and chert of the Siksikpuk, Otuk and Okpikruak units. The lower plate mineralization in the Main deposit consisted of sulphide-veined and silicified Ikalukrok shale and sulphide-bearing barite rock.

The Main deposit had four main mineralization types that formed a continuum:

- Barite-hosted disseminated to massive sulphides;
- Semi-massive to massive (variably brecciated) sulphides;
- Lesser sulphide-bearing siliceous rock;
- Veined black shale.

The sulphide mineralization is comprised of sphalerite, galena, and lesser iron sulphides (pyrite ± marcasite) within a quartz- or barite-rich gangue.

7.2.2 Aqqaluk

The Aqqaluk deposit is defined as any mineralization that is potentially mineable by open pit methods that lies north of the roughly east–west line made by Shelly Creek and Red Dog Creek, downstream of the Shelly Creek intersection. Any Paalaaq (sub-lower plate) mineralization mined in an open pit would also be considered to be part of the Aqqaluk deposit. Lower-plate mineralization forms the largest component (70% to 80%) of the Aqqaluk Mineral Reserves and Mineral Resources. The dimensions of the mineralization at the Aqqaluk deposit are 700 m east–west, 600 m north–south and up to 150 m thick. A schematic section of the Aqqaluk deposit is included as Figure 7-4.

In general the base of the Aqqaluk deposit is defined as a mélange unit that corresponds to the lower plate thrust. In contact with the mélange is a mineralized sequence of veined Ikalukrok shale, followed by semi-massive to massive sulphide rock that is interfingered with mineralized silica exhalite. Capping this sulphide-rich package is a weakly mineralized to barren barite cap. Thicknesses of the veined unit vary from 3 m to 30 m, whereas the sulphide and the silicic exhalites vary from 3 m to 80 m in thickness. The barite cap ranges from 1 m to 80 m thick.

To the south of Red Dog Creek, mineralization at Aqqaluk is overthrust by the median plate of the Main deposit. To the north, east, and west, Aqqaluk is either bounded by the lower plate thrust, or grades into unmineralized, silicified Ikalukrok shale.

7.2.3 Paalaaq

The Paalaaq deposit is an arcuate-shaped mineralized zone lying to the north of the Aqqaluk deposit. The deposit is approximately 1,200 m long in a north–south direction, is 100 m to 200 m wide from east to west and up to 60 m thick.

The currently wide-spaced drilling has not allowed a detailed geological breakdown of mineralization types; however, they are interpreted to be similar to those found in the Main and Aqqaluk zones.

The Paalaaq deposit is contained within a thrust sheet below the Aqqaluk deposit, referred to as the sub-lower plate. Complex stacking of at least five different thrust panels within the sub-lower plate has been interpreted, suggesting that Paalaaq's present geometry is a product of multiple episodes of thrust imbrication consistent with inferred polydeformation of the Red Dog plate throughout the Red Dog district. The mineralization is open to the north, pinches out to the east and is partially structurally terminated on its western extension. It appears to be truncated by the lower plate thrust to the south. A section through the deposit is included as Figure 7-5.

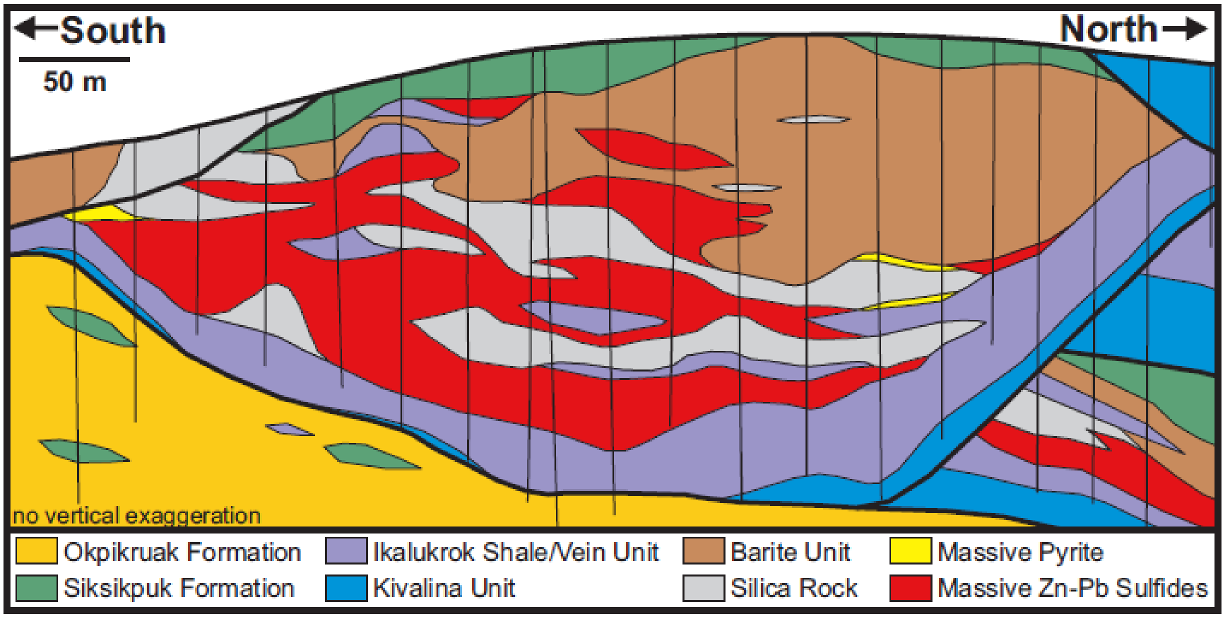

Figure 7-4: Schematic Cross Section Aqqaluk Deposit

Note: Figure from Blevings et al, 2013.

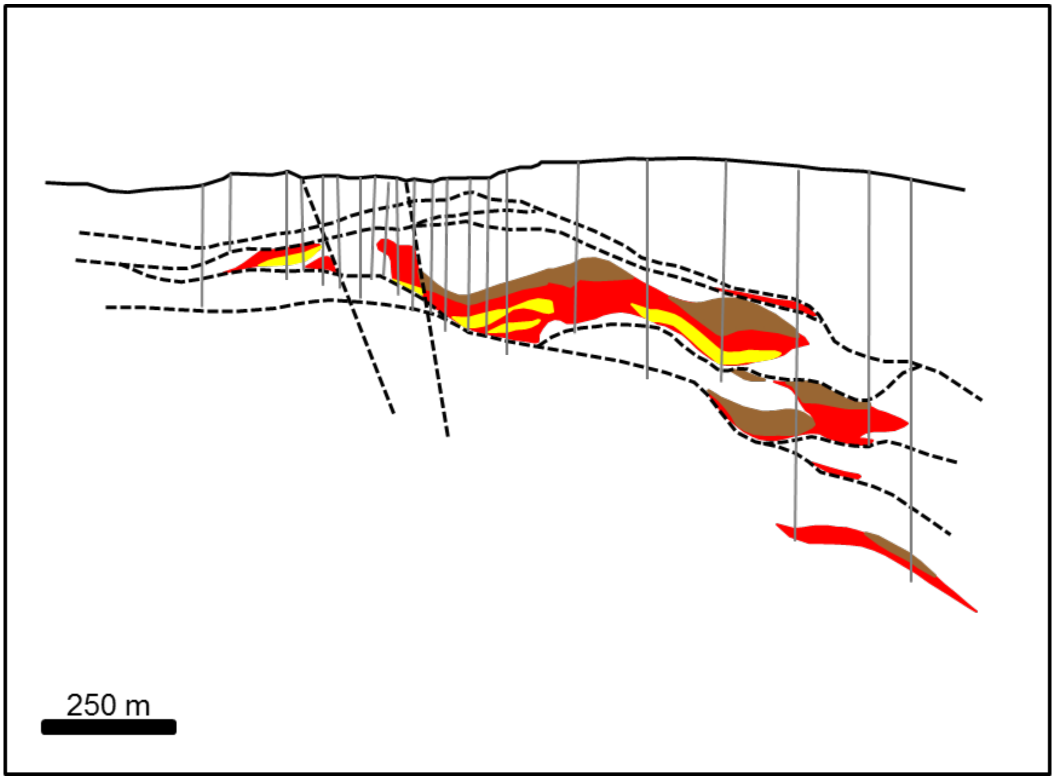

Figure 7-5: Schematic Cross Section Paalaaq Deposit

Note: Figure prepared by Teck, 2016. Looking southwest. Brown bodies represent mineralized barite, red represents mineralized silica rock and massive sulphides, and yellow represents sulphide veined unit. The dashed black lines represent geologic structures and the grey lines are drill hole traces.

7.2.4 Qanaiyaq

The Qanaiyaq deposit (known historically as the Hilltop deposit) lies approximately 600 m to the south of the Main deposit. It is contained in a flat-lying segment of the Red Dog plate that is 850 m long by 600 m wide, which has been thrust over a thick sucession of the Okpikruak Formation within the Wolverine Creek plate. The segment of Red Dog plate forms the crest of a hill, thus the limits of mineralization are well defined. Ore grade mineralization occurs in a zone that is approximately 450 m long by 300 m wide with an average thickness of 45 m.

The Ikalukrok unit hosts the mineralization. There is an internal lithostratigraphy that can be recognized including: an upper barite unit that overlies massive sulphides, and an underlying veined black shale unit.

The mineral assemblage and internal structure of Qanaiyaq is similar to that observed in the Main deposit. However, much of the deposit appears to have been eroded, as evidenced by less abundant barite and deep weathering that has oxidized most near-surface sulphides. Despite this weathering, the cores of massive sulphide lenses are often unweathered and typically have very high zinc and lead grades. The northwest part of the deposit contains locally significant chalcopyrite (assays up to 6% Cu).

A typical cross-section is included as Figure 7-6.

7.3 Aŋarraaq

The Aŋarraaq deposit is situated 6.2 km northwest of Paalaaq. It is an elongate lens-shaped massive sulphide body hosted within black, carbonaceous, siliceous shale at an average depth of 650 m). It occurs near the base of a large northeast-vergent thrust sheet in a sequence of black shale, chert and calcareous turbidite of the Ikalukrok unit. A massive barite body straddles the contact between Ikalukrok unit and the overlying Etivlik Group chert and shale, and is separated from the deposit by ~90 m. Unlike the Main, Aqqaluk, Paalaaq and Qanaiyaq deposits, the massive barite at Aŋarraaq is not mineralized.

The Aŋarraaq deposit is dominantly stratabound and consists of sphalerite, galena, and pyrite bodies. The mineralization is texturally variable and consists of both fine-grained laminated sphalerite and chaotic, breccia-textured, medium- to coarse-grained massive sphalerite. An upper zone of laminated, pale, cream-coloured sphalerite that is Ag-poor overlies a Ag-rich, brecciated zone containing very fine to coarse grained red sphalerite. Pyrite occurs throughout and exhibits a range of textures.

The mineralization, as defined by current drilling, occurs in a lenticular zone approximately 1,000 m long, 500 m wide and up to 80 m thick. The mineralized zone is contained within a larger lens of silicified and pyritic shale that is 1,200 m long, 700 m wide and 140 m thick. A cross-section through the deposit is included as Figure 7-7.

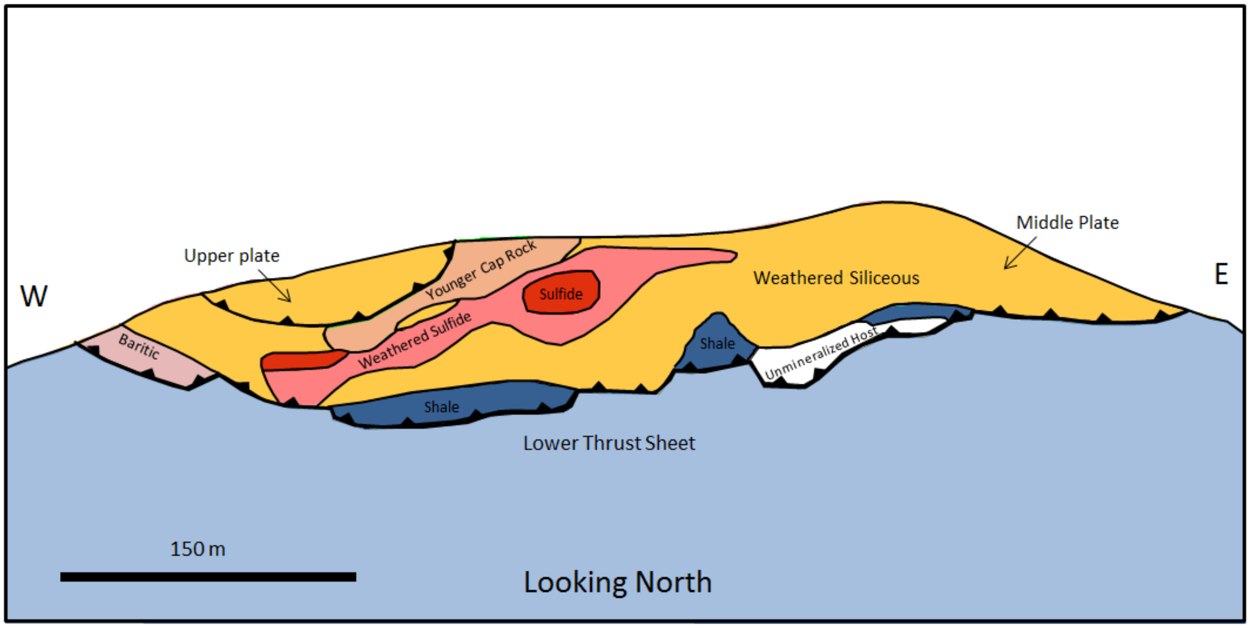

Figure 7-6: Cross Section Qanaiyaq Deposit

Note: Figure prepared by Teck, 2016.

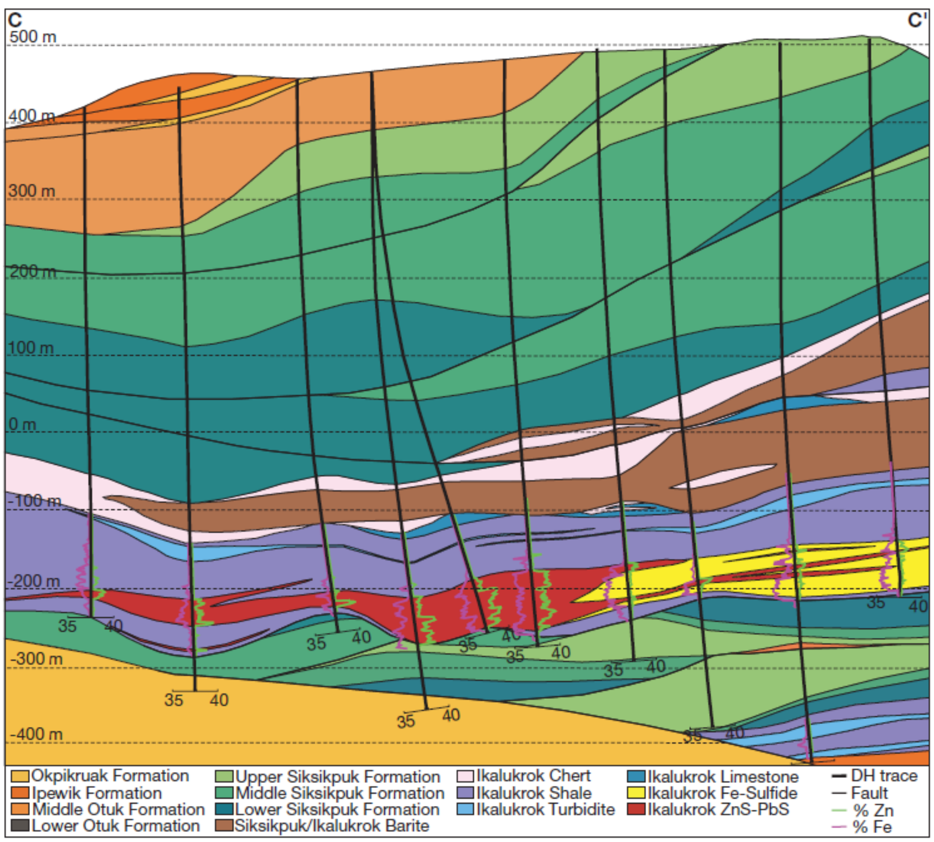

Figure 7-7: Schematic Cross Section Aŋarraaq Deposit

Note: Figure from Blevings et al., 2013. Looking west.

7.4 Aktigiruq

The Aktigiruq deposit is situated directly to the north of the Aŋarraaq deposit and roughly 12 km to the northwest of the Red Dog Mine. Aktigiruq is the most aerially extensive of the known Red Dog district deposits, and has a mineralized footprint of approximately 2,500 m by 1,300 m. The deposit dips to the southwest, and the thickest section of mineralization is roughly 850 m deep; mineralization occurs from about 400 to 1,000 m depth.

The mineralization at Aktigiruq trends northwest–southeast, and is hosted within a series of southwest-dipping thrust sheets of Ikalukrok unit strata that are terminated by a large basal thrust. The series of low-angle thrust faults have structurally repeated the mineralization, resulting in a series of stacked lenses.

Mineralization at Aktigiruq is predominantly stratabound and consists of laminated fine-grained tan sphalerite, disseminated galena and nodular pyrite. Grade variations are dominantly controlled by the abundance of sphalerite, pyrite and silicified shale. The lower to medium-grade mineralized zones consist of a combination of black silicified shale with variable abundances of millimetre-scale sphalerite laminations and massive pyrite, whereas in the higher-grade sectors, the majority of the sphalerite is either poorly laminated or massive. Brecciated zones do exist, though their spatial extent currently unknown.

No known barite body is directly associated with the Aktigiruq deposit.

7.5 Su

The Su deposit is located 22 km northwest of the Red Dog Mine and is interpreted to be situated on the same north–south trending package of Red Dog plate stratigraphy (Su sub-plate) that overlies the Wolverine Creek plate to the east, and underlies higher structural plates, including the IP Creek plate and the Kelly River Allochthon to the west.

Mineralization is truncated at depth to the west by an interpreted east-vergent back thrust separating the Su sub-plate and the Kelly River Allochthon. The double plunge of mineralization to the north and southwest is interpreted to be caused by some combination of fault-block rotation and gentle folding during the Brookian Orogeny, which has resulted in the mineralization at Su being slightly offset by a set of steeply northwest-dipping normal faults.

Limited geochemical data on the Su deposits indicate that higher zinc, lead and silver grades occur along the eastern portion of the deposit, near surface.

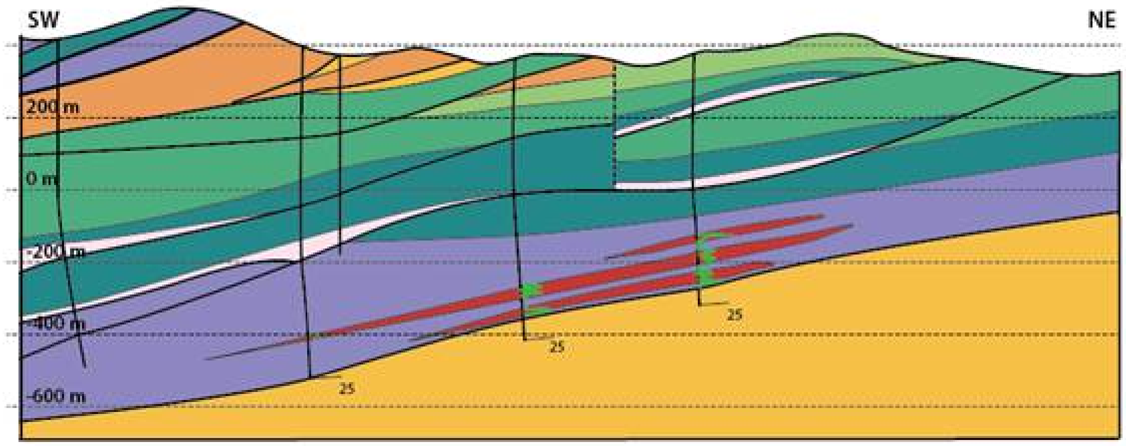

Figure 7-8: Schematic Cross Section Aktigiruq Deposit

Note: Figure prepared by Teck, 2016. Geological units are the same as in Figure 7-7.

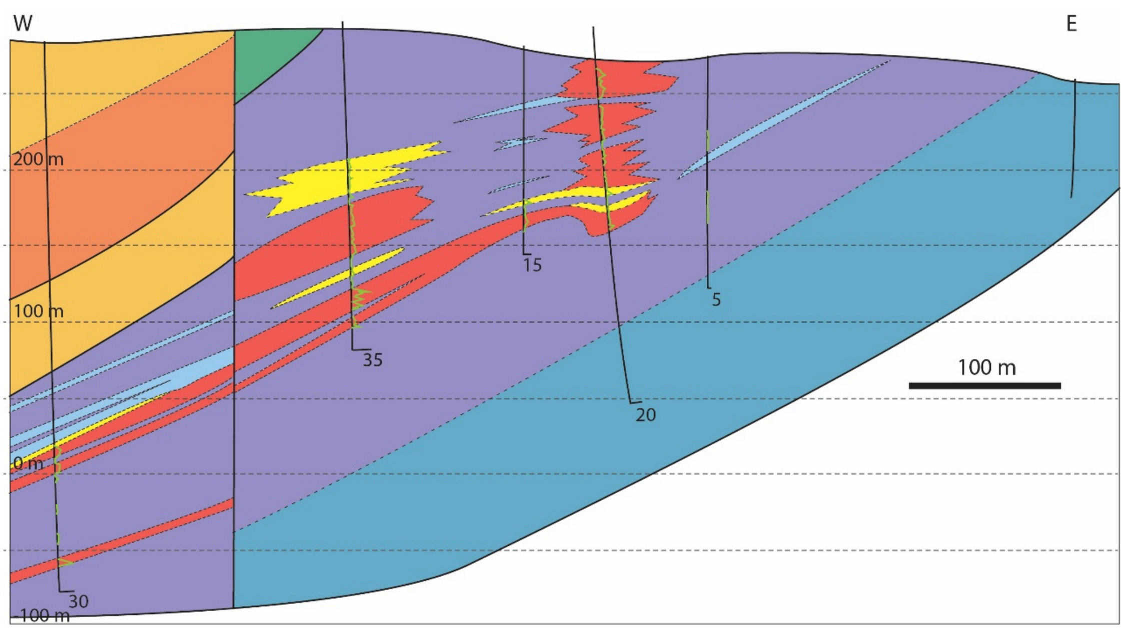

Figure 7-9: Schematic Cross Section Su Deposit

Note: Figure prepared by Teck, 2016. Geological units are the same as in Figure 7-7.

8 DEPOSIT TYPE

Sediment-hosted zinc–lead–silver deposits can be divided into two main groups: clastic-dominated deposits and carbonate replacement deposits (Leach et al., 2005, Leach et al., 2010):

- Clastic-dominated lead–zinc deposits are hosted in shale, sandstone, siltstone, or mixed clastic rocks, or occur as carbonate replacement within a clastic-dominated sedimentary rock sequence. This subtype includes deposits that have been traditionally referred to as sedimentary exhalative (SEDEX) deposits. The clastic-dominated lead–zinc deposits occur in passive margins, back-arcs and continental rifts, and sag basins, which are tectonic settings that, in some cases, are transitional into one another;
- Carbonate-hosted lead–zinc deposits occur in platform carbonate sequences, typically in passive-margin tectonic settings, and have been traditionally referred to as Mississippi Valley-type deposits.

The deposits in the Red Dog district are classified as clastic dominated, although they also exhibit characteristics of carbonate replacement deposits.

The majority of the world's major clastic-dominated lead–zinc–silver deposits formed during two main time periods: the Proterozoic and the Paleozoic (Cooke et al., 2000; Leach et al., 2010). Notable Proterozoic deposits include those of the Mt Isa belt and the Broken Hill district in Australia, and the Sullivan Mine in western Canada. Deposits of the Red Dog district (together with similar deposits in the Selwyn Basin and Kechika Trough in Canada) formed during the Paleozoic in passive margin sequences along the western edge of ancestral North America. Despite the broad similarity of age and geological setting compared with deposits in the Selwyn Basin and Kechika Trough, deposits in the Red Dog district are distinctly higher in grade. Typical zinc and lead grades for the major deposits in the Selwyn Basin and Kechika Trough are between 5% and 13% (Zn + Pb), whereas the Red Dog deposits are between 20% and 26% (Zn + Pb).

The QP is of the opinion that exploration programs that use a clastic-dominated sediment-hosted model are appropriate.

9 EXPLORATION

9.1 Introduction

Exploration work in the Red Dog District began in 1978 and has been nearly continuous with a few breaks reflecting economic cycles. Exploration work from early in the discovery and development of the deposits has included geological mapping, geochemical sampling, geophysical surveys (both airborne and ground) and core drilling.

The early-stage exploration techniques at Red Dog, such as geological mapping, geochemical sampling and geophysical surveys, have been superseded by the drilling and mining activities and are only mentioned for historical interest in this report.

Geochemical sampling focused on grab and composite rock samples where outcrop was present, and has relied on stream sediment and soil samples in areas with limited rock exposures. Geochemical sampling helped define areas of lead–zinc anomalism for further testing.

Geophysical survey methods used include airborne electromagnetics (EM), induced polarization (IP), controlled source, audio-frequency magneto-tellurics (CSAMT), time-domain electromagnetics (TEM), University of Toronto electromagnetometer (UTEM), and gravity. The original gravity and IP surveys were generally small surveys of specific claims or geological targets. More recent gravity surveys have been completed on a regional scale. Gravity is partially credited with the discovery of the Aŋarraaq deposit. Down-hole IP has also proved effective in the past at Aŋarraaq.

Since 2004, Teck has focused exploration in the Red Dog area into a systematic pipeline approach that has included detailed mapping, soil and stream sampling and various airborne and ground geophysical techniques to identify prospects that could be tested via core drilling. Beyond those deposits discussed in this report, exploration to date has not identified any additional economic mineralization. Teck continues to identify, define, and test additional targets throughout the district.

9.2 Grids and Surveys

A variety of coordinate systems and surveying methodologies have been utilized during the mining and exploration stages.

All geographic coordinates are recorded by Red Dog Mine Survey Department employees using Alaska State Plane, Zone 7 coordinates. Surface measurements and distances are provided using imperial units (US survey feet, yards, miles). Data are reported in Alaska State Plane, Zone 7, NAD of 1927, NGVD of 1929 format with 5,000,000 subtracted from the northing to conform to the local mine grid. The mine survey team currently uses Trimble TSC3 data collectors and SPS882 antenna in GPS\RTK correction mode. The nominal precision of the instrument is ±0.6 cm horizontal and ±1.2 cm vertical.

In areas around the Red Dog Property the exploration team also uses WGS84 (World Geodetic System 1984) Complex UTM (Universal Transverse Mercator) Zone 3 coordinates for mapping and geophysical surveys.

10 DRILLING

10.1 Introduction

Since 1977 Teck and its predecessor entities have drilled 394,244.7 m in 2,019 holes in the Red Dog district (Table 10-1), of which 1,821 (371, 477.4 m) are core holes, and 198 (22,767.3 m) are RC holes.

Table 10-1: Drill Summary Table

Year	Type	Purpose	# Holes	Meterage	Year	Type	Purpose	# Holes	Meterage
1977	Core	Expl	6	609.70	1996	Core	Expl	1	780.90
1978	Core	Expl	31	3,897.00		Core	Mine	49	9,679.90
1979	Core	Expl	11	1,757.90		RC	Mine	13	1,751.10
1980	Core	Expl	10	1,468.20	1997	Core	Expl	1	761.70
	Core	Mine	9	1,024.60		Core	Mine	67	16,131.50
1981	Core	Expl	17	2,001.10		RC	Mine	7	1,043.90
	Core	Mine	30	3,522.40	1998	Core	Expl	1	184.60
	RC	Expl	1	22.90		Core	Mine	9	3,542.50
1982	Core	Expl	22	3,673.40	1999	Core	Expl	40	21,719.90
	Core	Mine	35	5,009.40		Core	Mine	58	8,420.70
	RC	Expl	1	118.00	2000	Core	Expl	25	19,491.40
1983	Core	Expl	10	1,247.20		Core	Mine	106	18,226.10
	Core	Mine	34	2,176.10	2001	Core	Expl	20	13,505.20
1984	Core	Expl	9	979.20		Core	Mine	53	6,126.50
	Core	Mine	6	334.80	2004	Core	Expl	3	2,704.50
1985	Core	Expl	8	1,013.20		Core	Mine	21	3,206.60
	Core	Mine	2	156.40	2005	Core	Expl	6	1,804.30
1986	Core	Expl	13	1,502.80	2006	Core	Mine	71	9,722.20
1987	Core	Expl	3	434.30	2007	Core	Expl	10	8,788.60
1988	Core	Expl	2	677.00		Core	Mine	52	10,224.70
1989	Core	Expl	2	330.70	2008	Core	Expl	14	9,231.00
	Core	Mine	15	1,253.00		Core	Mine	66	10,648.20
1990	Core	Mine	46	5,899.10	2010	Core	Mine	22	2,268.30
1991	Core	Expl	40	4,674.70	2011	Core	Expl	13	6,251.00
	Core	Mine	5	144.80		Core	Mine	163	24,127.20
	RC	Mine	29	2,878.80	2012	Core	Expl	12	7,105.50
1992	Core	Mine	34	3,814.60		Core	Mine	49	13,412.40
	RC	Mine	64	6,416.00	2013	Core	Expl	7	4,185.20
1993	Core	Mine	35	5,062.00		Core	Mine	63	17,156.30
	RC	Mine	32	4,791.50	2015	Core	Expl	25	18,173.40

Year	Type	Purpose	# Holes	Meterage	Year	Type	Purpose	# Holes	Meterage
1994	Core	Mine	18	2,520.20	2016	Core	Mine	20	2,910.50
	RC	Mine	15	1,819.40		Core	Expl	8	5,627.50
1995	Core	Expl	5	711.30		Core	Mine	64	4,959.00
	Core	Mine	83	12,596.00					
	RC	Mine	36	3,925.80					

This drilling consists of 150,763 m (359 holes) of exploration and 243,482 m (1,660 holes) of Mineral Resource and/or Mineral Reserve definition drilling. The mine drilling is distributed among the Main, Aqqaluk, Paalaaq, and Qanaiyaq deposits, while drilling at Aŋarraaq, Aktigiruq, and Su is included in the exploration drilling meterage. Drill collars associated with each of the above deposits are shown in Figure 10-1. Prior to 2016, an additional 193 drill holes tested exploration targets. None of these targets are currently associated with economic mineralization. The majority of the Mineral Resource and Mineral Reserve drilling has been diamond drilling; however, at the Main deposit almost one quarter of the definition drilling was completed using RC methods, and at Qanaiyaq 35 of the total of 300 drill holes were completed with RC drilling.

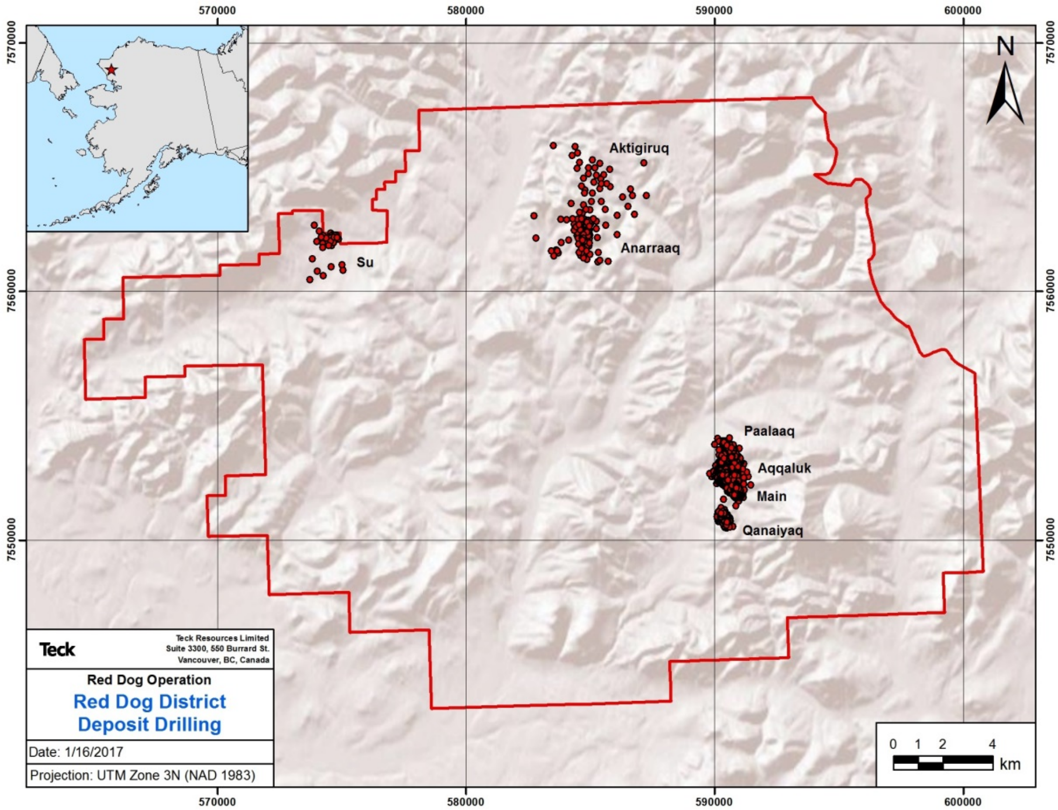

Figure 10-1: Drill Hole Collar Location Plan for Red Dog District Deposits

Note: Figure prepared by Teck, 2016. Collars from non material drill holes have been excluded from this map.

Core and RC drill hole techniques have been used to test mineralization at Red Dog as these are considered appropriate to the mineralization style of the deposit. The sole use of core drilling for Resource definition since 1998 follows industry-leading practices.

10.2 Drill Methods

In general, most coring drill holes were collared using HQ (62.3 mm diameter) core and reduced to NQ (48 mm) at greater depths. Reverse circulation holes were collared with a 146 mm bit and reduced in steps to a 130 mm bit as necessary.

Almost all of the holes at the Main, Aqqaluk, Paalaaq and Qanaiyaq deposits have been drilled vertically, with a few holes inclined for geotechnical investigations. Drilled widths of mineralization are typically greater than the mineralization true width.

Holes have been drilled to depths ranging between 13 m and 874 m, and average around 140 m. The 95 holes drilled at the Aŋarraaq deposit have generally been collared vertically but deviation at depth (depths >300 m.) is recorded. Drill hole depths at Aŋarraaq averaged approximately 760 m.

Blast holes are typically 165 mm in diameter and drilled to bench grade (7.6 m) plus a sub-drill depth (1.2 m) for a total typical depth of 8.8 m. Pattern spacing depends upon expected material type but ranges from 4.9 m x 5.6 m in unmineralized softer shales to 3.6 m x 4.1 m in siliceous ore. Blast holes do not support Mineral Resource or Mineral Reserve estimation.

10.3 Drilling Extent by Deposit

10.3.1 Main Deposit

Between 1980 and 2011, 54,385 m of drilling in 441 core drill holes and 19,169 m of drilling in 156 RC holes was completed at the Main deposit. An additional 257 m of drilling in five geotechnical holes was completed in 2010 to assess pit wall stability and 175.6 m of drilling in five holes was completed in 2011 to confirm mineralization at the bottom of the southern lobe of the pit.

A drill collar location plan showing the drill collars in the Main, Aqqaluk, and Paalaaq deposit areas is included as Figure 10-2.

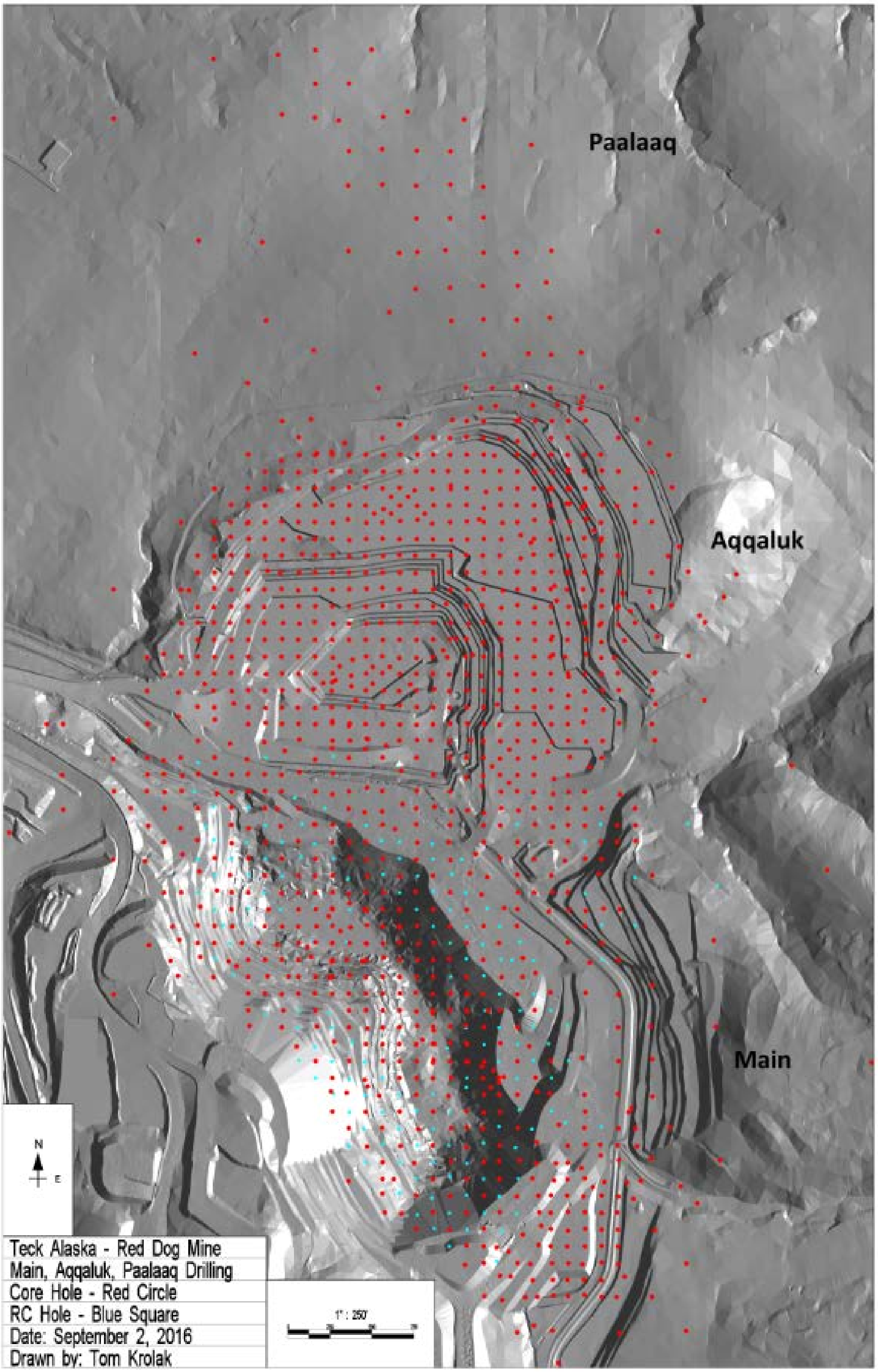

Figure 10-2: Drill Hole Collar Location Plan, Main, Aqqaluk and Paalaaq Deposits

Note: Figure prepared by Teck, 2016.

10.3.2 Aqqaluk Deposit

In the period from 1980 to 2016, 661 core holes (107,113 m) and five RC holes (558 m) have been completed (Table 10-2). Drill collar locations were included in Figure 10-2.

Drill spacing is nominally 30 m x 30 m over the majority of the deposit. Along the northern and western edges, the drilling density decreases.

Table 10-2: Aqqaluk Deposit Drilling History

Year	**1980**	**1981**	**1982**	**1985**	**1991**	**1992**	**1994**	**1995**	**1996**
Core Holes	2	7	1	2	11	2	2	50	20
Metres	195	748	55	156	1,465	235	391	9,316	3,223
RC Holes	—	—	—	—	2	—	—	2	—
Metres	—	—	—	—	168	—	—	244	—
Total Holes	*2*	*7*	*1*	*2*	*13*	*2*	*2*	*52*	*20*
Total Metres	*195*	*748*	*55*	*156*	*1,633*	*235*	*391*	*9,560*	*3,223*
Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2004**	**2006**	**2007**	**2008**
Core Holes	31	4	29	59	4	16	71	49	66
Metres	5,407	388	3,625	11,883	609	2,497	9,722	7,965	10,648
RC Holes	1	—	—	—	—	—	—	—	—
Metres	146	—	—	—	—	—	—	—	—
Total Holes	*32*	*4*	*29*	*59*	*4*	*16*	*71*	*49*	*66*
Total Metres	*5,553*	*388*	*3,625*	*11,883*	*609*	*2,497*	*9,722*	*7,965*	*10,648*
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016 ***		**Total**
Core Holes	17	105	18	23	25	20	27		661
Metres	2,011	20,568	3,206	3,550	3,116	2,911	3,221		107,113
RC Holes	—	—	—	—	—	—	—		5
Metres	—	—	—	—	—	—	—		558
Total Holes	*17*	*105*	*18*	*23*	*25*	*20*	*27*		*666*
Total Metres	*2,011*	*20,568*	*3,206*	*3,550*	*3,116*	*2,911*	*3,221*		*107,671*

Note: *Drilling not included in current Resource estimate.

10.3.3 Paalaaq Deposit

Since 1995, 97 diamond drill holes have been drilled for a total of 41,584 m in the Paalaaq deposit area (Table 10-3). Drill spacing in this area is nominally 60 m x 60 m. Drill collar locations were included in Figure 10-2.

Table 10-3: Paalaaq Deposit Drilling History

Year	1982	1995	1996	1997	1998	1999	2007	2013	2014	Total
Core Holes	1	1	6	16	5	1	3	26	38	97
Metres	337	195	3,161	7,811	3,155	763	2,260	9,862	14,041	41,584

10.3.4 Qanaiyaq Deposit

The Qanaiyaq deposit is defined by 265 cored holes, totaling 17,774 m of drilling and 35 RC holes totaling 2,900 m (Table 10-4). The majority of the area is drilled out at 30 m x 30 m. Figure 10-3 shows the drill hole collars in relation to the ultimate pit outline.

Table 10-4: Qanaiyaq Deposit Drilling History

Year	1981	1983	1989	1992	1995	2001	2004	2011	2012	2016 *	Total
Core Holes	2	6	12		15	9	5	53	126	37	265
Metres	203	386	782		999	728	709	3,384	8,844	1,738	17,774
RC Holes				20	15						35
Metres				1,660	1,241						2,900
Total Holes	*2*	*6*	*12*	*20*	*30*	*9*	*5*	*53*	*126*	*37*	*300*
Total Metres	*203*	*386*	*782*	*1,660*	*2,240*	*728*	*709*	*3,384*	*8,844*	*1,738*	*20,674*

Note: *Drilling not included in current Resource estimate.

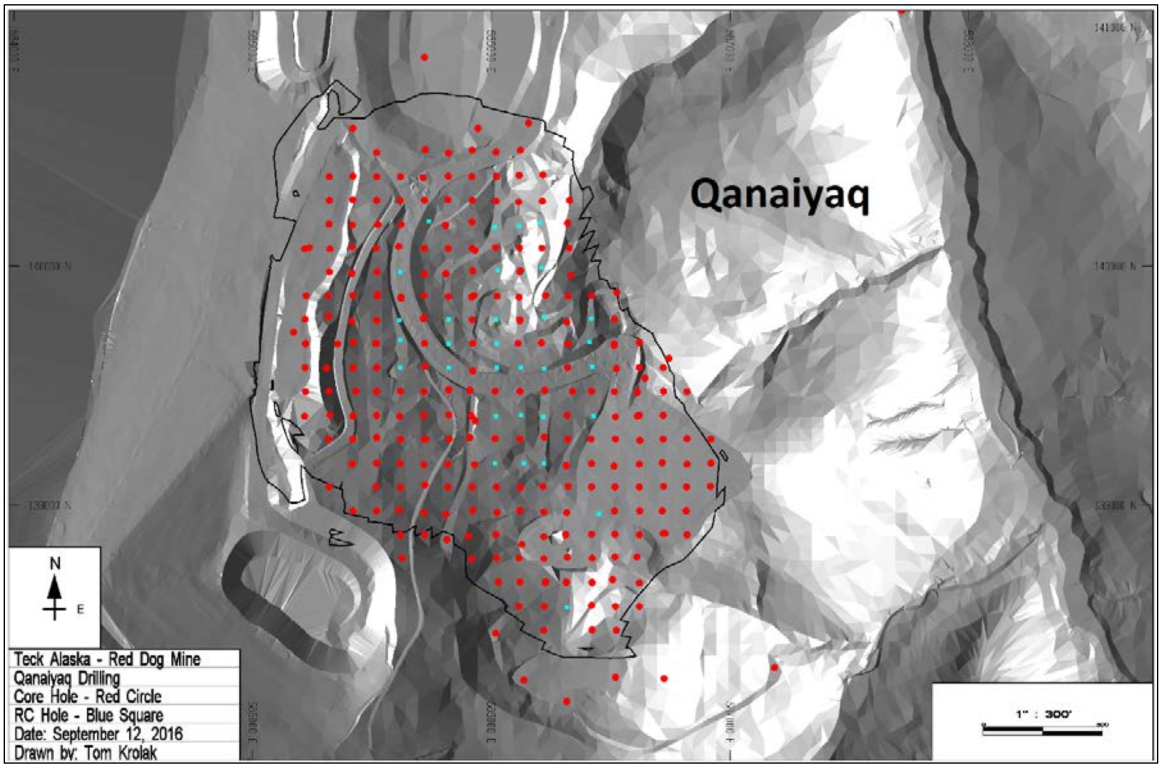

Figure 10-3: Drill Hole Collar Location Plan, Qanaiyaq Deposit

Note: Figure prepared by Teck, 2016.

10.3.5 Aŋarraaq Deposit

Ninety-five drill holes have been completed at the Aŋarraaq deposit to date, for a total of 66,393.4 m of core (Table 10-5). Drill spacing at this deposit is nominally 60 m x 60 m. A collar location plan is included as Figure 10-4.

Table 10-5: Aŋarraaq Drilling History

Year	1981	1999	2000	2001	2007	2008
Core Holes	1	22	19	2	2	2
Metres	112	14,674	15,478	804	1,612	1,532
Year	**2011**	**2012**	**2013**	**2015**	**2016 ***	**Total**
Core Holes	4	8	7	22	6	95
Metres	2,845	5,182	4,154	16,033	3,966	66,393

Note: *Drilling not included in current Resource estimate.

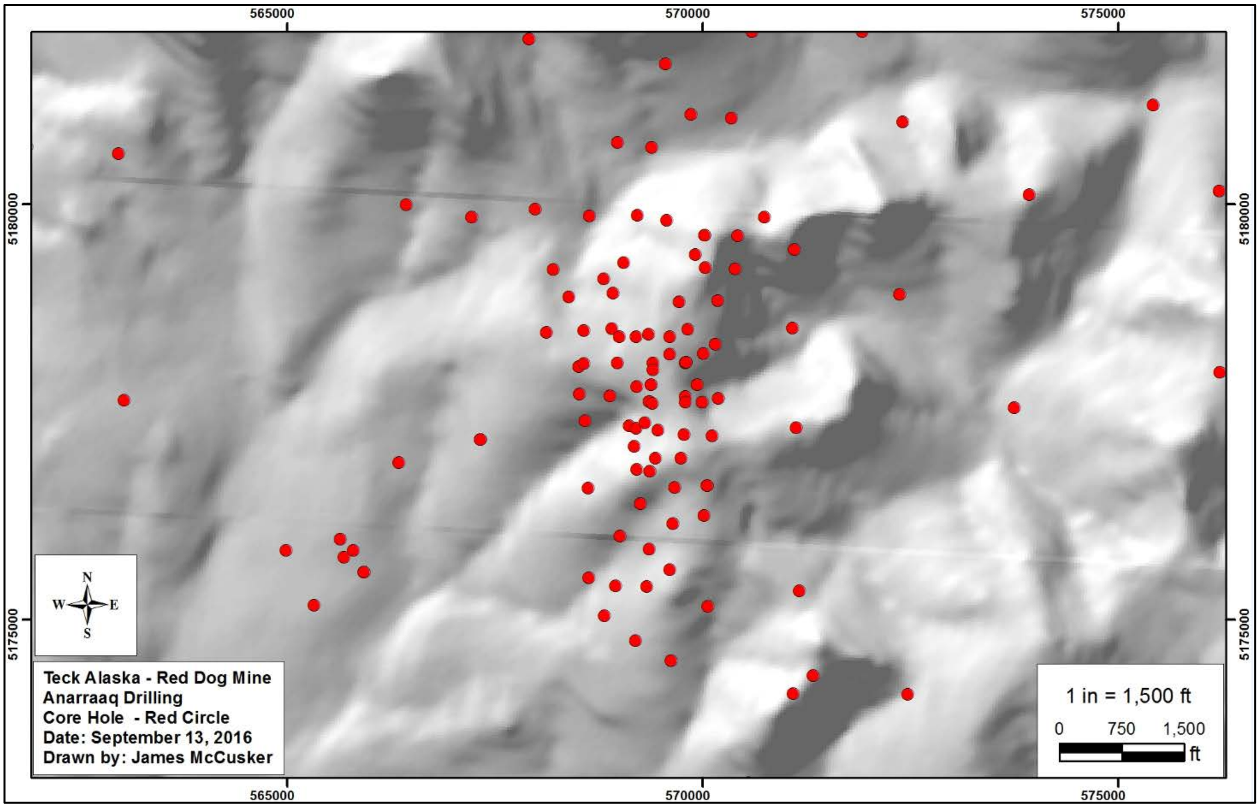

Figure 10-4: Drill Hole Collar Location Plan, Aŋarraaq Deposit

Note: Figure prepared by Teck, 2016.

10.3.6 Aktigiruq Deposit

Twenty-nine holes have been completed at Aktigiruq deposit to date for a total of 23,955.4 m of core (Table 10-6). Drill spacing at this deposit is still large, nominally at 350 x 350 m. A collar location plan is included as Figure 10-5.

Table 10-6: Aktigiruq Drilling History

Year	1999	2000	2004	2007	2008	2014
Core Holes	2	3	3	8	8	1
Metres	886	2,958	2,704	7,162	6,432	624
Year	**2015**	**2016**				**Total**
Core Holes	2	2				29
Metres	1,516	1,658				23,995

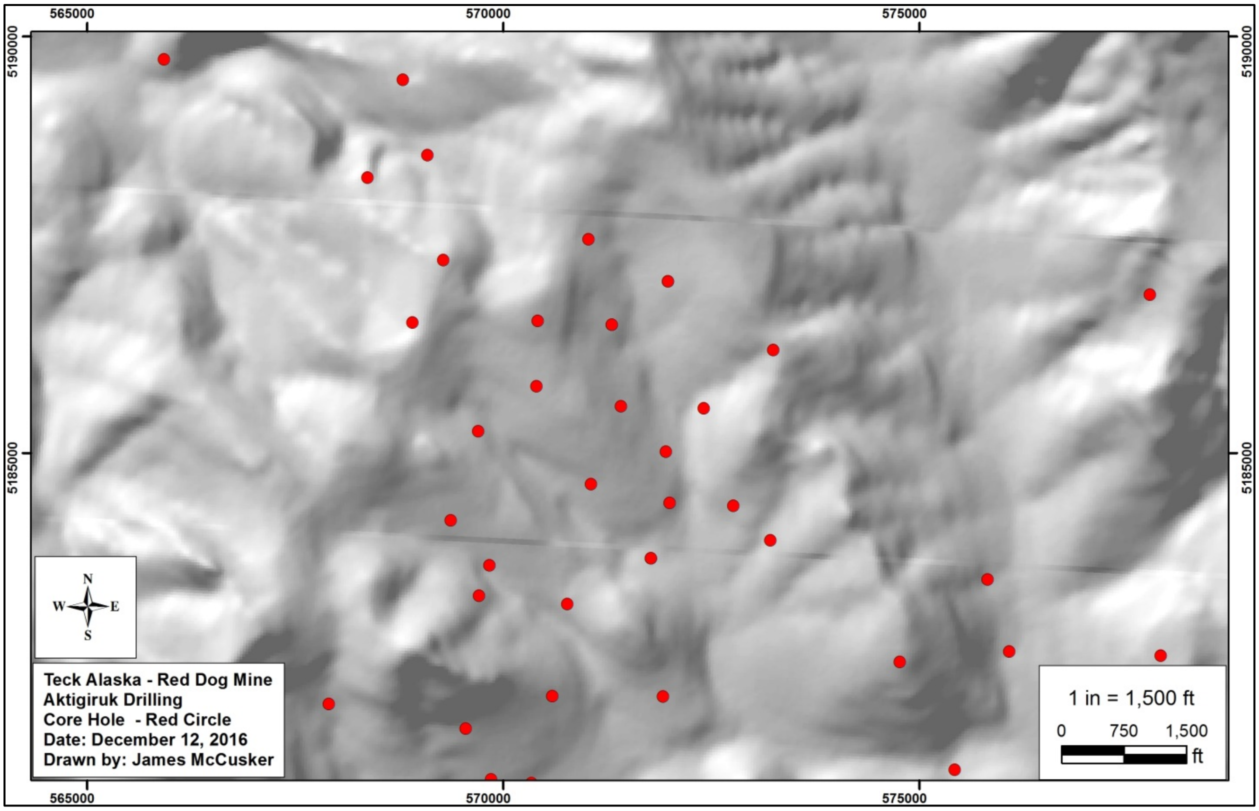

Figure 10-5: Drill Hole Collar Location Plan, Aktigiruq Deposit

Note: Figure prepared by Teck, 2016.

10.3.7 Su Deposit

Thirty-three holes have been completed at Su to date, for a total of 8,877.5 m of core (Table 10-7). Limited information exists for this deposit. A collar location plan is included as Figure 10-6.

Table 10-7: Su Drilling History

Year	1977	1978	1979	1980	1981	1982
Core Holes	2	11	7	2	1	3
Metres	412	2,679	2,905	926	221	283
Year	**1983**	**1985**	**1987**	**1990**	**1992**	**Total**
Core Holes	1	1	1	1	2	33
Metres	105	342	182	290	290	8,877.5

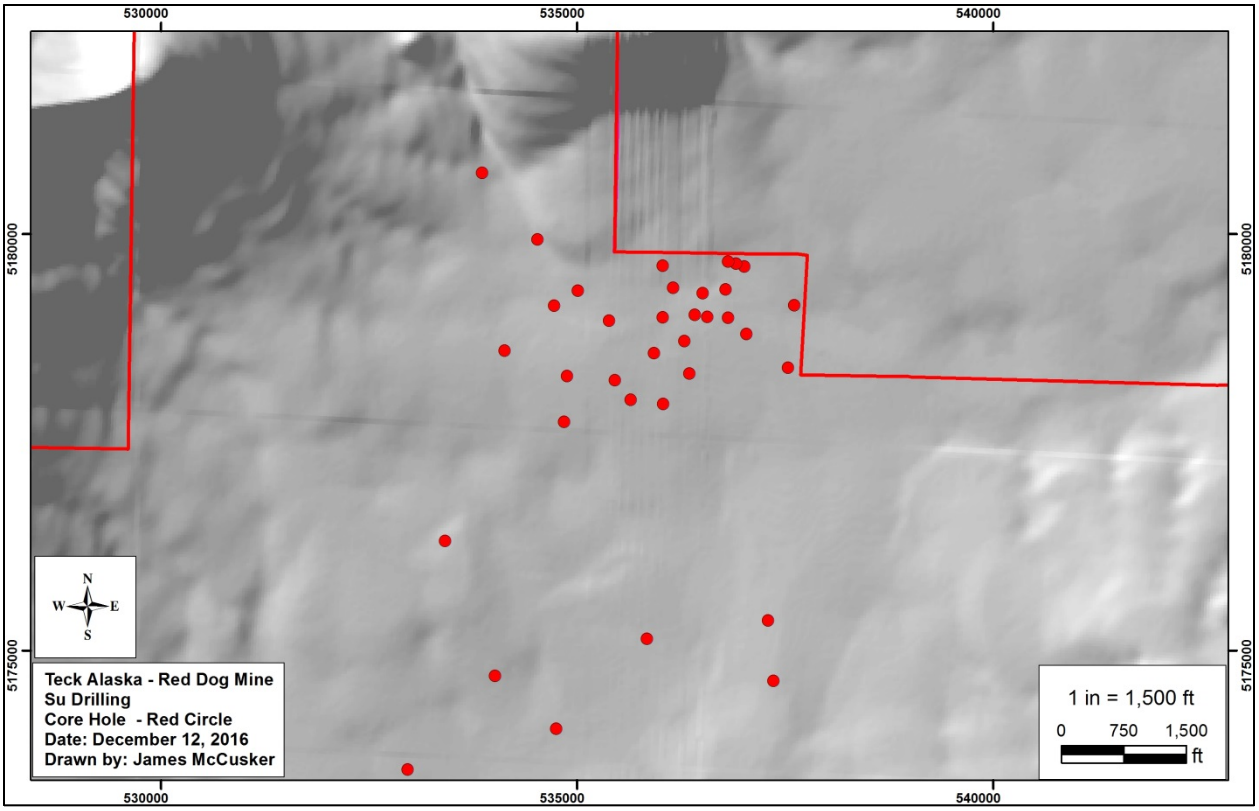

Figure 10-6: Drill Hole Location, Su Deposit

Note: Figure prepared by Teck, 2016.

10.4 Core Recoveries

In general, core recoveries obtained by the drilling contractors have been very good, on average exceeding 90%, except in localized areas of faulting or fracturing, or in surface oxidized (heavily weathered) rock.

In 2007, AMEC analyzed recovery data from 53 core holes, including nine from Aŋarraaq. Recoveries ranged from 76.1% to 97.5%, and the mean recovery from surface was 92.05%. These estimates include drill holes affected by poor surface drilling conditions, but are considered representative for Paalaaq, Aqqaluk, and Aŋarraaq.

Review of recovery data from Qanaiyaq has indicated somewhat lower recoveries. Recoveries in 37 drill holes completed in 2016 ranged between 25% and 96%, with a mean recovery of 65% (per drill hole). The effects of low recovery on overall grade are unknown; however, they are considered to be more likely to affect fractured and oxidized zones near the surface.

10.5 Collar Surveys

Collar locations are set out pre-drilling by the mine survey department with wooden stakes marking the collar and 15.2 m (50 ft) and 22.9 m (75 ft) offset positions. The off-set stakes are used to re-site the collar position if the collar stake is moved during drill pad preparation.

Following drilling, the collar position is re-surveyed and “As-Built” x, y, and z coordinates are provided to the exploration team for entry into the acQuire database.

Magnetic azimuth measurements are corrected to grid north with a declination correction.

The mine’s surveyors, with the exception of some of the more remote and pre-1985 holes, have also surveyed the collar locations of most of the exploration holes on other parts of the Project area.

Blast holes locations were historically laid out by the surveyors but are now programmed into the drill GPS system and those locations are loaded into the MineSight database for use in the ore control system to determine tonnes and metal grades of material in a blast. Surveyors pick up the blast hole locations after the holes have been drilled as a check on the GPS and those locations are used in the blast tie-in map.

10.6 Downhole Surveys

Magnetic tools have been the preferred downhole survey tool due to the lack of background magnetic interference from the stratigraphy and the relatively low cost.

Since 1997, all holes in excess of 150 m have been surveyed with a down hole instrument. These longer holes were surveyed at 150 m intervals and at the final hole depth using a single-shot Sperry Sun instrument. Since 2001 a Reflex surveying system has been used with individual readings. Experience has indicated that there is very little deviation in holes less than 150 m. Before 1997, the only holes with down-hole surveys were from 1982–1983. More recently (from 2013 to date) drill hole orientations have been surveyed more consistently at approximately 30 m intervals using Reflex’s “EZ Shot” digital logging tool.

A 2015 study comparing measurements using the EZ-Shot single-shot (30 m spacing) and multi-shot survey (6 m spacing) methods, a Reflex MEMS Gyro and an acoustic televiewer with an inbuilt magnetic orientation tool determined that the 30 m spacing of the EZ-Shot single-shot surveys was adequate for capturing hole orientations.

10.7 Drilling Sampling and Logging Procedures

10.7.1 Core Drilling

All drilling, logging and sampling at the Red Dog mine is conducted using the US standard system of measurement (decimal feet). Once drilled, core is removed from the core barrel by the drillers, washed and placed in plastic or wax-coated core boxes.

All boxes and box lids are well identified with the hole number, feet “from–to”, and box number written with a permanent marker on the front. Individual drill runs are identified with small wooden blocks, where the depth (feet) and hole number are recorded. Core boxes are transported to the core logging facility at the mine complex several times a day.

Since 2001 all core has been photographed wet, after logging, and before sampling takes place.

10.7.1.1 Geological Logging

A geologist completes a written log for the hole, which includes geological information. All geological information is ultimately incorporated into an acQuire GIM Suite database. Geotechnical information was also logged on paper until 2013, after which direct-to-digital geotechnical logging using acQuire was implemented. The geological data captured include identification of specific geological formations, colour, measurements of structural features relative to the core axis (bedding, foliation, cleavage), any inclusions of bitumen, nature of fracture filling and a geological description. The geological description is a complete visual description of the core, and includes such items as: hardness, grain/crystal sizes, textures, lithological characteristics, deformation styles, sedimentary and structural features, spatial relationships, contact styles, and a comprehensive description of the mineralization.

The geologist also visually estimates the percentage content of lead, zinc, iron and barium.

10.7.1.2 Geotechnical Logging

The geotechnical data captured include total core recovery (TCR), rock quality designation(RQD), fracture frequency, rock strength and weathering/alteration estimates (ISRM 1981 and Brown 1981 standard field identification methods), and detailed discontinuity information, including: feature classification, orientation, surface properties and infill characteristics. Detailed geotechnical logging procedures were established by Golder Associates and geotechnical logging is carried out by TAK exploration geologists.

Historically, point load tests (PLT) were conducted on site as requested by the engineering department; however, since 2013, PLT testing has been conducted systematically every ~ 9 m in core drill holes. These tests are performed at the mine site.

10.7.1.3 Density/Specific Gravity

Specific gravity measurements are conducted on site on the same samples as the PLT measurements. SG/PLT samples are selected to be as close to 10 cm intervals as possible and should be representative of the overall interval from which it is taken. Pieces containing vein material, or unrepresentative material are not selected. Specific gravity is measured using water displacement tests. The procedure is to measure the sample both dry and then suspended in water. Dry sample weights are measured using air-dried samples; an oven is not used. Density is calculated using the following formula:

$$density = \frac{dry\ mass}{dry\ mass - immersed\ mass}$$

Physical specific gravity measurements are used to support the values obtained using the tonnage factor formulae, and modify if necessary, the different density algorithms used in each resource model (refer to Section 14.5).

10.7.2 Reverse Circulation Drilling

No RC drilling has been undertaken within the Project area since 1997. RC drilling comprised about 24% of the drilling at the now mined-out Main Deposit (160 of 667 holes) and consists of about 14% of the drilling total at the Qanaiyaq deposit (35 of 300 holes). No RC drilling was performed at Paalaaq, and the five RC holes at Aqqaluk represent about 0.5% of the drilled metreage total.

Similar to the core drilling, RC logging and sampling at the Red Dog Mine is performed using US standard units (decimal feet).

10.7.2.1 Geological Logging

RC chip descriptions were based on 1.5 m sample intervals. The header information on the first page of each drill log contains similar information to the core logs. Geological information is plotted in three columns labelled rock type/description, colour, and oxide. The last five columns contain the sample number of each interval and the estimated grade of lead, zinc, iron, and barite.

The sample is viewed with a binocular microscope and hand lens to determine lithology, colour, grain size, extent of oxidation, estimated grade, and any other observations for the sample.

10.7.3 Blast Hole Drilling

No geological logging is completed for the blast holes.

11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

Sampling programs on the Project have included stream sediment, soil, surface rock, rock chip, drill core, RC and blast hole samples. All of the sampling was carried out by TAK/TCAK personnel or contractors (or prior to 2001 by Cominco American Incorporated). All of the early stage sampling methods have been superseded by diamond and RC drilling and blast hole sampling.

11.1 Sampling Procedures

11.1.1 Core Drilling

Sampling for Resource estimation has been conducted on diamond drill core obtained from holes drilled between 1980 and 2016. The 2016 holes are not included in the Resource update discussed in this report. Samples are selected based on the visual presence of trace mineralization, and sampling extends approximately 25 ft (7.6 m) above and below mineralization. Samples are selected using five criteria:

- Presence of trace or greater zinc mineralization;
- Standard, and average, 5 ft (1.5 m) sample size (can range from 3–7 ft as necessary);
- Consistent zinc grade based on visual estimates;
- Consistent recovery (samples do not cross zones with no recovery);
- Formational contacts are honoured.

Prior to sampling, core is refitted back to its original orientation to ensure unbiased sampling. Sample lines and arrows are drawn down the centre of the core with a lumbar crayon of the core to designate where core should be split. Arrows marking the start and end of each sample are drawn on the inside of the core box using a black permanent marker, and the sample tag is stapled inside the core box at the start of each sample. Each core box is photographed wet after samples have been marked, but before sampling. Photographs are checked for quality prior to sampling and retaken if necessary.

Prior to 2014, a pneumatic splitter was used to split samples. Since 2014, samples have been cut using an automatic circular saw, in which core is fed through the saw using plastic trays and an automatic core feeding system.

One half of the core is sent for sampling and the other half remains in the core box as a permanent record, although in some cases whole core samples have been used for metallurgical test work.

11.1.2 Reverse Circulation Drilling

Reverse circulation drilling was completed during the 1991 to 1997 drilling campaigns at the Main deposit, in the 1991, 1993 and 1997 campaigns at the Aqqaluk deposit and the 1992 and 1995 drilling campaigns at the Qanaiyaq deposit. There were two exploration RC holes drilled, one in 1981 and one in 1982. The majority of the RC holes were in the now mined-out Main deposit.

RC samples were collected at 5 ft (1.5 m) intervals using a hydraulic sample splitter. The driller was required to clear out the drill hole prior to the next sample being drilled and collected.

If water was encountered, the excess water was allowed to overflow from the bags as long as rock chips are not being washed out of the bag. If the sample water was muddy with considerable suspended material, a five gallon bucket was placed under the sample port and the rock chips and muddy water were collected. The five gallon bucket was set aside at the end of the sample interval to settle out before it was decanted and put in a sample bag.

Samples were placed in pre-labelled cloth bags, and the hole number, sample number and drilled interval were recorded. Representative samples of each drill interval were retained in plastic chip boxes.

11.1.3 Blast Hole Drilling

Blast holes are drilled with Atlas Copco DM-L drills, and holes are drilled and sampled by Teck employees.

Blast holes are typically 165 mm in diameter and drilled to bench grade (7.6 m) plus a sub-drill depth (1.2 m) for a typical total depth of 8.8 m. Exceptions are shots along the final highwall, where sub-drill varies and is sometimes eliminated along the back row of holes.

Pattern spacing depends upon expected material type.

Blast hole sampling is done using a pipe sampler that is closed at the bottom. Typically, every hole in a blast pattern is sampled. The samples are collected in polyurethane bags by the drillers, and the drillers transport the samples to the preparation laboratory. No quality assurance or quality control (QA/QC) samples are inserted in the sample stream by the mine but the Red Dog laboratory does have internal QA/QC protocols (standard reference materials and duplicates) it follows when analyzing blast hole samples.

11.1.4 Summary

Sampling procedures for core and RC drill holes are in line with industry standards, and acceptable for use in Resource and Reserve estimation.

11.2 Analytical Laboratories

Prior to the mine start-up in 1989, all sample preparation and analysis was done at Cominco Ltd.'s Exploration Research Laboratory (ERL) in Vancouver, BC. From 1990 to 2012, all analytical work was done on site at the RDM-AL. In 2010 and 2011, sample infill and exploration analysis was conducted by the RDM-AL, with a subset of data (~50%) also analyzed for zinc, lead, iron, copper and silver by Acme in Vancouver. All sample preparation in 2010 and 2011 was conducted by the RDM-AL and pulps were sent to Acme for additional analysis where required.

At present and since 2013, all sample preparation and analysis of Red Dog pit infill and exploration core has been carried out by Bureau Veritas Commodities Canada Ltd. (BV), formerly Acme Analytical Laboratories Ltd (Acme), in Vancouver, BC. Production and metallurgical sample preparation and analyses are carried out by the Red Dog Mine Assay Laboratory (RDM-AL).

The RDM-AL and ALS Vancouver both serve as check laboratories for BV for exploration samples. Both laboratories use assay methods dissimilar to BV but suitable for the quantification of total zinc, lead, and silver.

The RDM-AL is an in-house laboratory directly under the control of the company and at the Report effective date does not have any formal certification. BV in Vancouver is certified to ISO 9001 (certificate No: FM 63007) and ISO/IEC 17025 for selected methods. ALS Vancouver holds ISO/IEC 17025 accreditations for specific analytical methods.

11.2.1 Red Dog Mine Assay Laboratory

11.2.1.1 Sample Preparation and Shipment

At present, no drill core is sent to the RDM-AL. The facility is well-equipped and the staff well-trained. All sample preparation procedures and QA/QC protocols were established by the RDM-AL and previously by Cominco American Incorporated. The facility has the capacity to process 1,300 to 1,400 samples per month from a combination of blast hole, mill, environmental and concentrate shipping samples. Before 2012, exploration samples were processed at the RDM-AL. From that date onward, split core samples have been forwarded to BV for sample preparation.

Sample preparation involves drying, crushing, and pulverizing. No crushing is used for production, mill or concentrate samples; before 2012, core samples were jaw crushed to 90% passing 2 mm. Samples are pulverized in a ring and puck pulverizer to achieve nominal 90% at -125 mesh. No regular sieve checks are done to check this protocol; however, a particle size analyzer is periodically used to assess the fineness of the pulverized material. The equipment is cleaned with compressed air and occasionally “green sand” if the clay content is high. No pulp rejects are generated.

The laboratory includes standard reference materials (SRMs) and duplicates with every batch of production or mill samples; prior to 2012, laboratory personnel inserted the preparation duplicates and standard reference materials in exploration jobs where requested by geologists.

11.2.1.2 Analyses

Prior to 2012, core and blast hole samples were routinely assayed by the laboratory according to the protocols shown in Table 11-1. Daily mill and concentrate shipping samples are routinely assayed by the laboratory according to the protocols shown in Table 11-2.

Table 11-1: Red Dog Analysis on Drill Core, RC Cuttings, Blast Holes prior to 2012

Element	Symbol	Analytical Method	Analytical Detection Limit
Lead	Pb	30 ml aqua regia digestion/AA	0.4%
Zinc	Zn	30 ml aqua regia digestion/AA	1.0%
Iron	Fe	30 ml aqua regia digestion/AA	0.5%
Barium	Ba	XRF/ Powder	0.5%
Silica	Si	XRF/ Powder	4%
Non-sulphide Lead	sPb	Weak acid leach/AA	0.2%
Non-sulphide Zinc	sZn	Weak acid leach/AA	0.2%
Silver	Ag	30 ml aqua regia digestion/AA	1 oz/t
Copper	Cu	30 ml aqua regia digestion/AA	0.004%
Sulphur (elemental)	S	Solvent leach/ gravimetric	0.01%
Total Organic Carbon	TOC	Leco	0.1%

Table 11-2: Red Dog Analysis on Daily Mill and Concentrate Samples prior to 2012

Element	Element	Analytical Method	Analytical Detection Limit
Lead	Pb	30 ml aqua regia digestion/AA	0.3%
Zinc	Zn	30 ml aqua regia digestion/AA	0.6%
Iron	Fe	30 ml aqua regia digestion/AA	0.5%
Silver*	Ag	30 ml aqua regia digestion/AA	1 oz/t
Cadmium**	Cd	30 ml aqua regia digestion/AA	—

Note:*Daily mill samples only. **Concentrate samples only.

In 2012, the laboratory was upgraded and a WD-XRF was installed. Since 2012, the WD-XRF has become the primary analytical tool and the protocols were updated to the protocols shown in Table 11-3 and Table 11-4.

Table 11-3: Red Dog Analysis on Drill Core, RC Cuttings, Blast Holes since 2012

Element	Symbol	Analytical Method	Analytical Detection Limit
Lead	Pb	Pressed pellet XRF	0.2%
Zinc	Zn	Pressed pellet XRF	0.2%
Iron	Fe	Pressed pellet XRF	0.2%
Barium	Ba	Pressed pellet XRF	0.2%
Silica	Si	Pressed pellet XRF	2%
Silver	Ag	Pressed pellet XRF	1 oz/t
Cadmium	Cd	Pressed pellet XRF	0.01%
Copper	Cu	Pressed pellet XRF	0.01%
Sulphur (elemental)	S	Solvent leach/ UV spectrophotometer	0.01%
Total Organic Carbon	TOC	Leco	0.05%

Table 11-4: Red Dog Analysis on Daily Mill & Concentrate Shipping Samples since 2012

Element	Element	Analytical Method	Analytical Detection Limit
Lead	Pb	Pressed pellet XRF	0.2%
Zinc	Zn	Pressed pellet XRF	0.2%
Iron	Fe	Pressed pellet XRF	0.2%
Silver*	Ag	30 ml aqua regia / AA	1 oz/t
Cadmium**	Cd	30 ml aqua regia / AA	0.01%

Note:*Daily mill samples only. **Concentrate samples only

Prior to all exploration preparation and analysis being completed at an external laboratory in 2013, all coarse rejects were stored at the mine; however, the volume of the material and degradation due to oxidation made this impractical to continue. When a drill program was planned, it was decided what, if any, reject material would be required for metallurgical work. If coarse rejects were required, they were stored in nitrogen-flooded, vacuum-sealed plastic bags. Only those rejects over 6% Zn were retained. Upon completion of the drill program, the appropriate rejects were selected for compositing and metallurgical test work. Once samples were no longer needed for test work, they were discarded.

Commencing in 2006, the mine laboratory has reported the results digitally to the geology department, as well as submitting signed paper certificates. Prior to 2006, only electronic versions were consistently received by the geology department; signed assay certificates were not routinely provided. All hard copy certificates are stored in a well-organized manner in a secure location on site.

11.2.1.3 RDM-AL QA/QC Activities

Before 2012, samples submitted by the mine were subject to only a limited quality control program. The geology department submitted duplicates and standards within each batch of 10 to 15 samples. The department maintained an inventory of about five to 10 pulp standards of varying grade ranges and ore types that were custom made on site from ore in the pit. Standards selected for insertion were similar in grade and mineralogy to the accompanying sample batch. No split core duplicates, coarse or fine blanks, or external check assays were included as part of the QA/QC program.

During the logging process the geologist marked up the core to indicate which samples were to be duplicated and during sample preparation a pulp or reject duplicate was made from the sample. Since the geology department requested the laboratory to duplicate samples and insert the standards, none of the QA/QC program can be considered “blind” to the laboratory. No QA/QC program was in place for the blast hole or mill samples prior to 2012.

Since 2012, no core has been processed at the RDM-AL. A QA/QC program was implemented for blast hole, mill and concentrate samples. Standards are included with every batch of samples and blast hole split duplicates are included with every batch of production samples.

Upon completion of the analysis of the QA/QC samples, the laboratory reviews the results and informs the geology department. Duplicates that exceed 6% difference are requested to be checked by the laboratory. Any standards that exceed a two-standard deviation (SD) difference of the "Best Value" are re-analyzed along with the entire batch.

11.2.1.4 Standard Reference Materials

Teck utilizes standard reference materials (SRMs) that are prepared in-house. For standards 21 through 30, the best values are established on the basis of multiple results (typically three samples of each standard) from a small number of independent laboratories (typically three), plus the Red Dog laboratory (RDL) for most elements (except non-sulphide lead, silver, and total organic carbon). Thus Red Dog's round robin-derived values are typically based upon four laboratories. Most round robins for geological standard reference materials use more laboratories than this, but few laboratories are competent to deal with the very high zinc and lead grades encountered at Red Dog, particularly with the complications of a high barite matrix.

Teck calculated the mean of the results from each laboratory and then calculated the mean of these, which is equivalent to using the global mean of all the results since each laboratory assayed each SRM the same number of times. Standard 21 lead results were an exception, where Teck discarded the results from one particular laboratory because they were much lower than the other three laboratories.

More recently, the laboratory has routinely control charted their standard performance to ensure that they are maintainning a consistent quality. The laboratory currently regularly uses four in house standards (a zinc concentrate, a lead concentrate and high-grade and low-grade geological material). These are included in every batch of samples processed by the laboratory. A control chart for zinc in the zinc concentrate standard in all determinations since 2011 shows good control, with a total coeffecient of variation (CV) of <1% and a bias of 0.1% if outliers are left in. Approximately 3% of the dataset are outliers at two SDs from the mean, which is acceptable. The coeffecient of variation of the results is very low (<1%). While this standard for zinc demonstrates particularly good control, there is also good control demonstrated in all standards for lead, zinc, iron, and silver, all of which demonstrate a CV% of 5% or less on standards and negligible bias except for silver in samples approaching the detection limit of the method, as would be expected.

11.2.1.5 Summary

Sampling and assaying information in the drill hole and blast hole databases are acceptable to support Mineral Resource and Mineral Reserve estimates.

11.2.2 Bureau Veritas Laboratories

From 2013, samples from all exploration and infill drill holes have been analyzed by Bureau Veritas Laboratories (formerly Acme Laboratories) in Vancouver, BC. Umpire samples are sent to either ALS Vancouver or RDM-AL (or both) for verification (~5% each year).

11.2.2.1 Sample Preparation and Shipment

Once samples have been taken, sample bags are double checked to ensure that no samples are missing and that QA/QC sample insertion has been done correctly. They are grouped into rice bags and the first and last sample in the bag is recorded on the rice bag. These are packed inside a tri-wall cardboard shipping box for dispatch. The samples are tracked from the warehouse to the BV receiving facility.

Once received by BV, samples are dried for 24 hours at 60^{o}C. Samples are crushed directly to 80% passing 10 mesh (2 mm), riffle split down to 250g and pulverized to 85% passing 200 mesh. Both a crush reject and a pulp reject are retained.

During sample preparation, a pulp duplicate and a crusher duplicate are taken at an approximate insertion rate of one in 50. These QC points are independent of the laboratory QC samples.

All quality control is captured in an acQuire database and batch-level QA/QC uses the modules of this system to assess quality.

11.2.2.2 Analyses

Since 2013, samples for assay have been submitted for several methods. Samples have been consistently submitted for digestion using a "total" digestion method. A prepared 0.5 g sample is cold digested with nitric acid solution, then heated in the digestion block with an acid solution of HCl-HF-HClO4. After cooling, the solutions are brought to volume using diluted HCl. Elemental concentrations are then determined using AA. This was known at Acme as the Code 8TD package and is now referred to at BV as (MA404). This is an ISO17025 certified method for the determination of base metals. For zinc, lead and iron, over-range determinations were made using a modified aqua regia digestion designed by Cominco's ERL and provided to the analytical laboratory. A multi-element suite was determined by the aqua regia method (Acme code 7AX, BV code AQ270). Elements included Ag, Al, As, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Ni, P, Sb, Sc, Se, Sr, Th, Ti, Tl, U, V, and W.

Major element concentrations are determined using an oxidative fusion with X-ray diffraction (XRF) using Acme code 4X. Since 2015, BV have also been reporting lead and zinc assays from their XRF facility (BV code LF726/ LF726 for over-range).

11.2.2.3 QA/QC Activities

Every batch of samples dispatched from the project to BV has an accompanying quality control program. This typically includes three certified reference materials, one pulp duplicate, one crush duplicate, three sample duplicates, three coarse blanks and one pulp blank per 60 samples.

Blanks are sourced from a quartzite layer of the Tingmerkpuk Formation. SRMs are made from matrix matched geological samples. These cover the range of concentrations and matrices commonly seen in the mine. These were created on site by the RDM-AL, homogenized in a Vblender, and sent out to four to five independent assay laboratories for certification via round-robin analysis (see also discussion in Section 11.2.1.3).

QA/QC is performed at a batch level as each batch of samples is reported by the laboratory in order to provide timely feedback to the BV of any issues. At the conclusion of each annual program, a comprehensive QA/QC review is completed, which summarizes results for the year and makes any necessary recommendations. An umpire assay program is also initiated at the conclusion of each field program.

11.3 Databases

Teck Exploration maintains an acQuire database for all the drilling data in the Red Dog project. This includes all generations of data from GDL, RDM-AL and, since 2013, at BV. This database includes collars, downhole surveys, assays and geological descriptions. Data generated prior to the acQuire implementation in 2014 was subsequently imported into acQuire from existing digital media (spreadsheet and database files). Post acQuire implementation, geotechnical data is collected in real time using an acQuire data entry object, assay data is imported from .csv files received from the laboratory, and geologic, collar, and survey data are transcribed directly into an acQuire data entry object from the paper copies (geologic logs, survey tags, etc.).

Standard database management techniques are utilized that limit access and user rights to ensure data integrity.

Primary original documents, logs, down-hole surveys, core photographs, and assay certificates are cataloged and stored on site in the mine. Digital copies are stored on networks drives that are backed-up daily.

11.4 Sample Security

Prior to dispatch, field technicians insert SRMs. The positions of the SRMs and duplicates in the submissions are assessed by the supervising geologists. Samples are bagged and wrapped onto pallets and are dispatched via a freight company to BV. Upon receipt of the samples, BV inform Teck and provide notification of any sample number discrepancies or other issues. BV's chain of custody is initiated once they receive the sample dispatches. Assays are reported digitally and directly imported into acQuire.

SRMs are stored on site in a secure location. All pulp and coarse rejects since 2012 are stored in a secure facility at Teck's Highland Valley Mine. All coarse rejects from before 2012 were discarded given the rate of degradation of samples stored on site. A pulp reject record has been kept for all drilling since about 2000, and is stored in sea containers. Sampled core is stored at the mine.

11.5 Comments on Sample Preparation, Analysis and Security

In the opinion of the QPs, the sample preparation, analysis and security are acceptable and meet industry standard practices. The data are adequate for Mineral Resource and Mineral Reserve estimation and mine planning purposes based on the following:

- The blast hole sampling technique employed at the mine has been demonstrated to produce a representative result when compared to whole pile sampling;
- The quality of the data produced by the RDM-AL is acceptable for reconciliation work completed there at present. Comparisons with certified external assays suggest that the data generated by the RDM-AL is both accurate and precise;
- The quality of the data produced by BV is acceptable for the Resource assaying that is completed there at present. Industry-standard sample preparation procedures and analytical techniques have been employed to generate assay results;
- Since 2012, a comprehensive QA/QC program has been in place on all exploration samples and pit infill programs. Analyses were completed at an ISO9001 certified laboratory;
- Prior to this, a less comprehensive QA/QC program was in place at the RDM-AL but historical reconciliation data suggests that these data provided an accurate measure of the concentrations of economic metals;
- QA/QC programs do not indicate any substantial or systematic errors in the data that would represent at red flag for Resource estimation;
- Sample collection and handling of core was undertaken in accordance with industry standard practices;
- Sample security relies on the fact that the samples were always attended or locked in the on-site sampling and preparation facility until it is dispatched to the laboratory. Chain-of-custody procedures consist of filling out sample submittal forms that are sent to the laboratory with sample shipments to make certain that all samples are received by the laboratory and the tracking of the shipment.

12 DATA VERIFICATION

12.1 Internal Verification

Internal data verification at the Red Dog Mine has been conducted as a team effort. Data have been continually verified from the initial infill drilling programs through to the current drill programs, and are supported by over 27 years of operational data.

12.1.1 In-Field Data Validation/Verification

A comprehensive in-field data validation/verification program has been implemented since 2011. The purpose of this program is to assure data quality. Data verification involves ensuring all the requisite information is collected for each drill hole, data are of adequate quality, and are stored in an accessible but secure location.

12.1.2 Databases

The acQuire GIM Suite database was implemented in 2014. The use of acQuire prevents the introduction of overlapping intervals, gaps, inconsistent rock codes, etc. during the data entry step by restricting unreasonable/wrong entries through built-in data validation steps. Data entry is checked against the paper records before sampling and before hole sign-off to eliminate transcription errors. Upon completion, the data manager signs-off on each hole both digitally in acQuire, and physically on the front of the file folder where all hard copies of drill logs/survey records, etc. are kept. Digital copies of paper files are maintained on servers at both Red Dog Mine and in the Vancouver Head Office and hard copies are filed in both the Mine Geology and Exploration offices onsite. This data validation process is documented in a written manual, and is accessible to all Project personnel.

Prior to the Aqqaluk, Paalaaq, Qanaiyaq and Aŋarraaq Resource updates, data validation was carried out in Vulcan and included “from–to” checks, ensuring no “% Assays” were greater than a 100% and that the collar elevations matched the most accurate digital terrain model (DTM) that was available. No drill holes were excluded based on validation processes.

12.1.3 Standard Reference Materials

Depending on the year and the size of the program to be executed, the number of SRMs used in any given year may be restricted in order to obtain a statistically significant number of insertions.

Standards are assessed as every batch of samples is reported. Any SRM that fails, and the six surrounding samples, are requested for reasssay. If there is a bias in the samples as well as the standard, then the batch is requested for reassay. If there is only a problem with the initial standard value, then this value is replaced and the initial values are accepted. A log of all failed batches and analytical requests is maintained.

At the conclusion of each campaign, data quality is assessed. The precision of results from SRMs are assessed in terms of the percentage co-efficient of variation (CV%) of the results on the standard. For an element other than gold to be classified as acceptable for resource estimation, the CV% should be less than five, and there should be a <5% failure rate where a failure is any sample outside of three standard deviations. The data received back from BV has to date passed these criteria for all economic elements that are above the detection limit of the method. Bias is assessed using all SRMs.

The results from all drilling since 2013 have shown that there is generally good data for the economic elements of interest in the dataset. Several reviews have indicated a negative bias for lead when the data are assessed against the SRM values. This bias is not enough to indicate a failed standard, but over time, shows a mean value that is consistently below the certified value.

In 2016, a reanalysis program was completed on the standards, using Bureau Veritas Perth, ALS Perth, Bureau Veritas Mt Isa, ALS Vancouver, and Bureau Veritas Vancouver. All of these facilities are used to dealing with high-grade lead and zinc samples. These laboratories all consistently reported this same slight negative bias for lead, and suggests that the standards were initially certified with a high bias. A slight negative bias for lead is now accepted as correct.

12.1.4 Sample Duplicates

On a batch by batch basis, duplicates are not used to fail batches of samples. This is in part because results are generally not received until the completion of the program, given the logistical delays in getting the samples from the mine to Vancouver. The laboratory is informed if crush or pulp duplicates are failing at a rate of more than 10%.

Overall, there has been a higher than preferred failure rate for lead and zinc. This is interpreted to be caused by a combination of factors. There are occasional sample swaps and data entry errors but often, it is caused by veins of mineralization, combined with the fact that only ¼ core is used for duplicates, whereas routine samples are taken as ½ core. Teck is currently investigating whether the duplicates procedures should be amended.

Database staff are of the opinion that the majority of failures in the pulp duplicates and crush duplicates are indicative of sample swaps rather than a problem with the quality of routine analyses.

12.1.5 Blanks

As of 2016, both coarse and fine blanks are used to assess contamination in the laboratory. Prior to 2016, only coarse blanks were used.

Evaluation of blank data indicates that there are occasional high concentration failures, that there is not systematic contamination indicated in the results, and that the absolute level of contamination is very low when compared with the grades commonly encountered in mineralized material. There has been no systematic indication of contamination in the blanks in any generation of data.

12.1.6 Blast Hole Sampling

Teck has undertaken two blast hole sampling reviews, in 2002 and 2004. The 2002 review incorporated 70 blast hole cuttings piles sampled. The study then compared tube (routine) samples against assay splits from the entire cuttings pile. Two assays were performed on each sample to verify the adequacy of the sample mixing process; no significant issues were identified. The 2004 program sampled five blast hole piles, from 21 different blast hole patterns using a different sampling method to that of 2002, by removing cuttings from the top of the pile to reduce the effect of sub-drill contamination, and then cutting a “slot” (trench) through the pile. There was no significant difference between slot and tube samples using a t-test evaluation.

12.1.7 Reconciliation

The Red Dog operation has demonstrated 27 years of production history, and currently reconciliations are showing less than 10% difference between F1 factors (blast hole depletions versus long-range model depletions) and F2 factors (“ore received at the mill” versus “delivered to the mill”), see Section 18. The QPs note that although ore from Qanaiyaq was encountered in Q4 of 2016, it has been stockpiled and will not be milled until after the effective date of this Report, so no reconciliation data can currently be provided that supports geological, mining, processing, marketing, environmental, permitting or social assumptions for this area.

12.2 External Verification

12.2.1 AMEC (2001)

A data verification program was completed as part of a technical report on the Project in 2001. AMEC reviewed the QA/QC data from the 1999–2000 drill program at the Aqqaluk deposit, found them to be well within acceptable limits, and therefore suitable for use in Mineral Resource and Mineral Reserve estimation.

12.2.2 AMEC (2007)

A site visit and data review were undertaken in support of a technical report on the Project in 2007. The purpose of the 12–13 January site visit was to review the geology and mineralization which support of the resource models, as well as review of the mine plans and metallurgical processes. AMEC briefly reviewed the laboratory on 13 January 2007, and in general AMEC was of the opinion at the time that the laboratory was providing satisfactory results.

Data reviews conducted included checks on data entry (selected collar, survey, assay and recovery data), reviews of sample preparation and assay protocols, density data reviews, QA/QC review of selected data, and verifying a data dump of assay data from the MineSight resource model against original assay source data. A check of the reconciliation data was also performed.

Overall, based on the checks performed, the duration of operations, and the satisfactory reconciliation data, AMEC accepted that the drill hole and blast hole databases provided valid support for the Resource and Reserve estimates.

A number of suggestions were made to improve the QA/QC program such that the program was blind to the analytical laboratories, and was both more robust and more comprehensive.

12.2.3 Amec Foster Wheeler (2015)

Amec Foster Wheeler conducted an audit of the Mineral Resources and Reserves, processes, controls and documentation, and operational risks and opportunities in 2015. A site visit was conducted from July 29–August 1, 2015.

Amec Foster Wheeler again reviewed the RDM-AL and concluded that it was suitable for the reconcilication work that it currently performs. Some changes to the quality practices at the RDM-AL were recommended, a portion of which are still to be implimented.

Data reviews were performed on selected collar, downhole survey, assay, lithology, mineralization and blast hole data from Aqqaluk and Qanaiyaq. The reviews indicated the data were suitable to support Mineral Resource and Mineral Reserve estimates.

12.3 Comments on Data Verification

The Red Dog property has a long history of exploration drilling and sampling and none of the qualified persons have been intimately involved with all aspects of the program since project inception. This work has been a team effort conducted over 12 years of initial exploration and delineation activities, and over 27 years of operation from 1990 to date. The QPs therefore cannot speak directly to the drilling, logging, sampling and analytical procedures and methodologies employed or data verifications performed during all of the phases of exploration and exploitation.

However, given the QPs' experience and familiarity with the analytical procedures and methodologies used on the Project, and with the verified data and observations discussed above, it is our opinion that the dataset has been appropriately validated and verified, and is adequate for Mineral Resource and Mineral Reserve estimation and for use in mine planning.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Historical Testwork

Metallurgical test work completed in support of the initial mill design included mineralogical analysis, and comminution, locked and open cycle, flotation, and thickening tests. A number of modifications and improvements have been made to the plant over the 27-year operational history.

The majority of the initial testwork was conducted over the Main deposit, which was the sole ore producer between 1989 and 2010; this has subsequently been mined out. The mill feed material for the remaining mine life is to be sourced from the Aqqaluk and Qanaiyaq deposits.

13.1.1 Metallurgical Testing and Results

Metallurgical testing of both Aqqaluk and Qanaiyaq deposits have been performed using a multi-phase approach. The work was completed mostly using resources from the Teck Applied Research and Technology group. Some of the comminution modelling was completed in collaboration with an Amira GEM project.

In 1998 and 2000, five large composites were produced from the drilling program based on geological interpretation. The composites were representative of 80% of the known Mineral Reserves and numerous open and locked cycle flotation tests were performed on these samples. Initial metallurgical response from this test work was used to justify additional metallurgical test work to further refine the metallurgical models.

In 2006, a large geo-metallurgical program was undertaken in collaboration with the Amira GEM project. Using more recent drilling material, 56 composites of various grades and ore texture were identified and subjected to lead and zinc flotation tests. Based on the flotation response, some of the composites were combined further to 30 final composites for lead and zinc cleaner flotation tests. The laboratory results from this test work were combined with results from similar testwork performed on 40 composites from the Main pit to form the basis of the recovery models described below.

As part of the GEM program, 108 samples were collected from Aqqaluk core to represent the various textures of both ore and waste across a variety of grades. These samples were then submitted to hardness tests, including the GEM RBT single particle size tests. In addition, 23 samples were submitted to the more thorough SMC test and ball mill Bond test. These results, combined with a small set of Main pit hardness results were used to develop the hardness (both semi-autogenous grind (SAG) mill breakage parameter (Ab) and Bond Ball mill work index (BBMWi) models.

The first phase of metallurgical testing of Qanaiyaq was initiated in 2001; three composites were produced from recently drilled core. Both open and locked cycle tests were performed following the same methodology as Aqqaluk to obtain an estimate of metallurgical performance and justify additional metallurgical test work. The test work proved that, although the deposit was highly weathered, it was possible to make saleable concentrate as long as materials from the high-copper zone were discarded.

In 2013, additional geo-metallurgical analysis was undertaken. A total of 30 samples were selected to represent the cross-section of ore types, assays and weathering. For many of the samples, saleable concentrates could not be produced and this material was classified as waste. A total of 16 samples produced acceptable metallurgy and their metallurgical results were used to develop the metallurgical models described below. In order to obtain a throughput model, 10 samples were send for ball mill Bond test only as most of the samples are extremely friable and will not cause a restriction to SAG throughput. The results were used to create a simple hardness model (BBMWi).

Test work was also conducted in 2005 to determine the metallurgical effects of blending Aqqaluk and Qanaiyaq ore types. The purpose was to ascertain if blending a weathered Qanaiyaq ore would have a detrimental effect on the lead and zinc metallurgy of Aqqaluk. Generally, the blending of Qanaiyaq with Aqqaluk did not impact the overall metallurgy for the combinations tested. The impact of pyrite in the blend and the type of water used for flotation will however be a limiting factor and as the proportion of pyrite in the feed increases, the blending strategy may need to be adjusted.

13.2 Basis for Recovery and Throughput Estimates

13.2.1 Flotation

The metallurgical characteristics and performance of the Aqqaluk and Qanaiyaq deposit ores have been well established and developed since mine start-up. Metallurgical recoveries are calculated for zinc, lead, and silver for each deposit using universal recovery formula (URF) models. The recovery equations are based on a fixed concentrate grade that is different for each deposit.

13.2.1.1 Aqqaluk

For the Aqqaluk deposit, the metallurgical recoveries for zinc concentrate and for lead concentrate are calculated using one of two forms of a URF model: the regular model, and a specific model for rock with high barium and low zinc and low iron. The formulae applied in the regular model are based on the degree of weathering of the rock derived from the ratio of non-sulphide lead to total lead. Low and moderately weathered rock is amenable to the production of sellable concentrates of both zinc and lead. More highly weathered rock is only amenable to the production of a sellable zinc concentrate.

The regular model includes non-sulphide lead assays and considers the exponents in the recovery formulae as variables instead of constants. In the case of the zinc concentrate, the exponents are a function of the barium grade, whereas for the lead concentrate they are a function of the iron grade. The general form of the recovery model for zinc recovery to zinc concentrate is:

$$\%ZnRecLab = K \times \%Zn^{m1} \times \%Pb^{m2} \times \%Fe^{m3} \times \%SiO_2^{m4} \times \%Ba^{m5} \times \%sPb^{m6} \times \%solPb^{m7}$$

Due to the low number of high barium/high non-sulphide lead samples in the data used to develop the zinc recovery equation (aURFz), it overestimates zinc recovery from blocks with those grade combinations. As those blocks are present in the weathered rock in the Aqqaluk deposit, the barium grade is capped at 4.9% prior to calculating the zinc recovery for those blocks. This capping will need to be used until more data are obtained to improve the model for high barium/high non-sulphide lead blocks. In addition, the historical URF model for zinc recovery to zinc concentrate continues to be applied to some specific high Ba blocks, those which have low Zn (≤ 7%), low Fe (≤ 7%), and high Ba (≥ 23%). This was found necessary as the revised model was found to be less robust in that grade space. Both the barium-capped exponential form of the formula, and the specific form of the universal formula used to more accurately model high barite rock are named $aURFz^{BA}$.

The laboratory zinc recovery estimate from the URF model is bounded by upper and lower limits of 93% and 30% respectively. To reflect the potential average performance in the plant, a transfer function is applied to the laboratory-based recovery values before they can be used in the mining block model. Based on historic plant performance, two laboratory to plant recovery transfer functions are used, one for the baritic ore type and one for all other ore types. The resulting plant zinc recovery estimate is bounded by upper and lower limits of 93% and 30%.

For lead recovery to lead concentrate, no transfer function is required to convert the laboratory-based lead recovery estimate to a plant estimate before using it in the mining block model. The plant lead recovery estimate is bounded by upper and lower limits of 84% and 15%.

Because weathered, low-grade, high-non-sulphide lead samples from Aqqaluk do not produce sellable concentrate, the URF is not applied to those blocks.

13.2.1.2 Qanaiyaq

For the Qanaiyaq deposit, the metallurgical recoveries are calculated based on deposit-specific URF models for zinc and lead concentrates. The formulae are applied based on the degree of weathering, measured by the ratio of non-sulphide lead to total lead, and the copper grade. Low to moderately weathered rock with low copper grades is classified as “Regular” metallurgy and both concentrates can be produced. More highly weathered ore, but with low copper grades is classified as “Regular-zinc” metallurgy, and only a zinc concentrate can be produced.

The plant zinc recovery estimate is bounded by upper and lower limits of 93% and 0%. The plant lead recovery estimate is bounded by upper and lower limits of 84% and 0%.

13.2.1.3 Paalaaq

The Paalaaq deposit appears to exhibit different metallurgy than the Aqqaluk deposit. Because some parts of the southern end of the Paalaaq deposit are accessed from the base of the Aqqaluk pit, the concentrate grades and recoveries for those blocks will be as defined for the Paalaaq Mineral Resource/Mineral Reserve.

13.2.1.4 Aqqaluk, Qanaiyaq, and Paalaaq Silver

Zinc and lead recoveries to non-primary concentrates are also calculated. Although these recoveries exhibit larger scatter due to the high grade variation in the Red Dog deposits, simpler models are used as they are less important to ore valuation.

For silver, the same recovery models are used for the Aqqaluk, Qanaiyaq, and Paalaaq deposit sulphide ores. The silver recovery to zinc concentrate estimate is bounded by a lower limit of 0% and an upper limit of 71% based on the data used to develop the model.

The silver recovery to lead concentrate estimate is bounded by a lower limit of 0% and an upper limit of 87% based on the data used to develop the model. As these two recoveries are calculated independently, the total silver recovery to both zinc and lead concentrates is also bounded by the same upper limit of 87%. Where this limit is exceeded the two recoveries are decreased on a proportional basis. The matrix of secondary and silver recovery equation application is shown in Table 13-1.

Table 13-1: Concentrate Basis for Aqqaluk, Qanaiyaq, and Paalaaq Deposits

Deposit	Ore Type	Zinc		Lead		Ag Recovery	
		Rec (%)	Grade (%)	Rec (%)	Grade (%)	To Zn (%)	To Pb (%)
Aqqaluk	High Ba Low RPB	$aURFz^{BA}$	55.0	$aURFp^{BA}$	54.0	AgRZn	AgRPb
	High Ba High RPB	$aURFz^{BA}$	55.0	0	54.0	AgRZn	AgRPb
	Regular Low RPB	aURFz	55.0	aURFp	54.0	AgRZn	AgRPb
	Regular High RPB	aURFz	55.0	0	54.0	AgRZn	AgRPb
Qanaiyaq	Regular	qURFz	50.0	qURFp	50.0	AgRZn	AgRPb
	Regular-zinc	qURFz	50.0	0	50.0	AgRZn	0
	Oxide (non-sulphide)	0	50.0	qURFop	45.0	0	qURFop
Paalaaq	Siliceous (Type A)	43.8	49.6	49.6	48.6	AgRZn	AgRPb
	Veined (Type B)	81.3	60.0	67.0	48.8	AgRZn	AgRPb
	Baritic	$aURFz^{BA}$	55.0	$aURFp^{BA}$	54.0	AgRZn	AgRPb

13.2.2 Grinding

Mill throughput is estimated based on an analysis carried out for the Red Dog deposits assessing the impact of ore hardness on mill throughput. The class based models are different for each deposit. Eleven mineralogical classes were identified along with seven class based breakage models. Class based models could not be developed for all classes as there were insufficient samples in several of the class types to adequately span the variability in the mill feed; these latter were grouped into a single universal model. Mineralogical class specific breakage models could only be defined in six of the eleven mineralogical classes, thus a universal model was developed for the remaining five.

For the same reason, the complete class-based set of models was not adopted for all classes. In each of these latter classes, two breakage parameters, Ab and BBMWi, were defined in order to calculate the throughput for each block. The Ab parameter is calculated using each individual class based model; however, the BBMWi, is only calculated using the individual class based model for barite, with all other classes using the Universal model.

The breakage parameters for the six mineralogical classes with models and the single, universal equation, for the five mineralogical classes without specific models, are a function of the mineralogy and grain size. However, in general, it was found that the BBMWi parameter in the class-based models appeared to be underestimating the energy required, leading to an overestimation of throughput. It is thought that this is due to insufficient sample diversity and quantity in some of the class subsets. Until more test data are obtained, a combination of the class-based A*b and the Universal BBMWi parameters is being used to calculate throughput for the Aqqaluk deposit blocks, with the exception of the baritic class for which the class-based BBMWi parameter is used.

To calculate the throughput for the Qanaiyaq deposit blocks, a Qanaiyaq-specific BBMWi model is used with the mineralogical class-based Ab parameter. The only exception is that a minimum Ab value of 150 is used for all weathered-geology coded blocks due to their significant physical weathering.

Upper and lower bounds are placed on the calculated values. For Ab, these are 300 and 15 for both deposits, as per the samples used as the basis for the modelling. For BBMWi these are 21 kWh/t and 8 kWh/t for the Aqqaluk deposit and 21 kWh/t and 3 kWh/t for the Qanaiyaq deposit.

Using these two grinding parameters, a throughput dependent upon both SAG and ball mill performance is calculated. The throughput or expected feed capacity (TPH) is a relationship between the BBMWi parameter and the installed mill power (kW), efficiency factors, feed density, SAG circuit transfer size (T80), and the drop weight specific power (DWAB). The ball mill throughput (TPH_{bm}) and the SAG mill throughput (TPH_{sag}) are calculated for each block and the minimum of these two values is assigned to the block.

13.3 Extent of Sample Representivity

Samples selected for metallurgical testing during feasibility and development studies were representative of the various types and styles of mineralization within the different deposits. Samples were selected from a range of locations within the deposit zones. Sufficient samples were taken so that tests were performed on sufficient sample mass.

13.4 Deleterious Factors

Iron as pyrite is the primary deleterious element with regards to metallurgical recovery with high absolute amounts or high ratios of iron as pyrite to zinc or to lead having an adverse effect.

Silica is the primary deleterious element with regards to metallurgical throughput with high absolute amounts having an adverse effect.

Weathering is also a deleterious process which impacts both lead and zinc metallurgy. Since the Qanaiyaq deposit is significantly weathered, both lead and zinc metallurgy are significantly inferior to Aqqaluk. Weathering will reduce the lead recovery significantly as oxidized galena has a poor recovery in a sulphide circuit. Zinc recovery will be reduced as some sphalerite will misreport to the prefloat and lead concentrates.

Although selenium leaching may limit the proportion and amount of Qanaiyaq that can be fed to the mill due to water discharge permit limits, the element itself does not have any deleterious impact on the metallurgical performance.

14 MINERAL RESOURCE ESTIMATES

The resource models were developed using either the commercially-available MineSight 11.50-2 or Vulcan 10 (Vulcan) software packages, and with respect to the applicable guidelines from the Canadian Institute of Mining, Metallurgy and Petroleum (CIM). Leapfrog software was used to generate estimation domains. Thomas Krolak, RM SME of TAK performed the Aqqaluk, Qanaiyaq, and Paalaaq Mineral Resource estimates and Kevin Palmer P.Geo. of Teck undertook the Aŋarraaq estimate.

14.1 Domain Modelling

Geology for Qanaiyaq, Aqqaluk, Paalaaq and Anarraaq deposits were interpreted in a three-dimensional environment using Leapfrog to create discreet solids from drill holes coded with the geological units, which varied by deposit. The geological features are well defined for Qanaiyaq, Aqqaluk and Paalaaq. At Qanaiyaq and Aqqaluk 31 domains are recognized, and are used for estimation (Table 14-1). Paalaaq contains 14 domains (Table 14-2). A combination of type of mineralization and structure were used to define the 17 domains at Aŋarraaq (Table 14-3).

Table 14-1: Qanaiyaq ("Q") and Aqqaluk ("A") Estimation Domains

Code	Deposit	Estimation Domain
1	A	Median plate lower-grade (<15% Zn) exhalite
2	A/Q	Lower-grade (<15% Zn) weathered exhalite, Aqqaluk any plate/Qanaiyaq lower plate
6	A	Median plate Ikalukrok vein unit, any grade
7	A	Sub-lower plate (Paalaaq) barite
8	A	Lower plate, lower-grade (<15% Zn) exhalite
10	A	Sub-lower plate (Paalaaq) vein unit, any grade
11	A	Median plate higher-grade (>15% Zn) exhalite
12	A/Q	Higher-grade (>15% Zn) weathered exhalite, Aqqaluk any plate/Qanaiyaq lower plate
13	A/Q	Lower plate lower-grade (<15% Zn) Ikalukrok vein unit
14	A/Q	Higher-grade (>15% Zn) Ikalukrok vein unit, Aqqaluk lower plate/Qanaiyaq upper plate
15	A	Median plate Ikalukrok barite
16	A	Lower plate Ikalukrok barite
18	A/Q	Lower plate higher-grade (>15% Zn) exhalite
21	A	Sub-lower plate (Paalaaq), lower-grade (<15% Zn) exhalite
22	Q	Upper plate, lower grade weathered exhalite (<15% Zn)
23	Q	Lower plate, lower grade weathered exhalite, with high Pb very low Zn (<1%)
24	Q	Upper plate, higher grade weathered exhalite (>15% Zn)

Table 14-2: Paalaaq Estimation Domains

Code	Estimation Domain
221	Sub-Lower Plate Exhalite - North Bottom Zone
207	Sub-Lower Plate Baritic - North Bottom Zone
307	Sub-Lower Plate Baritic - Main Zone
310	Sub-Lower Plate Vein Ore - Main Zone
321	Sub-Lower Plate Exhalite - Main Zone
407	Sub-Lower Plate Baritic - North Below Zone
421	Sub-Lower Plate Exhalite - North Below Zone
507	Sub-Lower Plate Baritic - North Down Zone
521	Sub-Lower Plate Exhalite - North Down Zone
510	Sub-Lower Plate Vein Ore - North Down Zone
621	Sub-Lower Plate Exhalite - North Up Zone
707	Sub-Lower Plate Baritic - South Zone
710	Sub-Lower Plate Vein Ore - South Zone
721	Sub-Lower Plate Exhalite - South Zone
221	Sub-Lower Plate Exhalite - North Bottom Zone
207	Sub-Lower Plate Baritic - North Bottom Zone
307	Sub-Lower Plate Baritic - Main Zone

Table 14-3: Aŋarraaq Estimation Domains

Code	Estimation Domain
100	Silver Lower Main 1
211	Pyrite Upper Main 1
212	Pyrite Upper Main 2
230	Pyrite Upper South
240	Pyrite Lower Main
250	Pyrite Lower South
311	Zinc Upper Main 1 N 1
312	Zinc Upper Main 1 N 2
313	Zinc Upper Main 1 S
330	Zinc Upper South
341	Zinc Lower Main 1
342	Zinc Lower Main 2
343	Zinc Lower Main 3
351	Zinc Lower South 1
352	Zinc Lower South 2
910	Waste Above Blue Fault
920	Waste Below Blue Fault

At Qanaiyaq, Aqqaluk, and Paalaaq these domains comprise sedimentary, exhalite and structural units that are unmineralized to strongly sulphide-mineralized. Many units are defined by structural location and lithology (e.g., barite-rich exhalite units, shale types). In the case of Qanaiyaq and Aqqaluk, the major waste shale units were also modelled.

At Aŋarraaq "waste" domains were modelled around the mineralized zones to estimate the effect of dilution on any mine planning. The solids were reviewed and modified as needed to produce a reasonable geologic interpretation. In mined-out areas of benches, geology from field observations and blastholes was used to update the solids. The solids were exported to MineSight or Vulcan, and the drill holes and geologic block model was coded using either the majority rule basis in MineSight or the centroid rule in Vulcan, meaning that there is one geology code per block in either software.

14.2 Exploratory Data Analysis

Exploratory data analysis has been carried out on the raw drill hole data as well as the composite data. Table 14-4 shows the variables modelled for each deposit.

Table 14-4: Variables Estimated by Deposit

	Qanaiyaq	Aqqaluk	Paalaaq	Aŋarraaq
Zn	✓	✓	✓	✓
Pb	✓	✓	✓	✓
Ag	✓	✓	✓	✓
Fe	✓	✓	✓	✓
Ba	✓	✓	✓	✓
sPb	✓	✓	✓	-
S	✓	✓	✓	-
Cu	✓	-	-	-
TOC	✓	✓	✓	-

In order to preserve the correlation noted in the raw drill hole data variables that had a high correlation (i.e. 0.7 or greater), the same variogram and search criteria were used during the estimation process.

The solids generated in Leapfrog were used to code the raw drill hole data with a unique code for each solid.

In three of the deposits, Qanaiyaq, Aqqaluk, and Paalaaq the drill holes were composited into 3.8 m (12.5 ft) down-the-hole, fixed-length composites that honoured estimation domains. In this process, the compositing begins at the top of the drill hole and composites are generated for each 3.8 m interval down the length of the drill hole. If the geology changes down the hole at a distance of less than 3.8 m, then a new composite is started at the point the geology changes. Composites at the end of the hole that are less than half the length of the standard composite length are merged with the previous composite. A similar process was used for Aŋarraaq but the composite length was adjusted to 1.5 m (5 ft).

Capping is applied to variable values that are outliers. The outlier values are reduced to a single value that is adjudged to be acceptable. This is carried out in order to reduce the influence of the outliers; otherwise the result may be an estimate that is biased too high. At all four deposits each variable within each domain was reviewed using histograms, cumulative distribution frequencies, and variance plots. The effect of the capping was reviewed by comparing the mean of the capped versus the uncapped, and if the initial capping was regarded as being too severe the level of capping was reduced. Examples of capping are shown for the primary domains in Table 14-5 to Table 14-8.

Table 14-5: Aqqaluk Capping Levels

Code	Zn (%)	Pb (%)	Ag (oz/t)
1	—	—	—
2	35	30	—
6	25	16	—
7	—	—	—
8	—	—	—
10	—	—	—
11	—	—	—
13	35	18	8.5
15	—	—	—
16	—	—	—
18	—	—	—
21	50	21	—

Note: Code refers to Estimation Domain shown in Table 14 -1. Note that "–" indicates no capping level

Table 14-6: Qanaiyaq Capping Levels

Code	Zn (%)	Pb (%)	Ag (oz/t)
2	30	27	35
12	—	—	—
13	—	—	—
14	—	—	—
18	—	—	—
22	18	48	25
23	11	—	—
24	—	—	—

Note: Code refers to Estimation Domain shown in Table 14 -1. Note that "–" indicates no capping level

Table 14-7: Paalaaq Capping Levels

Code	Zn (%)	Pb (%)	Ag (oz/t)
207	—	—	—
221	—	—	—
307	—	—	—
310	—	15	—
321	—	25	—
407	—	—	—
421	30	—	—
507	—	—	—
510	20	5	5
521	39	—	—
621	—	—	—
707	—	—	—
710	—	—	—
721	—	—	—

Note: Code refers to Estimation Domain shown in Table 14 -1. Note that "–" indicates no capping level

Table 14-8: Anarraaq Capping Levels

Code	Zn (%)	Pb (%)	Ag (oz/t)
100	—	—	—
211	—	0.75	—
212	—	—	—
230	0.5	0.4	—
240	2.5	1.5	—
250	—	0.2	—
311	—	—	—
312	—	5	0.7
313	—	—	—
330	—	—	1.8
341	—	6	—
342	—	—	—
343	—	—	2.8
351	—	—	1.2
352	—	—	—
910	5.5	2	—
920	8	1.8	0.4

Note: Code refers to Estimation Domain shown in Table 14 -1. Note that "–" indicates no capping level

The solids generated in Leapfrog are based primarily on lithology, or zinc, or barium grades. During contact analysis the nature of the contacts of adjacent solids is investigated by variable. The contact is broken down into three types:

- Hard, when there is a significant difference in the value across contact and the average values of the variable of the two solids is different;
- No contact, when there is little difference across the contact and between the averages;
- Soft, when there is little difference across the contact, but the averages are significantly different.

At Aqqaluk, where the model can be reconciled with production, the decision was made to use hard contacts for all solids as this had been used in earlier models, and a good reconciliation against the model is being achieved.

In order to determine the direction of spatial continuity of variables in each domain variography was carried out using the commercially-available Supervisor software. Experimental variography was conducted for zinc, lead, iron, barium, silver, non-sulphide lead (not at Aŋarraaq), elemental sulphur, total organic carbon and copper (only at Qanaiyaq). Variograms used a spherical model and the parameters for zinc in the Qanaiyaq and Aqqaluk deposits are shown in Table 14-9 and Table 14-10, respectively as examples.

Table 14-9: Qanaiyaq Variogram Parameters for Zinc

Domain	Geology Codes	Azimuth (degrees)	Dip (degrees)	Nugget	Model 1		Model 2		Model Axis (MineSight)
				C_0	Range (ft)	C_1	Range (ft)	C_2	
Weathered <15% Zn, Lower Plate		-20	0		290		540		Major
	2	0	0	0.2	100	0.5	170	0.3	Minor
		0	90		30		280		Vertical
Weathered >15% Zn, Lower Plate		-55.9	0		130		460		Major
	12	-8.5	0	0.25	120	0.55	420	0.2	Minor
		-12.4	90		60		140		Vertical
Veined Ikalukrok <15% Zn, Lower Plate		-15	0		200		750		Major
	13	0	0	0.2	220	0.54	820	0.26	Minor
		0	90		30		130		Vertical
Veined Ikalukrok >15% Zn, Lower Plate		135	0		180		1170		Major
	14	0	0	0.1	120	0.6	250	0.3	Minor
		15	90		30		60		Vertical
Exhalite >15% Zn, Lower Plate		-15	0		200		750		Major
	18	0	0	0.2	220	0.54	820	0.26	Minor
		0	90		30		130		Vertical
Weathered <15% Zn, Upper Plate		135	0		180		1170		Major
	22	0	0	0.1	120	0.6	250	0.3	Minor
		15	90		30		60		Vertical

Domain	Geology Codes	Azimuth (degrees)	Dip (degrees)	Nugget	Model 1		Model 2		Model Axis (MineSight)
				C_0	Range (ft)	C_1	Range (ft)	C_2	
Weathered, Ag and Oxide Pb, Lower Plate		-20	0		290		540		Major
	23	0	0	0.2	100	0.5	170	0.3	Minor
		0	90		30		280		Vertical
Weathered >15% Zn, Upper Plate		135	0		180		1170		Major
	24	0	0	0.1	120	0.6	250	0.3	Minor
		15	90		30		60		Vertical

Table 14-10: Aqqaluk Variogram Parameters for Zinc

Domain	Geology Codes	Azimuth (degrees)	Dip (degrees)	Nugget	Model 1		Model 2		Model Axis (MineSight)
				C_0	Range (ft)	C_1	Range (ft)	C_2	
Exhalite >15% Zn Middle Plate		105	0		115		455		Major
	11	0	0	0.04	145	0.52	435	0.44	Minor
		15	90		30		40		Vertical
Exhalite >15% Zn Lower Plate		60	0		245		860		Major
	18	0	0	0.01	70	0.85	220	0.15	Minor
		0	90		5		75		Vertical
Exhalite < 15% Zn, Middle Plate		10	0		90		815		Major
	1	0	0	0.04	145	0.38	245	0.58	Minor
		0	90		10		190		Vertical
Exhalite < 15% Zn, Lower Plate		50	0		315		1430		Major
	8	0	0	0.01	75	0.62	830	0.38	Minor
		140	90		135		340		Vertical
Ikalukrok Barite		115	0		540		1475		Major
	15, 16	0	0	0.01	530	0.58	1325	0.41	Minor
		5	90		45		1200		Vertical
Weathered		60	0		215		915		Major
	2, 12	0	0	0.15	145	0.32	325	0.53	Minor
		0	90		60		65		Vertical
Veined Ikalukrok, Lower Plate		50	0		315		320		Major
	13, 14	0	0	0.42	175	0.42	590	0.16	Minor
		145	90		180		390		Vertical
Veined Ikalukrok < 15% Zn, Middle Plate		145	0		215		815		Major
	6	0	0	0.23	145	0.23	215	0.54	Minor
		0	90		50		190		Vertical
Exhalite		15	0		280		995		Major

Domain	Geology Codes	Azimuth (degrees)	Dip (degrees)	Nugget	Model 1		Model 2		Model Axis (MineSight)
				C_0	Range (ft)	C_1	Range (ft)	C_2	
< 15% Zn, Paalaaq Plate	21	0	0	0.17	100	0.29	270	0.54	Minor
		0	90		40		125		Vertical
Ikalukrok Barite, Paalaaq Plate		155	0		235		385		Major
	7	0	0	0.3	150	0.22	330	0.48	Minor
		10	90		15		50		Vertical
Veined Ikalukrok, Paalaaq Plate		150.3	0		220		325		Major
	10	16.7	0	0.01	80	0.38	165	0.62	Minor
		31.2	90		15		125		Vertical

14.3 Geological Block Models

There are four three-dimensional block models (3DBM) used for the estimation of Mineral Resources at the Qanaiyaq, Aqqaluk, Paalaaq, and Aŋarraaq deposits. Project limits and block sizes for each 3DBM are summarized in Table 14-11. The coordinates for all deposit models are a truncated version of Alaskan State Plane Coordinate System Zone 7 (ASPC Zone 7) referred to as the mine grid. Block sizes range from 7.6 to 30.5 m (25 to 100 feet). At Paalaaq and Aŋarraaq, sub-blocking has been used to better define the shapes as this enhancement will provide a more realistic model for the planned underground mining scenario. The minimum sub-block size is 1.5 m x 1.5 m x 0.77 m (5 ft x 5 ft x 2.5 ft) at Paalaaq and Aŋarraaq.

Table 14-11: Red Dog Model Project Coordinates (ASPC Zone 7) and Parent Block Size

Deposit	Axis	Minimum (ft.)	Maximum (ft.)	Block Size (ft.)
Aqqaluk	East (x)	585,000	589,500	25
	North (y)	144,500	149,500	25
	Elevation (z)	-100	1,350	25
Qanaiyaq	East (x)	584,500	587,500	25
	North (y)	137,500	141,000	25
	Elevation (z)	1,000	1,600	25
Paalaaq	East (x)	584,800	589,200	100
	North (y)	145,600	150,200	100
	Elevation (z)	-1,700	1,300	12.5
Aŋarraaq	East (x)	567,500	567,100	100
	North (y)	173,900	183,000	100
	Elevation (z)	-1,300	400	5

14.4 Grade Estimation

Metal grades for all four deposits are estimated with a three-pass interpolation methodology using drill hole composites that respect lithological and/or grade domains. At Qanaiyaq and

Aqqaluk the same search criteria are used for each variable in each domain, whereas the criteria vary by variable and domain at Paalaaq and Aŋarraaq. The modeling parameters used at Qanaiyaq and Aqqaluk have been the same since 1995 and have not been changed as the estimation criteria have provided a reasonable F3 (resource model to plant) reconciliation.

14.4.1 Qanaiyaq and Aqqaluk

The first pass is plate matching to fill as many blocks as possible and employs a search ellipsoid of 243.3 m x 243.8 m x 61 m (800 ft x 800 ft x 200 ft). A minimum of three and a maximum of 24 composites are needed to estimate a block and no more than four composites can come from one hole. The geology matching second pass employs a search ellipsoid of 121.9 m x 121.9 m x 61 m (400 ft x 400 ft x 200 ft) and a minimum of five and a maximum of 24 composites are needed to estimate a block. No more than four composites can come from one hole. The geology matching third pass employs the same 400 ft x 400 ft x 200 ft search ellipsoid, but a more restrictive minimum of 13 composites are needed to estimate a block. The maximum remains at 24 and no more than four composites can come from one drill hole. In both deposits the three passes interpolate zinc, lead, iron, barium, silver, non-sulphide lead (sPb), elemental sulphur, and Total Organic Carbon (TOC) using ordinary kriging (OK). This estimate is validated using inverse distance squared (ID) and nearest neighbour (NN) estimates. The ID method uses exactly the same search parameters as the OK method. In the Qanaiyaq deposit copper is also interpolated. Interpolation profiles for Aqqaluk and Qanaiyaq are shown in Table 14-12. The grade estimation was carried out in MineSight, and the process has subsequent passes overwriting the values estimated in the previous pass. The criteria for the subsequent pass are more restrictive, and this results in fewer estimates being carried out.

Table 14-12: Aqqaluk and Qanaiyaq Interpolation Profiles

	Search (feet)			Match	# Comps	Max #
	X	Y	Z		Min/Max per Block	Comps/hole
Aqqaluk Model						
Pass 1	800	800	200	Plate	3/24	4
Pass 2	400	400	200	Domain	5/24	4
Pass 3	400	400	400	Domain	13/24	4
Qanaiyaq Model						
Pass 1	800	800	150	Plate	3/24	4
Pass 2	400	400	200	Domain	5/24	4
Pass 3	400	400	200	Domain	13/24	4

14.4.2 Paalaaq

The estimates for Paalaaq were carried out in Vulcan. Three passes were used to interpolate zinc, lead, iron, barium, silver, non-sulphide lead, elemental sulphur, and Total Organic Carbon using ordinary kriging. The process has subsequent passes only estimating previously unestimated blocks. The criteria for the subsequent passes are less restrictive. Examples for the criteria used to estimate zinc in two of the 14 domains are shown in Table 14-13. Inverse distance squared and nearest neighbour estimates were used to validate the ordinary kriging.

Table 14-13: Paalaaq Interpolation Profile Examples

	Search Direction (^{0})			Search Distance (feet)			# Comps	Max #
	Bearing	Plunge	Dip	Major	Semi-Major	Minor	Min/Max	Comps/hole
Domain 207								
Pass 1	260.628	19.683	-3.616	258	260	82	13/24	4
Pass 2	260.628	19.683	-3.616	548	552	176	5/24	4
Pass 3	260.628	19.683	-3.616	1096	1104	352	2/24	4
Domain 221								
Pass 1	60	0	-150	760	360	30	13/24	4
Pass 2	60	0	-150	1899	903	72	5/24	4
Pass 3	60	0	-150	3798	1806	144	2/24	4

14.4.3 Aŋarraaq

The estimates for Aŋarraaq were carried out in Vulcan. Three passes were used to interpolate zinc, lead, iron, barium and silver using ordinary kriging. The process has subsequent passes only estimating previously-unestimated blocks. The criteria for the subsequent passes are less restrictive. Examples for the criteria used to estimate Zn in two of the 17 domains are shown in Table 14-14. Inverse distance squared and nearest neighbour estimates were used to validate the ordinary kriging.

Table 14-14: Anarraaq Interpolation Profile Examples

	Search Direction (^{0})			Search Distance (feet)			# Comps	Max #
	Bearing	Plunge	Dip	Major	Semi-Major	Minor	Min/Max	Comps/hole
Domain 207								
Pass 1	266	-23	-6	165	145	40	13/24	4
Pass 2	266	-23	-6	590	395	145	5/24	4
Pass 3	266	-23	-6	1180	790	290	2/24	4
Domain 221								
Pass 1	64	15	1	400	185	35	13/24	4
Pass 2	64	15	1	670	360	80	5/24	4
Pass 3	64	15	1	1340	720	160	2/24	4

14.5 Bulk Density

Bulk density is estimated for each block based on a formula that is applied to the estimated measurements. The formula is derived from empirical density estimates using the Archimedes method that were performed on a range of zinc and barium grades from drill hole samples, and uses US standard measurement units.

The bulk density equations for Qanaiyaq and Aqqaluk were amended in early 2014 to account for the influence of non-sulphide lead, different estimates of porosity, and to expand the number of default tonnages assigned by sub-classifying the non-exhalite units.

For the Aqqaluk deposit, the tonnage factor is calculated using the following equation:

TF (ft^3/ton) = (11.5917 – [(11.5917 - 7.81) / 67.0916 x Zn + (11.5917 - 4.27) / 86.5983 x Pb + (11.5917 – 5.09) / 68.3228 x sPb + (11.5917 - 6.54) / 46.5489 x Fe + (11.5917 - 7.12) / 58.8428 x Ba]) / 0.95962

Non-exhalite waste shale units are assigned specific tonnage factors: 7.99 ft^3/ton for baritic Siksikpuk Shale, 11.57 ft^3/ton for Siksikpuk Shale, and 12.19 ft^3/ton for all black shales.

A similar methodology was used for the Qanaiyaq deposit, but with one formula for non-weathered rock and a second formula for weathered rock. Weathering was defined as any block with a sPb/Pb ratio of ≥ 40%. For the non-weathered rock, the tonnage factor is calculated using the following equation:

TF (ft^3/ton) = (10.8210 – [(10.8210 - 7.81) / 67.0916 x Zn + (10.8210 - 4.27) / 86.5983 x Pb + (10.8210 – 5.09) / 68.3228 x sPb + (10.8210 - 6.54) / 46.5489 x Fe + (10.8210 - 7.12) / 58.8428 x Ba]) / 0.89174

For the weathered rock, the tonnage factor is calculated with the following equation:

TF (ft^3/ton) = (16.0375 – [(16.0375 - 7.81) / 67.0916 x Zn + (16.0375 - 4.27) / 86.5983 x Pb + (16.0375 – 5.09) / 68.3228 x sPb + (16.0375 - 6.54) / 46.5489 x Fe + (16.0375 - 7.12) / 58.8428 x Ba]) / 0.94307

All non-exhalite waste units are assigned a single specific tonnage factor of 14.54 ft^3/ton.

For the Paalaaq deposit, the tonnage factor is calculated with the following equation:

TF (ft^3/ton) = (12.3994 – [(12.3994 - 7.81) / 67.0916 x Zn + (12.3994 - 4.27) / 86.5983 x Pb + (12.3994 - 6.54) / 46.5489 x Fe + (12.3994 - 7.12) / 58.8428 x Ba]) / 0.99924

For the Aŋarraaq deposit, the tonnage factor is calculated with the following equation:

TF (ft^3/ton) = (12.4271 – [(12.4271 - 7.81) / 67.0916 x Zn + (12.4271 - 4.27) / 86.5983 x Pb + (12.4271 - 6.54) / 46.5489 x Fe + (12.4271 - 7.12) / 58.8428 x Ba]) / 0.99707

14.6 Model Validation

The Qanaiyaq, Aqqaluk, Paalaaq, and Aŋarraaq models have been checked for reasonableness of grade interpolation using the following techniques:

- Visual, comparing block model section to the drill hole data;
- Comparison of global statistics of OK, ID and NN;
- Swath plots;
- Volume–variance plots.

The validation shows the Resource estimates to be unbiased and that the estimates provide a reasonable representation of the information in the drill holes.

In addition, the Aqqaluk model has been reconciled against production tonnages and grades. The F3 reconciliation (where the F3 factor is F1 × F2 and enables a comparison of a mill's ability to recover the tonnage, grade and metal content estimated in Mineral Reserves), shown in Figure 14-1 and Table 14-15, is a comparison of block model predicted ore tonnes, zinc grade and zinc metal tonnes to actual mill production. The graph in Figure 14-1 shows that the difference between model prediction and milled values is often within 5% and rarely outside a 10% difference window.

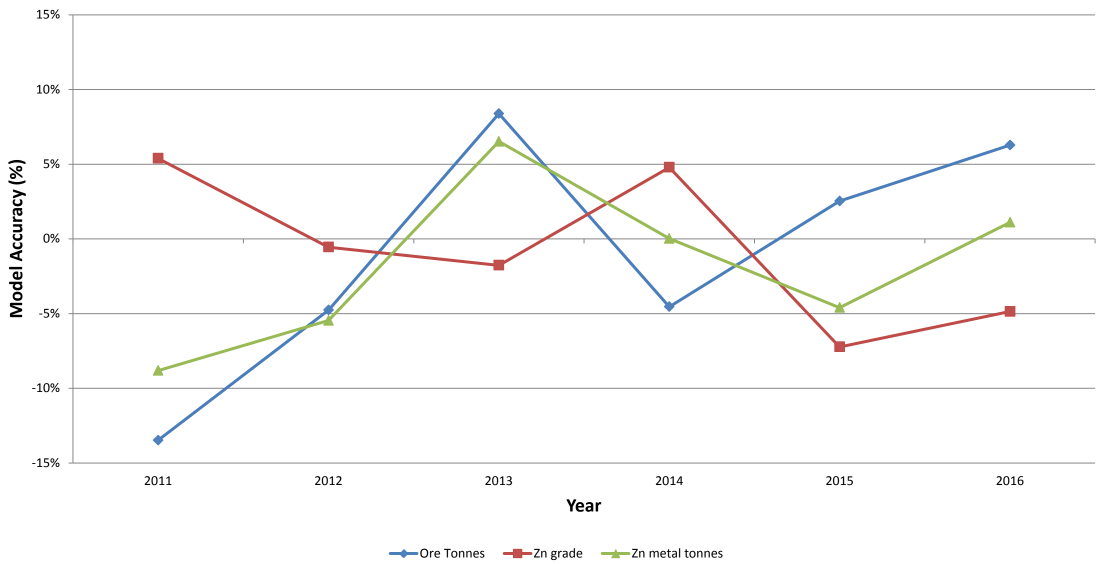

Figure 14-1: Aqqaluk F3 Reconciliation for Zinc and Ore Tonnes

Note: Figure prepared by Teck, 2016.

Table 14-15: Aqqaluk F3 Comparison Data for Zn

	2011	2012	2013	2014	2015	2016
Milled						
Ore Tonnes	3,673,065	3,575,584	3,852,807	4,186,560	4,190,601	4,128,929
Zn grade (%)	19.1	18.2	17.0	16.7	16.6	17.3
Zn metal (t)	701,555	650,756	655,937	700,987	695,640	713,980
Reserve Model						
Ore Tonnes	3,178,094	3,405,278	4,175,905	4,029,499	4,296,799	4,388,108
Zn grade (%)	20.1	18.1	16.7	17.1	15.4	16.5
Zn metal (t)	639,748	615,211	698,724	687,961	663,653	721,929
Model Accuracy						
Ore Tonnes	-13.5%	-4.8%	8.4%	-3.8%	2.5%	6.3%
Zn grade	5.4%	-0.5%	-1.8%	2.4%	-7.2%	-4.9%
Zn metal	-8.8%	-5.5%	6.5%	-1.9%	-4.6%	1.1%

Although mining is in progress at Qanaiyaq there is insufficient data to provide a meaningful F3 reconciliation.

14.7 Resource Classification

14.7.1 Mineral Resources Potentially Amenable to Open Pit Mining Methods

Inferred Mineral Resources are defined by drill spacing (outside of 30 m x 30 m hole spacing) and geological confidence, based upon drilling density and orebody structure. Indicated Mineral Resources are defined by drill spacing (within an area of 30 m x 30 m hole spacing) and geologic confidence in the orebody structure. No Measured Mineral Resources have been classified.

An example of the classification scheme at Aqqaluk is provided in Figure 14-2, in Figure 14-3 for Qanaiyaq, Figure 14-4 for Paalaaq and in Figure 14-5 for Aŋarraaq.

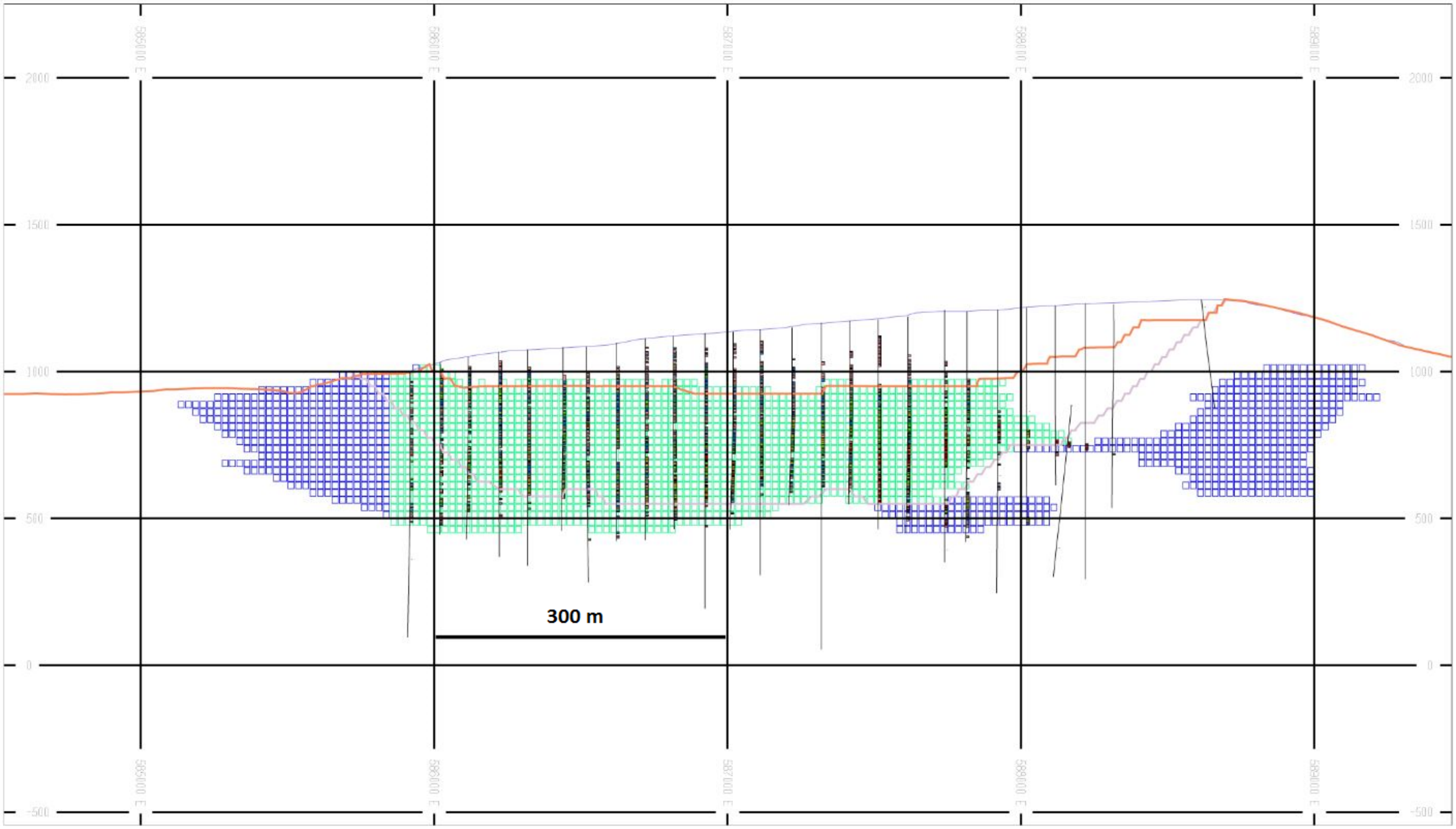

Figure 14-2: East–West Section through Aqqaluk at 146,675N looking North

Note: Figure prepared by Teck, 2016. Green blocks are Indicated Mineral Resources and blue Inferred Mineral Resources. Co-ordinates are in feet. Drill holes shown are within 15 m of the section. Surfaces shown are original ground, estimated EOY 2016 and Aqqaluk ultimate reserves pit Aqq12e.

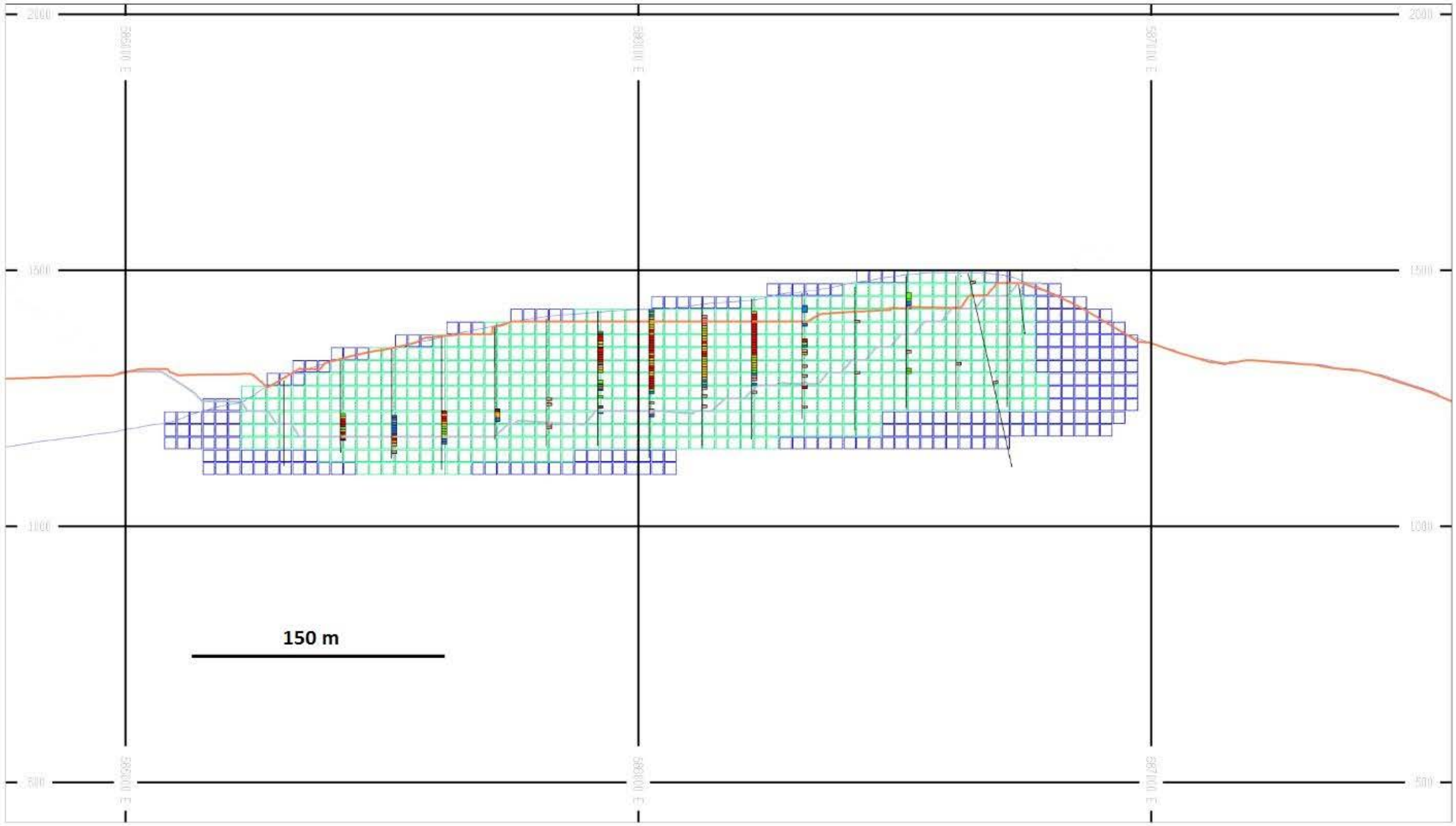

Figure 14-3: East–West Section through Qanaiyaq at 139,575 N looking North

Note: Figure prepared by Teck, 2016. Green blocks are Indicated Mineral Resources and blue Inferred Mineral Resources. Drill holes shown are within 15 m of the section. Surfaces shown are original ground, estimated EOY 2016 and Qanaiyaq ultimate reserves pit Qan12e.

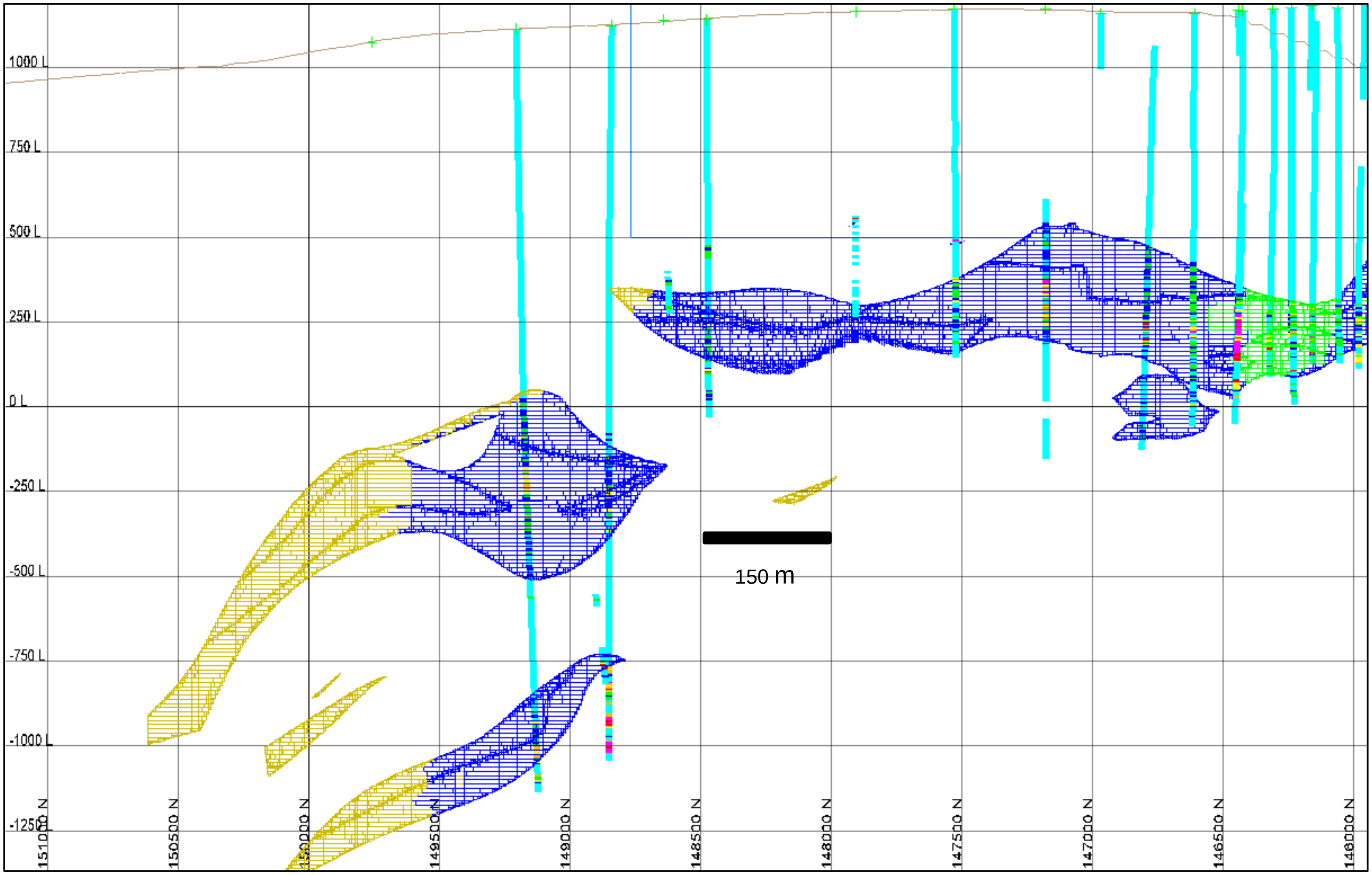

Figure 14-4: Oblique Section through Paalaaq looking East

Note: Figure prepared by Teck, 2016. Green blocks are Indicated Mineral Resources, blue blocks are Inferred Mineral Resources and brown blocks are unclassified. Co-ordinates are in feet. Drill holes shown are within 30 m of the section.

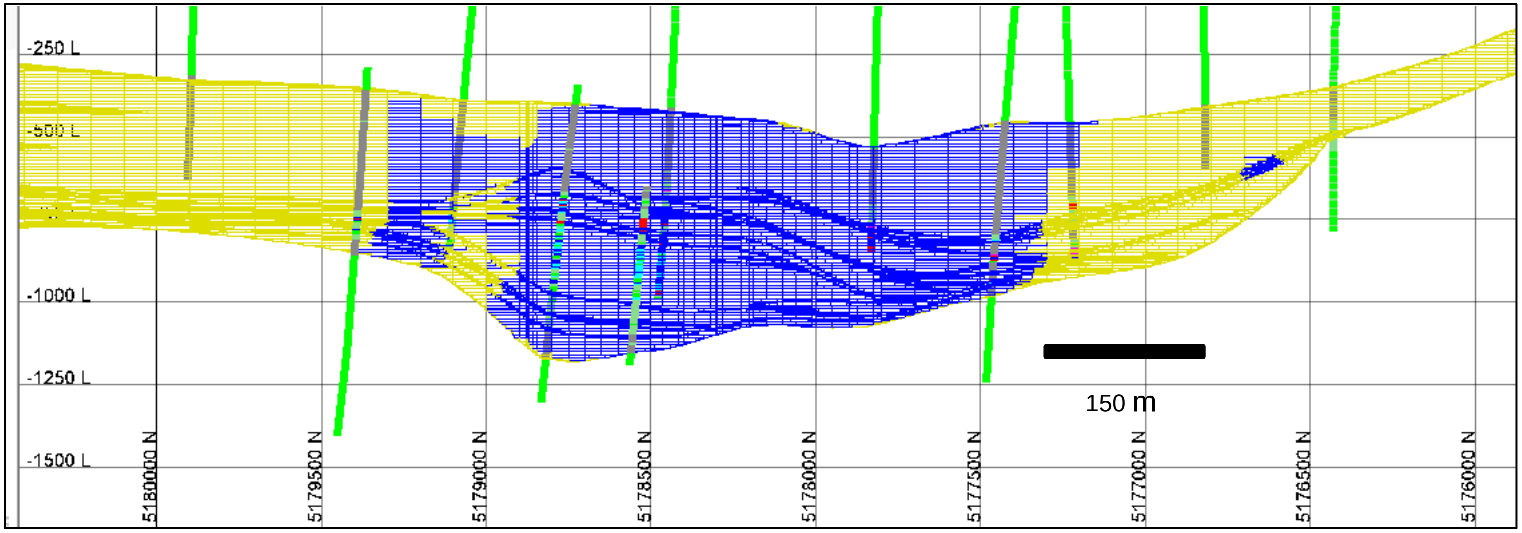

Figure 14-5: Section 569,200 East through Aŋarraaq looking East

Note: Figure prepared by Teck, 2016. Blue blocks are Inferred Mineral Resources and brown blocks are unclassified. Co-ordinates are in feet. Drillholes shown are within 30 m of the section.

14.7.2 Mineral Resources Potentially Amenable to Underground Mining Methods

Mineral Resources are classified as Indicated at Paalaaq if three drill holes are within 27.4 m (90 ft) or two drill holes are within 12 m (40 ft) of a block centroid, approximating a 38 m (125 ft) grid.

Inferred Mineral Resources for both Paalaaq and Aŋarraaq are classified when a the centroid of a block lies within 85.3 m (280 ft) of three drill holes or 50.3 m (165 ft) of two drill holes, approximating a 122 m (400 ft) grid.

No Measured Mineral Resources have been classified.

14.8 Consideration of Reasonable Prospects for Eventual Economic Extraction

The Mineral Resources for all deposits were estimated using long-term metal prices from Teck's May 2016 Reserve & Resource Reporting Guidelines ($1.00/lb for zinc, $0.90/lb for lead and $18.00/oz for silver).

Cutoffs for the open pit mines are based on a net dollars per second ($/s) metric. The $/s value is computed by multiplying the block's net valuation on a dollars per tonne ($/t) basis by the block's modelled throughput rate in tonnes per hour, converted to units of seconds. A time-based metric is used for the cutoffs to account for the variation in throughput of the ores in the deposits caused by their differing hardness and mineral grain sizes. Through 2019 the operating cutoff for mill feed for both open pit deposits is $4.60/second and the break-even cutoff for the low-grade stockpile is $0.00/second. At the beginning of 2020, after the completion of the VIP2 mill infrastructure expansion project (Section 17.1), the operating cutoff will drop to $3.60/second and mill feed will be directed to the appropriate destination using the lower cutoff. The break-even cutoff will remain at $0.00/second for the low-grade stockpile material, as this will generate profit. The current Resource statement accounts for the multiple cutoffs and material classified as an Indicated Mineral Resource is scheduled to be mined beginning in 2020.

In order to test for reasonable prospects of eventual economic extraction for Paalaaq and Aŋarraaq, long hole open stopes were generated using the Vulcan Stope Optimiser at incremental net smelter return (NSR) values beginning at $100/t and increasing by $20/t to a maximum of $200/t. The starting value of $100/t was chosen as preliminary estimates suggest that this will cover the site costs of mining, milling, indirects, and G&A, while providing a small allowance towards sustaining capital.

14.8.1 Aqqaluk Mineral Resources Potentially Amenable to Open Pit Mining Methods

The Aqqaluk deposit contains Indicated and Inferred Mineral Resources constrained using the RED2015-E model, an estimated end of December 2016 topographic surface and the Aqq12e ultimate pit shape.

The Aqqaluk Indicated Mineral Resource is contained in the Aqq12e ultimate pit. It consists of both mineralized material to be direct milled and to be stockpiled and milled at the end of the mine life. It is anticipated that a significant portion of the Indicated Mineral Resource may be able to be converted to Mineral Reserves once the VIP2 project (refer to Section 17.1) and the tailings storage facility (TSF) dam raises pass the pre-feasibility design stage and are approved for construction.

The Aqqaluk Inferred Mineral Resource is contained in the same design pit as the Aqqaluk Indicated Mineral Resource, and uses the same economic and metallurgical criteria, except that it is located along the fringes of the 30.5 m x 30.5 m (100 ft x 100 ft) spaced drilling and in areas of complex geology, making its extent less certain and supporting classification of the material as Inferred. The Inferred Mineral Resource contains material that has been classed as both direct milling and low-grade stockpile feed. Additional drilling may support confidence category upgrades for some or all of the Inferred material.

14.8.2 Qanaiyaq Mineral Resources Potentially Amenable to Open Pit Mining Methods

The Qanaiyaq deposit contains Indicated and Inferred Mineral Resources constrained using the QAN2012-K mode (updated in December 2016), an estimated end of December 2016 topographic surface, and the Qan12e ultimate pit shape.

The Qanaiyaq Indicated Mineral Resource is contained in the Qan12e ultimate pit. It consists of both mineraliized material to be direct milled and to be stockpiled and milled at the end of the mine life. It is anticipated that a significant portion of the Indicated Mineral Resource may be able to be converted to Mineral Reserves once the VIP2 project and the TSF dam raises pass the pre-feasibility design stage and are approved for construction.

The Qanaiyaq Inferred Mineral Resource is contained in the same design pit as the Qanaiyaq Indicated Mineral Resources, and uses the same economic and metallurgical criteria, except that it is located along the fringes of the 30.5 m x 30.5 m spaced drilling and in areas of complex geology, making its extent less certain and supporting its classification as Inferred. The Inferred Mineral Resource contains only material classed as direct mill feed.

14.8.3 Paalaaq and Aŋarraaq Mineral Resources Potentially Amenable to Underground Mining Methods

The Paalaaq deposit contains Indicated and Inferred Mineral Resources constrained using the paa1601_Mine_SB model which is dated 17 December 2016. The Aŋarraaq deposit contains only Inferred Mineral Resources constrained using the ANQ201605SB_Mining_rev2 model, which is dated 19 August 2016.

14.9 Mineral Resource Statement

The mineralization classified as Mineral Resource at Red Dog for Qanaiyaq and Aqqaluk and contained within the current ultimate pit designs is tabulated in Table 14-16. The Resources for Paalaaq and Aŋarraaq are also tabulated in Table 14-16 and include all zinc and silver domains within the optimized stopes, but do not include waste diluting material within the stopes. Mineral

Resources are reported exclusive of Mineral Reserves and use the classification confidence categories set out in the 2014 CIM *Definition Standards for Mineral Resources and Mineral Reserves* (2014 CIM Definition Standards).

Table 14-16: Red Dog Indicated & Inferred Mineral Resources as at December 31, 2016

Resource Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Indicated	Aqqaluk – Mill Feed	9,770	7.1	2.2	38
	Aqqaluk – LG Stockpile	3,200	4.3	2.4	38
	Qanaiyaq – Mill Feed	480	14.4	5.4	118
	Qanaiyaq – LG Stockpile	50	8.1	2.7	52
	Paalaaq – Mill Feed	2,910	12.3	4.2	91
Indicated Resource Total		***16,410***	***7.7***	***2.7***	***50***

Resource Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Inferred	Aqqaluk– Mill Feed	410	9.6	3.1	63
	Aqqaluk – LG Stockpile	80	3.9	2.8	45
	Paalaaq – Mill Feed	6,110	12.3	4.7	89
	Aŋarraaq – Mill Feed	19,440	14.4	4.2	73
Inferred Resource Total		***26,040***	***13.8***	***4.3***	***77***

<u>Note to accompany Mineral Resource Tables</u>

1. Tom Krolak, RM SME, Principal Geologist at Red Dog Mine is the Qualified Person responsible for the Aqqaluk, Qanaiyaq, and Paalaaq Mineral Resource estimates.
2. Kevin Palmer, P.Geo., Principal Geostatistician at Teck Resources Limited, is the Qualified Person responsible for the Aŋarraaq Mineral Resource estimate.
3. Mineral Resources have the following reporting dates: Aqqaluk, 31 December 2016; Qanaiyaq, 31 December 2016; Paalaaq, 17 December 2016; and Aŋarraaq, 19 August 2016.
4. Aqqaluk and Qanaiyaq are being mined using open pit mining methods. Metal prices used for NSR calculation were $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag. The reported numbers for mill feed are at cutoffs of $4.60 per second milled, pre-VIP2, and $3.60 per second milled, post-VIP2, and represents mill feed that is to be mined and directly processed. The VIP2 project is planned to include modifications to the grinding and flotation circuits. Metallurgical recoveries for mill feed for Aqqaluk are variable based on grade and rock type and average 81.5% for Zn, 40.4% for Pb, and 58.1% for Ag. Metallurgical recoveries for mill feed for Qanaiyaq are variable based on grade and rock type and average 39.0% for Zn, 18.9% for Pb, and 32.2% for Ag. The reported numbers for LG stockpile are at a cutoff of $0.00 per second milled; this material will be fed to the mill at the end of mine life. Metallurgical recoveries for LG stockpile for Aqqaluk are variable based on grade and rock type and average 72.2% for Zn, 53.4% for Pb, and 47.4% for Ag. Metallurgical recoveries for the LG stockpile for Qanaiyaq are variable based on grade and rock type and average 54.8% for Zn, 53.2% for Pb, and 45.4% for Ag.
5. No allowances for mining recovery and external dilution have been applied. Contact dilution between the 7.6 m x 7.6 m x 7.6 m blocks was applied.
6. The pit shell constraining the Aqqaluk estimate used the following assumptions: metal prices of US$0.75/lb Zn, US$0.68/lb Pb, and US$15.00/oz Ag; site costs of $2.78/t waste mining and $2.86/t mill feed mining, plus a vertical component per bench of US$0.0182/t (± 875 ft elevation) and $57.71/t mill feed process and G&A; and inter-ramp pit slope angles that ranged from 41–47°. The pit shell constraining the Qanaiyaq estimate used the following assumptions: metal prices of US$1.00/lb Zn, US$0.90/lb Pb, and US$20.00/oz Ag, site costs of $2.02/t waste mining and $2.37/t mill feed mining plus a vertical component per bench of US$0.0182/t (± 1325 ft elevation) and $57.93/t mill feed process and G&A; and inter-ramp pit slope angles that ranged from 26–37°.

7. Paalaaq and Aŋarraaq are expected to be mined using an underground mining method. The reported numbers are those from open stope shapes with a maximum size of 15 m x 30 m x 50 m generated in Vulcan Stope Optimizer using $100/t NSR as a cutoff. Isolated stope shapes were ignored. Metallurgical recoveries for Paalaaq are based on rock type and average 55.1% for Zn, 54.2% for Pb and 65.0% for Ag. At Aŋarraaq a standard recovery was used for all domains and this was 80.0% for Zn, 53.0% for Pb and 65.0% for Ag. Metal prices used for the NSR calculation were $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag. No dilution factor has been applied.
8. Numbers have been rounded for the individual entries so totals and weighted averages for the variables may vary slightly.
9. Mineral Resources are reported exclusive of Mineral Reserves and do not have demonstrated economic viability.
10. Reporting units are metric: Tonnes, dry metric tonnes; Zn and Pb percent (%); and Ag gram per tonne (g/t).

14.10 Comment on Mineral Resources

Factors that may affect the Mineral Resource estimates include:

- Changes to the metal price assumptions;
- Changes in the calculated metallurgical recovery factors;
- Changes in the calculated metallurgical throughput factors;
- Changes to the operating cutoff assumptions for mill feed or stockpile feed;
- Changes to the inputs to the density formulae;
- Changes to the inputs to the assumed pit designs for the Mineral Resources considered potentially amenable to open pit mining methods; changes to the inputs to the assumed stope designs for the Mineral Resources considered potentially amenable to underground mining methods;
- Inputs from additional drill data that may change interpretations of geological or other domains;
- Changes to the operating and permitting environments.

The Aqqaluk and Qanaiyaq Mineral Resources are inside the permitted and approved ultimate pits for the Red Dog Mine. No permits have currently been sought for any future underground operations at Paalaaq and Aŋarraaq. The Qualified Persons consider that Mineral Resources are unlikely to be materially impacted by any other environmental, permitting, legal, title, taxation, socioeconomic, marketing, political or any other relevant factor that is not discussed in this Report.

15 MINERAL RESERVE ESTIMATES

15.1 Introduction

The Mineral Reserve estimates for the deposits at Red Dog were prepared by Mr. Thomas Krolak, RM SME, and Mr. Norman Paley, PE, both Teck employees. Mineral Reserves have been converted from the Mineral Resource estimates discussed in Section 14. Mineral Reserves are defined as those blocks exceeding the cutoff, have been assigned an Indicated classification, and are constrained within an approved ultimate pit design. This is supported through a detailed mine plan that has been evaluated to a pre-feasibility level, and has been accepted by Teck Senior Management as corporately meeting the desired payback.

15.2 Mineral Reserve Statement

The mineralization classified as Mineral Reserves at Red Dog and contained within the current ultimate pit designs is tabulated below in Table 15-1. No Mineral Resources amenable to underground mining methods such as those from either Paalaaq or Aŋarraaq have been converted to Mineral Reserves. No Mineral Reserves using underground mining methods are reported; nor are any Proven Mineral Reserves reported.

Table 15-1: Red Dog Probable Mineral Reserves as at December 31, 2016

Reserve Category	Area	Tonnes (000's)	Zn (%)	Pb (%)	Ag (g/t)
Probable	Aqqaluk – Mill Feed	43,410	13.4	3.7	66
	Qanaiyaq – Mill Feed	7,480	24.7	6.9	138
Probable Reserve Total		***50,890***	***15.0***	***4.2***	***76***

Note to accompany Mineral Reserve Table

1. Norman Paley, PE, Principal Engineer at Red Dog Mine is the Qualified Person responsible for the Aqqaluk and Qanaiyaq Mineral Reserve estimates.
2. Mineral Reserves have the following reporting dates: Aqqaluk, 31 December 2016; Qanaiyaq, 31 December 2016.
3. Mineral Reserves are reported within the open pit designs based on metal prices of $1.00/lb Zn, $0.90/lb Pb, and $18.00/oz Ag and cutoffs of $4.60 per second milled, pre-VIP2, and $3.60 per second milled, post-VIP2, and represents ore that is to be mined and directly processed. The VIP2 project is planned to include modifications to the grinding and flotation circuits. Metallurgical recoveries for Aqqaluk are variable based on grade and rock type and average 85.5% for Zn, 58.1% for Pb, and 66.8% for Ag. Metallurgical recoveries for Qanaiyaq are variable based on grade and rock type and average 73.9% for Zn, 32.2% for Pb, and 50.6% for Ag.
4. No allowances for mining recovery and external dilution have been applied. Contact dilution between the 7.6 m x 7.6 m x 7.6 m blocks was applied. Aqqaluk inter-ramp pit slope angles range from 41–47° and Qanaiyaq inter-ramp pit slope angles range from 26–37°.
5. Numbers have been rounded for the individual entries so totals and weighted averages for the variables may vary slightly.
6. Mineral Reserves are reported exclusive of Mineral Resources.
7. Reporting units are metric: Tonnes, dry metric tonnes; Zn and Pb percent (%); and Ag gram per tonne (g/t).

15.3 Conversion Criteria

The same economic criteria and methods discussed in Section 14.8 and Section 14.9 were used in the estimation of Mineral Reserves. The conversion of Mineral Resources to Mineral

Reserves is primarily based on having cost estimates for infrastructure available at a minimum of a Preliminary Feasibility Study (PFS) level of detail. In particular for the Aqqaluk and Qanaiyaq pits, this infrastructure is the raise of the TSF dams from the current 986 ft elevation to the 996 ft elevation.

15.3.1 Aqqaluk

The Aqqaluk estimate Probable Mineral Reserve is constrained using the RED2015-E model, an estimated end of December 2016 topographic surface and the Aqq12e ultimate pit. The Mineral Reserve is contained within a zone of 30.5 m (100 ft) spaced drilling. The Probable Mineral Reserve confidence category is considered to be supported for this portion of the Aqqaluk deposit, based on the drilling density, metallurgical test work, and reconciliation data. The Aqqaluk Probable Mineral Reserve cutoff is $4.60/second, and includes only direct mill feed.

15.3.2 Qanaiyaq

The Qanaiyaq Probable Mineral Reserve is based on the QAN2012-K model, updated in December 2016, and is constrained using an estimated end of December 2016 topographic surface and the Qan12e ultimate pit. Since Qanaiyaq is hosted within a klippe, its spatial extent is well known. Given drill coverage of 30.5 x 30.5 m (100 x 100 ft.) over the bulk of the deposit, metallurgical testing that indicates large portions of the deposit can be processed in the current Red Dog mill, and ongoing work to mitigate issues related to selenium, sufficient confidence exists to support the Probable Mineral Reserve classification. The Qanaiyaq probable reserve cutoff is $4.60/second and is entirely direct mill feed ore.

15.3.3 Metallurgical Recovery

Metallurgical recovery is calculated for every block in the model and the average metal recovery for each deposit is used to calculate the metal recovery for that deposit.

In Aqqaluk, concentrate grades are 55% zinc in zinc concentrate and 54% lead in lead concentrate except in a small zone of intersection between the Sub-lower structural plate and the Aqqaluk pit. In this area the concentrate grades are 60% and 48.8% respectively for Veined ore, 49.6% and 48.6% respectively for Siliceous ore, and 55% and 54%, respectively for Baritic ore. Recovery averages 85.5% for zinc in zinc concentrate and 58.1% for lead in lead concentrate.

In Qanaiyaq, concentrate grades are 50% for both zinc in zinc and lead in lead concentrates. Recovery averages 73.9% for zinc in zinc concentrate and 32.2% for lead in lead concentrate.

For both deposits recovered zinc metal reported is only that contained in zinc concentrate, and recovered lead metal reported is only that contained in lead concentrate. Recovered silver metal reported is that contained in both zinc and lead concentrates for both deposits.

15.4 Comments on Mineral Reserves

Factors that may affect the Mineral Reserve estimates include:

- Changes to the metal price assumptions;
- Changes in the metallurgical recovery factors;
- Changes in the metallurgical throughput factors;
- Changes to the operating cutoff assumptions for mill feed and stockpile feed;
- Changes to the input assumptions used to derive the open pit outline and the mine plan that is based on that open pit design;
- Ability to mitigate the release of deleterious elements such as selenium into the environment;
- Ability to maintain social and environmental license to operate;
- Changes to the assumed permitting and regulatory environment under which the mine plan was developed.

As Red Dog is an existing operation and the Mineral Reserves are inside the permitted and approved mine plans, the Qualified Person considers Mineral Reserves are unlikely to be materially impacted by any other environmental, permitting, legal, title, taxation, socioeconomic, marketing, political or other relevant factor not discussed in this Report.

Potential upside exists for Mineral Reserves from the open pit deposits to be successfully converted from Mineral Resources once the cost estimates for the raising of the TSF dams from the 996 ft elevation to the 1006 ft elevation and for the VIP2 grinding and flotation circuit expansions are refined from the current scoping xStudy level of detail to a minimum of a PFS level of detail.

Potential upside exists for Mineral Reserves and the mine plan if the mineralization which can be accessed by underground mining methods can be successfully converted from Mineral Resources.

16 MINING METHODS

16.1 Introduction

The Red Dog mine currently operates two open pits at Aqqaluk and Qanaiyaq using conventional open pit drill and blast and truck and loader technology.

The larger of the two, the Aqqaluk pit, is approximately 945 m (3,100 ft) along its widest axis, east–west, and an average of 701 m (2,300 ft) in the perpendicular, north–south. The smaller of the two, the Qanaiyaq pit, is located 1.4 km (4,700 ft) south of the Aqqaluk pit and is approximately 732 m (2,400 ft) along its widest axis, northwest–southeast, and an average of 457 m (1,500 ft) in the perpendicular, northeast–southwest.

Both pits are mined on single 7.6 m (25 ft) benches and are accessed via two-lane haul roads. The haul roads are designed with a running width of 22.9 m (75 ft) and include 3.7 m (12 ft) safety berms and 1.8 m (6 ft) ditches; the total design width is 28.3 m (93 ft). Long-term haul roads are designed to a maximum grade of 10%, and short-term haul roads are designed to a maximum grade of 12%.

Mine operations at Red Dog are responsible for building pre-blended stockpiles, or batch piles, to supply approximately two weeks of concentrator feed. These stockpiles are built in thin lifts from various ore sources within the pit to conform to metal grade and metallurgical constituent constraints. Stockpile blending criteria are shown in Table 16-1.

Table 16-1: Stockpile Blending Criteria

Parameter	Limit
TOC	≤ 0.50%
Type 8	< 10%
Type 9	< 15%
Zn:Fe	≥ 2.1:1
Zn:Pb	≥ 3.0:1
sPb:Pb	< 0.25:1

Note: Type 8 is a Red Dog mine classification that describes rock which exhibits ultra-fine grain sphalerite; Type 9 is a Red Dog mine classification that describes rock which exhibits physical weathering

Mine operations also performs re-handling of the stockpiles to feed the primary gyratory crusher. Crushed ore is then conveyed to surge piles which are used to control the flow of ore conveyed to the semi-autogenous grind (SAG) mills.

16.2 Geotechnical and Hydrological Considerations

Open pit design for Red Dog uses geotechnical structural analysis, structural domains based on rock types, and rock mass quality ratings for the principal lithologies. Golder Associates are the engineer of record for the project and have approved the pit designs that reflect their recommendations for inter-ramp wall angles.

Pit slope inter-ramp angles for the Aqqaluk pit are based on lithology and range from 41° to 47° as shown in Table 16-2.

Pit slope inter-ramp angles for the weathered rock of the Qanaiyaq pit are based on the ISRM rock quality rating (R0, extremely weak rock, to R6, extremely strong rock) and range from 26.6° to 37° as shown in Table 16-3.

Table 16-2: Pit Slope Design Criteria, Aqqaluk

Depth from surface	Parameter	Rock Type		
		Exhalite/Barite	Siksikpuk	Mélange/Black Shale
0 to 100 ft	Inter-ramp angle (°)	41	41	41
	Bench face angle (°)	60	60	60
	Berm width (ft)	14.3	14.3	14.3
100 ft or more	Inter-ramp angle (°)	47	45	41
	Bench face angle (°)	70	65	60
	Berm width (ft)	14.2	13.3	14.3

Table 16-3: Pit Slope Design Criteria, Qanaiyaq

Wall Height	Parameter	ISRM Rock Quality Zone		
		R0 to R1	R1 to R2	R2 or greater
1 to 3 benches	Inter-ramp angle (°)	31	37	37
	Bench face angle (°)	60	60	60
	Berm width (ft)	27.2	18.7	18.7
3 to 5 benches	Inter-ramp angle (°)	28	37	37
	Bench face angle (°)	60	60	60
	Berm width (ft)	32.6	18.7	18.7
5 to 10 benches	Inter-ramp angle (°)	26.6	35	37
	Bench face angle (°)	60	60	60
	Berm width (ft)	35.5	21.3	18.7
10 or more benches	Inter-ramp angle (°)	26.6	34	37
	Bench face angle (°)	60	60	60
	Berm width (ft)	35.5	22.6	18.7

Only the Aqqaluk pit has been mined sufficiently to date to evaluate pit wall performance. In general, individual benches, particularly benches excavated in the competent barites, break back to steeply dipping joints and have exhibited adequate stability performance at both inter-ramp and bench scale. Benches located in the weaker shale materials in the upper portion of the pit have exhibited a higher degree of raveling and have shown some bench-scale instability along in-dipping foliation and/or bedding; however, inter-ramp stability has been adequate. No signs of large scale, multi-bench instability have been observed to date.

Teck Alaska has a formal Ground Control Management Plan that consists of ongoing systematic review of the following elements:

- Annual review meetings with Golder Associates;
- Geotechnical mapping;
- Trim and buffer blasting techniques to reduce wall damage;
- Thermistors to monitor depth to active layer/permafrost interface;
- Piezometers to monitor groundwater depth;
- Slope monitoring prisms monitored by a robotic total station.

The Aqqaluk pit is generally dry, but seeps occur in fracture zones. Pumping rates from the Aqqaluk pit vary from up to 75.7 l/s (1,200 gpm) in spring and summer, down to less than 6.3 l/s (100 gpm) in winter. The Qanaiyaq pit is generally dry. Wet conditions can become problematic in both pits during spring freshet after winters with deep snow pack if temperatures increase too quickly. This leads to rapid snow melt causing water to report to the lowest bench of the pits at a rate greater than the peak pumping capacity. These extreme freshets are mitigated by storing the excess water on the lowest bench and adjusting the mining plan to excavate higher benches for the few days required for the pumping system to catch up and remove the water.

16.3 Pit Designs

The Mineral Reserve models for the two open pit deposits include metallurgical data such that a recovery algorithm is applied which provides varying recoveries as a function of reserve model assays. Ultimate pit geometries were developed for the two deposits using a Lerchs-Grossman time value of money pit optimization routine. Pit shell outputs from this program were ranked to optimize net present value (NPV), and constraints such as minimum mining width and access points were considered. The various pit shells were then scheduled to produce an operating plan that limits annual flotation capacity to 1.10 and 0.25 Mt for zinc and lead concentrate respectively. Final pit configurations for the Aqqaluk and Qanaiyaq Pits are shown in Figure 16-1 and Figure 16-2, respectively.

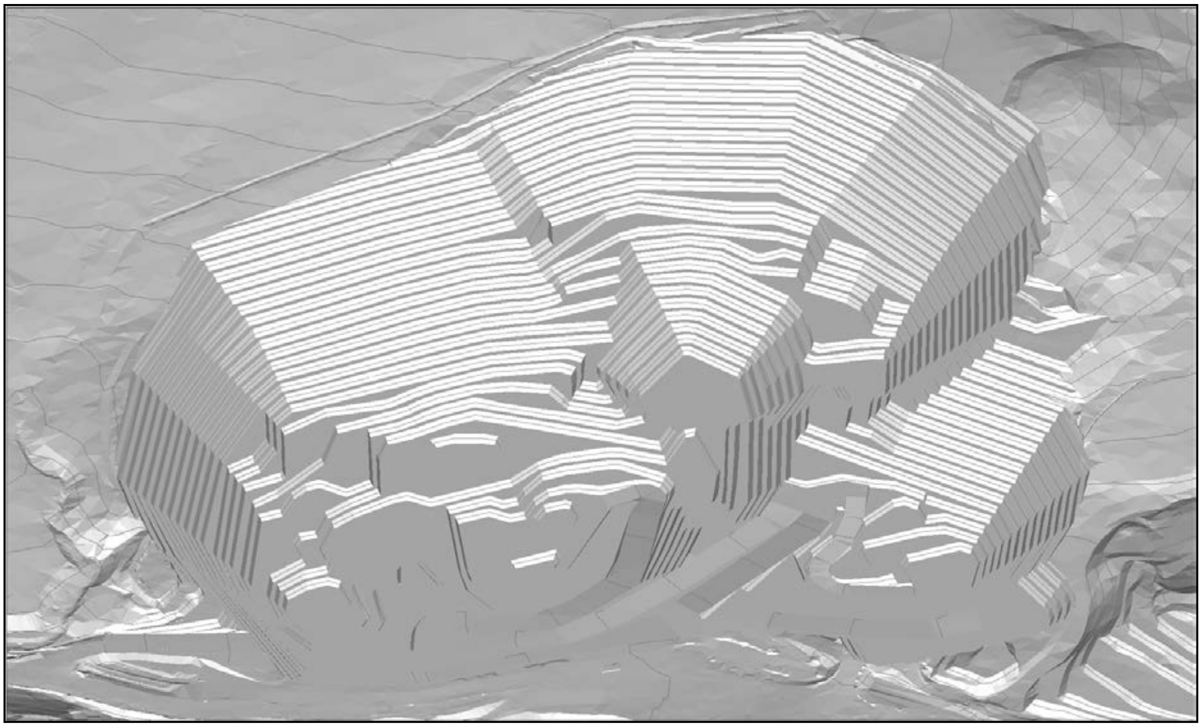

Figure 16-1: Final Aqqaluk Pit Configuration looking North, isometric view.

Note: Figure prepared by Teck, 2016. The pit is approximately 945 m (3,100 ft) along its widest axis, east–west, and an average of 701 m (2,300 ft) in the perpendicular, north–south.

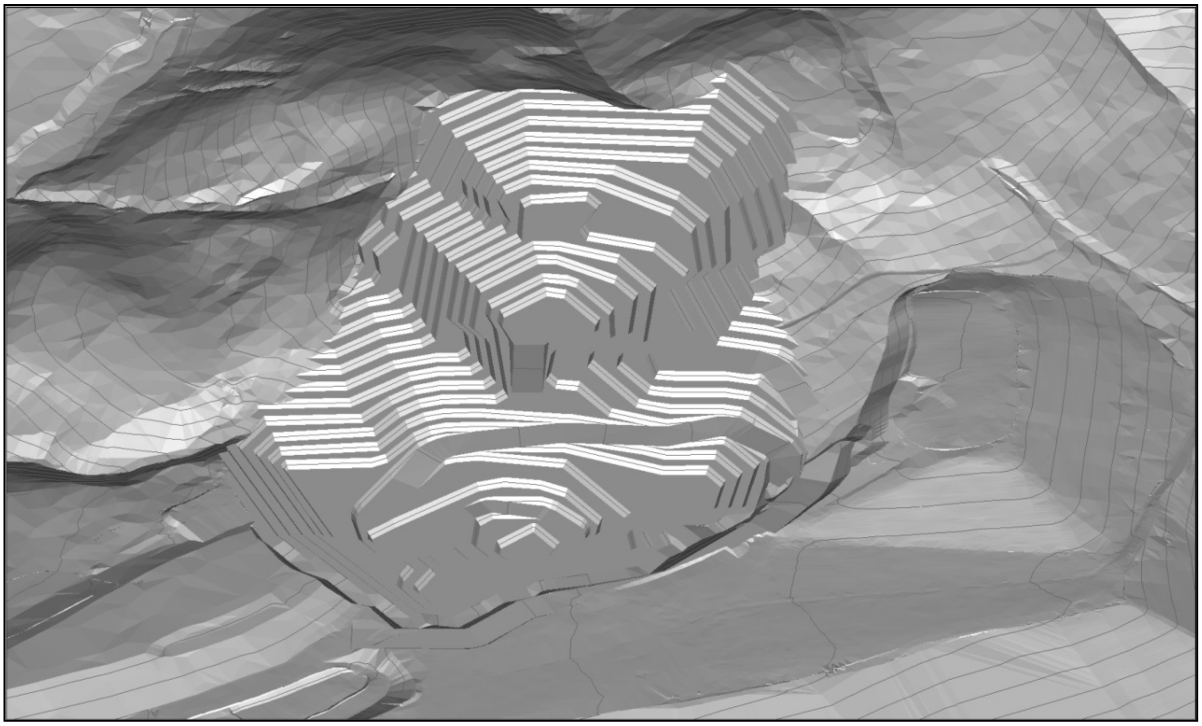

Figure 16-2: Final Qanaiyaq Pit Configuration looking Southeast, isometric view.

Note: Figure prepared by Teck, 2016. Pit is approximately 732 m (2,400 ft) along its widest axis, northwest–southeast, and an average of 457 m (1,500 ft) in the perpendicular, northeast–southwest.

The Aqqaluk and Qanaiyaq deposits are scheduled in a series of pushback phases that allow for even distribution of mine production, and result in higher-grade ore being sent to the mill in the early production years. There are three phases remaining in the Aqqaluk pit and two phases in the Qanaiyaq pit. Mining of the higher-grade Qanaiyaq pit supplements the declining grades of the Aqqaluk pit in its later years. The proportion of Qanaiyaq ore in the mill feed is controlled via a blending strategy. Total ore from Qanaiyaq is limited to a maximum of 33% of the total mill feed and no more than 50% of the Qanaiyaq ore can be weathered, i.e. a maximum of 16% of the total mill feed.

The Aqqaluk pit is the current source of feed supply for the Red Dog mill facility, and will continue to be until 2017 at which time the Qanaiyaq pit will also begin supplying mill feed. The Aqqaluk pit will continue to provide mill feed material until the end of pit life in 2031, while the Qanaiyaq pit will provide a portion of the mill feed until the end of pit life 2027. Mining will cease one year ahead of processing; and the last year of mill operations will treat ore from a long-term low-grade stockpile. The low-grade stockpile will be built 427 m (1,400 ft) to the south of the gyratory crusher and is expected to accumulate a total of 3.3 Mt of ore grading 4.4% Zn and 2.4% Pb by the end of pit operations.

The mine production rate averages 24 kt/day, varying from a maximum of 34.5 kt/day due to higher stripping requirements in the next four years of the Aqqaluk and Qanaiyaq pit mining schedules to a low of 15.5 kt/day in the last five years of operations. Mine production for mill feed averages 11.5 kt/day, but varies with ore hardness through the deposits and thus ranges through the mine life from a maximum of 13 kt/day to a low of 10.5 kt/day. From the combination of high-grade ore production and low-grade ore reclamation, the current mine plan projects concentrate production to extend into 2031.

Dilution based on Smallest Mining Unit (SMU) of 15.2 m (50 ft) is implemented in the mining plan through the block model for the deposits. Dilution algorithms are applied to the resource model in several steps in order to redefine the destination of isolated blocks or strands of single blocks when they are located within a field of dissimilar destination material. Dilution is applied to all materials with the exception of Cover rock that cannot have other materials diluted into it as it must remain unmineralized and thus can only dilute other materials.

16.4 Stripping Requirements

The waste to mill feed strip ratio over the life of the Aqqaluk pit is 0.87:1. The waste to mill feed strip ratio over the life of the Qanaiyaq pit is 2.18:1.

Waste rock from the Aqqaluk and Qanaiyaq Pits will be used to backfill both the Main pit, which was mined from 1989 to 2012, and the Qanaiyaq pit. The 47.3 M m^3 (61.8 M yd^3) capacity of these two pits is sufficient to store all the waste rock forecast from the mine plan.

16.5 Grade Control and Blasting

Blast hole drilling is discussed in Section 10, and the drill spacing and sampling methodology is described in Section 11.

Production blasting is on staggered patterns with higher powder factors used in ore to increase grinding throughput in the SAG mills. Wall control is done using buffer blasts along intermediate bench pushback walls and pre-split blasts along final pit walls. Drilling is with conventional down-the-hole (DTH) hammer methods with 165 mm (6-1/2 in) holes.

Teck Alaska owns an emulsion blasting agent manufacturing plant which is operated by a contractor. The manufacturing plant is capable of providing the blasting agent required for the mine plan. Emulsion blasting agent, ammonium nitrate, and fuel oil are blended in Triple Threat Trucks (TTT) to make a Heavy-ANFO for loading into dry holes or an Emulsion Blend for loading into wet holes. Consumption of emulsion decreases seasonally due to freezing temperatures and increases linearly with pit depth due to increasing groundwater inflow.

16.6 Mining Fleet

The pits are mined with a Teck Alaska-owned and maintained fleet of equipment. Generally, the pit equipment operates at low utilization rates as the mine easily supplies the necessary feed for the mill and concentrator. Major mining and support equipment required to achieve the peak production year of the mine plan includes the following:

- 11 CAT 777 haul trucks;
- 5 CAT 993 wheel loaders;
- 1 CAT 992 wheel loader;
- 3 Atlas Copco DM-L drills;
- 2 Tradestar "Triple Threat" bulk blasting agent delivery trucks;
- 2 CAT D10 track dozers;
- 2 CAT D9 track dozers;
- 3 CAT 16 motor graders;
- 1 CAT 14 motor grader;
- 1 CAT 385 excavator;
- 2 CAT 345 size class excavators;
- 1 CAT 325 excavator;
- 4 CAT 966 wheel loaders.

All of this equipment is currently in the equipment pool at the mine site, with the exception of one haul truck as it is not required in the current mine plan until 2019.

17 RECOVERY METHODS

17.1 Description of Process Plant

The Red Dog flow sheet uses three stages of grinding and froth flotation technology to recover sphalerite and galena to the zinc and lead concentrates respectively. Following crushing and grinding, slurry reports to a pre-flotation circuit to remove elemental sulphur and naturally occurring organic material. The pre-flotation section consists of both a rougher and a cleaner stage. The rougher stage consists of mechanical cells while the cleaner circuit is a Jameson cell. The Jameson cell is used to minimize the loss via entrainment of both fine lead and zinc particles to the pre-flotation concentrate using dilution. The lead flotation circuit consists of a rougher circuit in closed circuit with cleaner columns. Xanthate is used as sulphide collector and cyanide is used as the main pyrite depressant. Tower mills are used for regrind to provide additional mineral liberation. Typical lead recovery to the lead concentrate varies between 55-65% depending on ore type. The final lead concentrate is thickened and filtered. The lead flotation tailings reports to the zinc circuit. Copper sulfate is used to activate sphalerite while xanthate is used as the sulphide collector. The zinc flotation circuit consists of a rougher circuit followed by three stages of cleaning and a retreat circuit. The zinc rougher concentrate is reground by one M5000 IsaMill for additional liberation. The tailings from the zinc cleaner circuit is further reground in another M5000 IsaMill before feeding a three stage zinc retreat circuit. The zinc retreat final concentrate is combined with the zinc cleaner concentrate to make up the final zinc concentrate. The zinc concentrate is then thickened and filtered.

Concentrate is stored on site then hauled by truck to the port site facility on the Chukchi Sea. The concentrates are stored at the port and then shipped to the contracted smelting facilities during the shipping season between early July and early October.

A simplified flow sheet is included as Figure 17-1, and schematic flow sheets for the grinding and flotation circuits are presented in Figure 17-2 and Figure 17-3.

Tailings slurry from both the zinc rougher and the zinc retreat circuits are combined with the pre-flotation concentrate to form the final tailings. The final tailings are pumped to the tailings impoundment area where water is decanted and re-used in the milling circuit. During the summer months, excess water in the tailings impoundment area is treated prior to discharge via Outfall 001 to Red Dog Creek.

In order to maintain concentrate production close to current levels with the declining feed grades, and handle the expected harder ore, a capital project (referred to as the VIP2 project) is currently under review. The VIP2 project envisages that the main modifications to the grinding circuit will be to allow the SAG1 and SAG2 mills to draw the same amount of power as the SAG3 mill, and the addition of one M15000 IsaMill as a quaternary mill. The flotation circuit will be augmented with six OK-16 lead scavenger cells and one Jameson cell as a zinc 1st rougher concentrate cleaner.

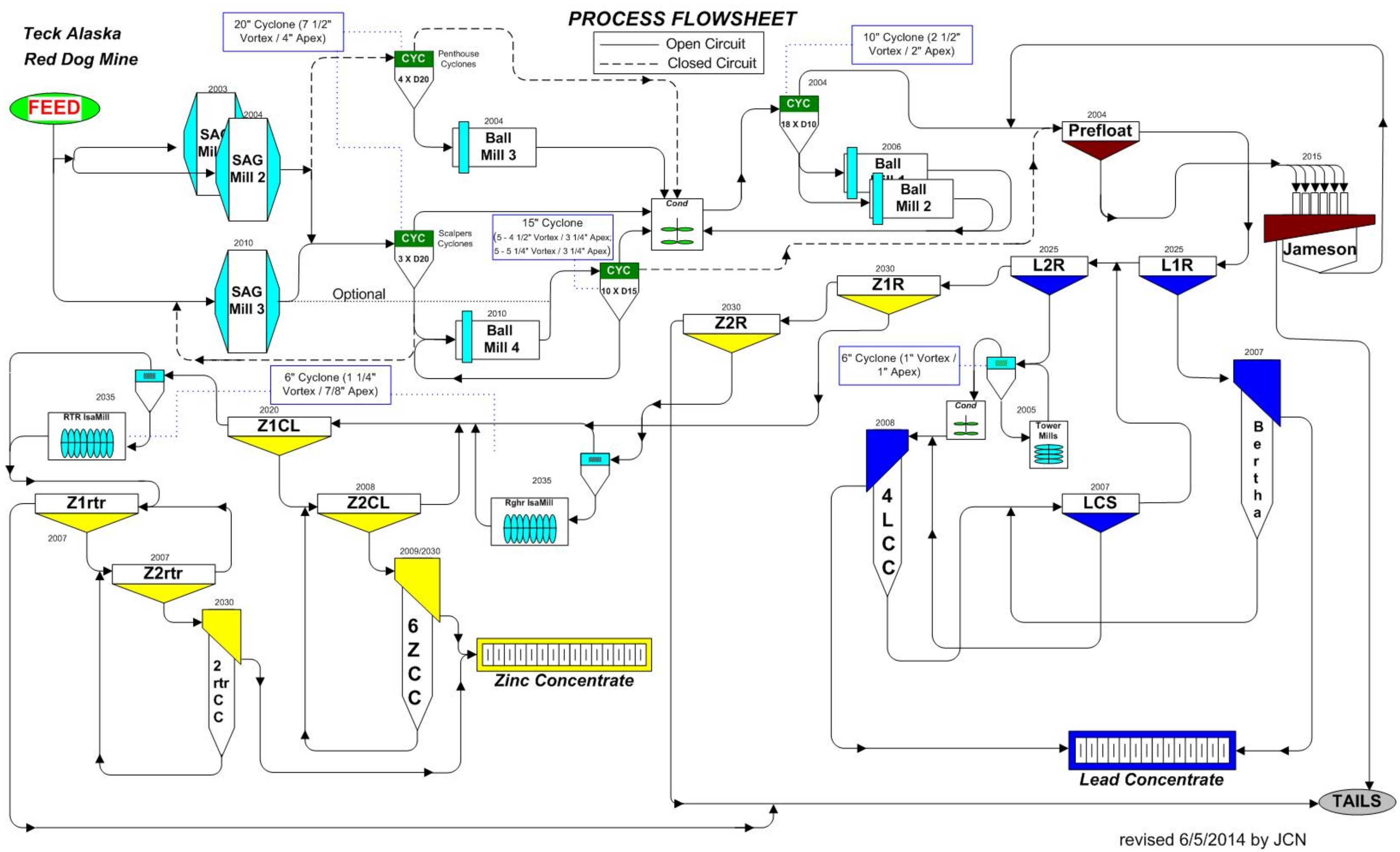

Figure 17-1: Simplified Metallurgical Flowsheet Schematic

Note: Figure prepared for Teck, 2014

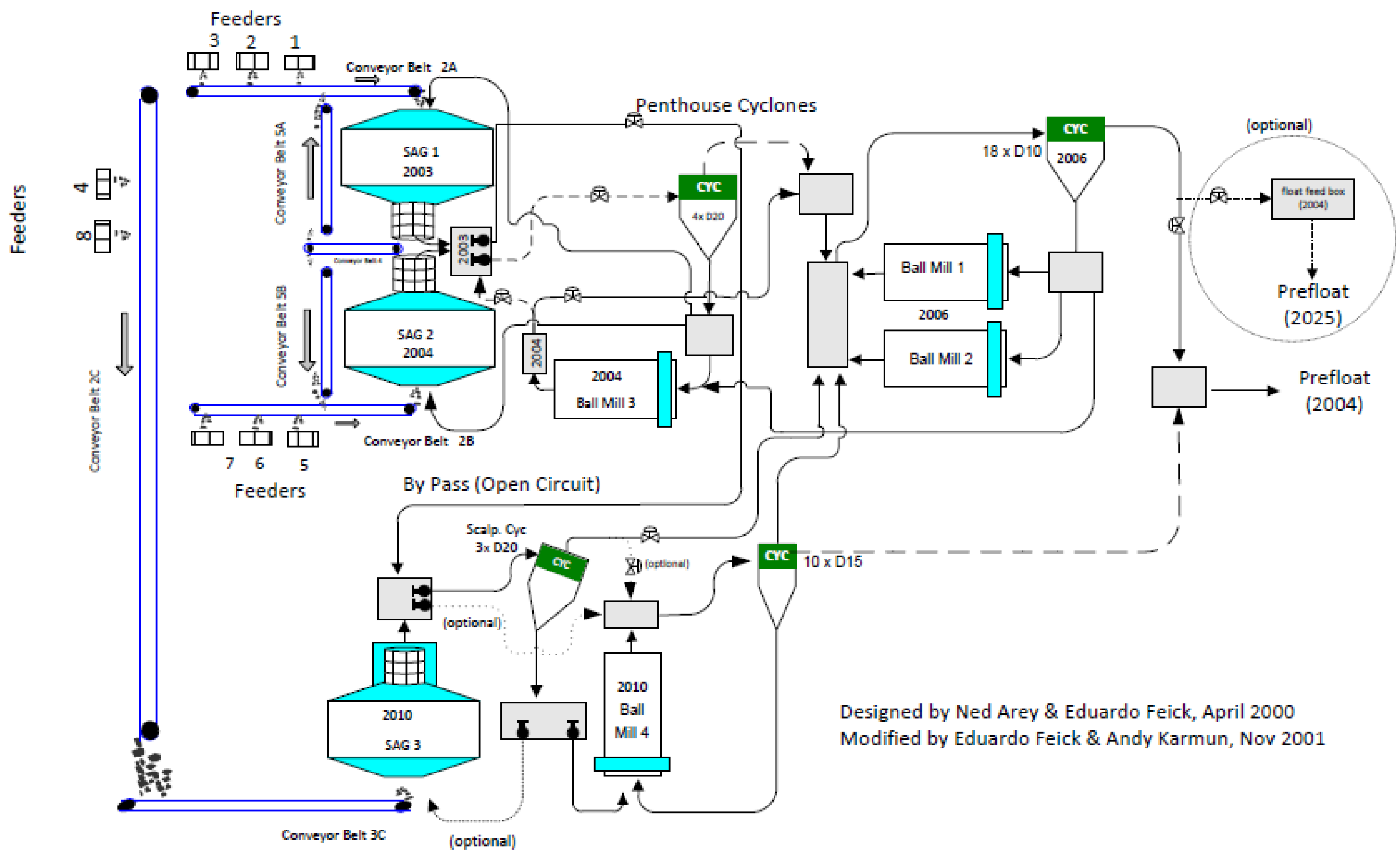

Figure 17-2: Grinding Process Flowsheet

Note: Figure prepared for Teck, 2001.

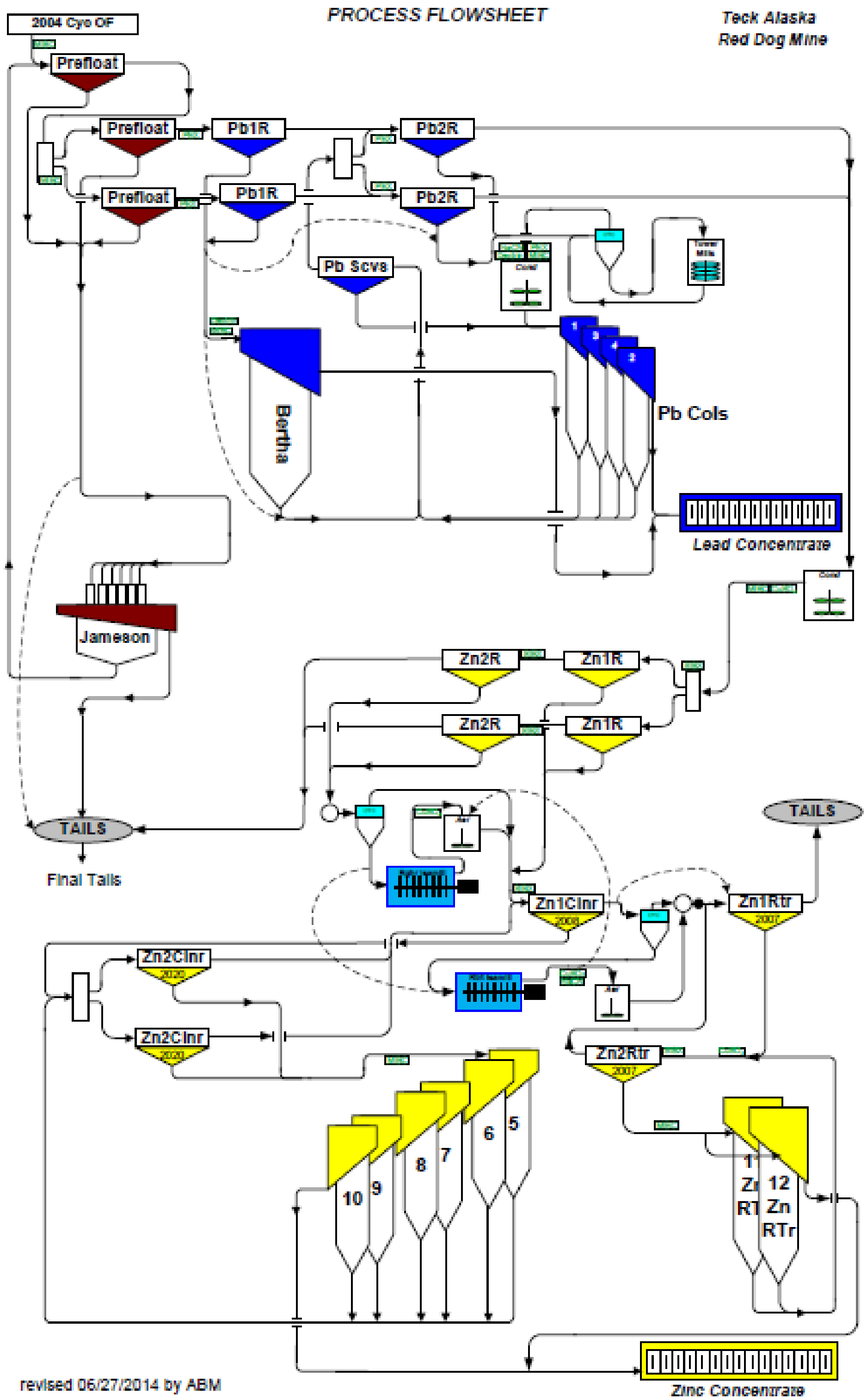

Figure 17-3: Flotation Process Flowsheet

Note: Figure prepared for Teck, 2014.

17.2 Plant Design

As Red Dog is currently a producing operation, all equipment required for milling is in place. Table 17-1 details the main pieces of equipment. The projected VIP2 equipment is also included in the table, and is identified in italics.

Table 17-1: Equipment Details

Equipment	Manufacturer	Description	HP	Comment
Primary Crushing				
Gyratory Crusher	Allis-Chalmers	42" x 65" with hydroset	400	Primary crusher
Jaw Crusher	Fuller-Taylor	42" x 60" with hydroset	200	Back up to gyratory
Primary Grinding				
SAG Mill 1	Fuller	22 ft diameter, 8.5 ft long, high / high belly lifters	2,000 *2,650*	*VIP2 Power increase*
SAG Mill 2	Fuller	22 ft diameter, 8.5 ft long, high / high belly lifters	2,000 *2,650*	*VIP2 Power increase*
SAG Mill 3	Fuller	22 ft diameter, 8.5 ft long, high / high belly lifters	2,650	
Secondary Grinding				
Ball Mill 4	Fuller	16 ft diameter, 18 ft long	3,000	
Tertiary Grinding				
Ball Mill 1	Marcy	12 ft diameter, 12 ft long	1,250	
Ball Mill 2	Marcy	12 ft diameter, 12 ft long	1,250	
Ball Mill 3	Marcy	10 ft 8" diameter, 15 ft long	1,000	
Quaternary Grinding				
IsaMill	*Glencore Technology*	*1 M15000 IsaMill*	*3,000*	*VIP2*
Pre-flotation				
Pre-flotation Rougher	Outokumpu	6 OK-50	950	2 swing cells can be used for lead
Pre-flotation Cleaner	Glencore Technology	B5400/18 Jameson cell 5.4 m diameter, 18 down-comers		
Lead Flotation				
Lead Rougher	Outokumpu	10 OK-50 100 HP each	1,000	Rougher bank split for 1st and 2nd roughing
Lead Primary Column		13.5 ft diameter, 42 ft tall	130	Cav-tubes
Lead Secondary Columns		4.9 ft diameter, 38 ft tall	275	2 Cav-tubes, 2 CPT air sparged
Lead Scavengers	Outokumpu	5 OK-16 + *6 OK-16*	*300 +*	*VIP2*

Equipment	Manufacturer	Description	HP	Comment
			360	
Lead Regrind Mills	MPSI	3 tower mills, closed circuit	1,515	Normally 2 operating, 1 stand-by
Zinc Flotation				
Zinc Rougher	Outokumpu	12 OK-50	1,550	Rougher bank split for 1st and 2nd roughing
Zinc 1st Rougher Cleaner	*Glencore Technology*	*E4232/10 Jameson cell 4.2 m x 3.2 m, 10 down-comers*		*VIP2*
Zinc 1st Cleaners	Outokumpu/Maxwell	4 OK-50, 5 OK-38	1,075	
Zinc 2nd Cleaners	Outokumpu	6 OK-50, 2 OK-38	800	
Zinc Cleaner Columns	CPT	6, 12 ft diameter, 52 ft tall	700	Cav-tubes
Zinc Cleaner Regrind Mills	Glencore Technology	1 M5000 IsaMill	2,012	
Zinc 1st Retreat	Outokumpu/Maxwell	3 OK-50, 4 OK-38, 2 MX-14	950	
Zinc 2nd Retreat	Outokumpu	6 OK-38	500	
Zinc Retreat Columns	CPT	2, 12 ft diameter, 52 ft tall	300	Cav-tubes
Zinc Retreat Regrind Mills	Glencore Technology	1 M5000 Isamill	2,012	
Lead Dewatering				
Lead Thickener	Eimco	60 ft diameter		
Lead Pressure Filter	Ingersoll-Rand	1 filter	142	
Zinc Dewatering				
Zinc Thickener	Eimco	140 ft diameter		
Zinc Pressure Filters	Ingersoll-Rand	4 filters	433	
Water Distribution				
Reclaim Barge 1		4 pumps, 5,700 gpm / pump	1,200	Summer operation
Reclaim Barge 2		3 pumps, 3,500 gpm / pump	600	Year round operation
Air Distribution				
Filter Press / Plant Compressed Air	Joy	4 Joy Compressors, Cap: 2,800 scfm @ 100-125 psi, 700 hp/compressor	2,100	Normally 3 operating
Flotation Column / WTP 1 & 2 Air	Sullair	8 Sullair Compressors, Cap: 1,000 scfm @ 100 psi, 200 hp/compressor	1,600	Normally 6 operating
Flotation Blower Air	Hoffman	3 Hoffman Blowers, Cap: 10,700 scfm @ 10 psi, 700 hp/blower	2,100	Normally 1 operating
Grinding Clutch / Dust Supr. Air	Atlas-Copco	2 Atlas-Copco compressors	70	
Sand Filtration				
	Eimco	4 sand filters		Normally 3 to 4 operating

17.3 Requirements for Energy, Water, and Process Materials

There is sufficient power available for LOM requirements. Average daily power draw is in the order of 23.1 MW peaking at 27.0 MW. The mill consumes approximately 92% of the power generated. A power study has shown that the VIP2 project will not require additional power generation equipment.

Process water is sourced from tailings water reclamation; consumption averages 6,000 gallons per minute (1.4 ML/hr). Precipitation is in excess of that required to replenish water lost in concentrate shipped off site, and is of sufficient quantity to require annual discharge of treated water from the tailing pond.

Flotation reagents, grinding media, and other process materials as well as spare parts for the plant are shipped to site during the summer shipping season. Flotation reagents include methyl isobutyl carbinol (frother), potassium ethyl xanthate (Pb collector), copper sulfate (Zn activator), sodium isobutyl xanthate (Zn collector), and cyanide (pyrite depressant).

18 PROJECT INFRASTRUCTURE

18.1 Introduction

Red Dog is an operating mine, and all the project infrastructure is in place at Red Dog including power, crushing and conveying facilities, milling and processing infrastructure, waste dumps, tailings impoundment, dams, maintenance facilities, roads, and port facilities.

Infrastructure locations in the general mine area are provided in Figure 18-1.

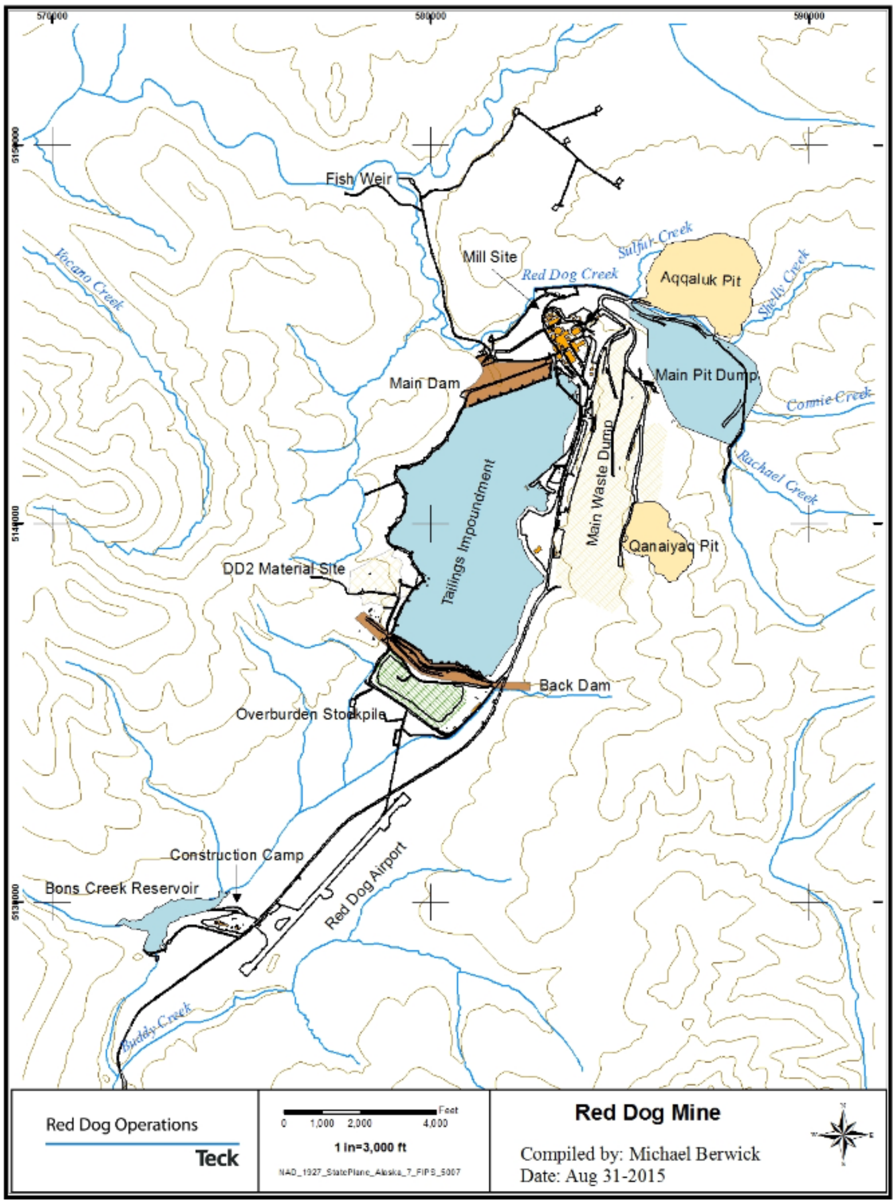

Figure 18-1: Mine Area Infrastructure Location Plan

Note: Figure prepared for Teck, 2015.

18.2 Logistics and Access

Red Dog has a 1,835 m (6,000 ft) paved airstrip, located 5 km (3 miles) from the mine site (Figure 18-1), which allows jet access from Anchorage and Kotzebue. Twice weekly, the air strip receives Alaskan Airlines charter flights (Boeing 737 aircraft) from Anchorage, as well as three times weekly local turboprop charters that service the community of Kotzebue and connect to Anchorage.

Although there are no conventional roads to the mine, an 84 km (52 mile) long gravel service road connects the mine to a port facility on the Chukchi Sea.

18.3 Infrastructure

Currently, the Red Dog onsite infrastructure comprises a year-round, totally enclosed facility, with rooms for 363 people, including kitchen and dining facilities, recreational areas, offices, analytical laboratory, and the milling operations. All of these can be accessed from a series of internal walkways.

The facility is located 1.2 km from the Aqqaluk open pit and 1.9 km from the Qanaiyaq open pit. Ore concentrate stockpiles are in a covered warehouse adjacent to the main facility, while the primary crusher is located within 230 m (750 ft) of the coarse ore stockpile building.

Core logging, cutting and storage areas are located in converted shipping containers, winterized tents or semi-permanent wooden or metal buildings located 5.5 km (3.5 mi) from the main facility, near the airport. A satellite camp, operated only in the summer and able to house an additional 148 persons, is also located in this area. The location of the main facility, crushers, stockpiles, tailings storage areas, mine waste disposal areas and the open pit are shown in Figure 18-1.

18.4 Port

The port facility has an all-weather camp with 96 rooms. Because of its northerly location, this port is seasonal, operating approximately 100 days per year from early July to early October. Care and maintenance is carried out the rest of the year with a minimal workforce.

Concentrates are shipped to the port from the mine on a 24 hour basis and stored in two storage buildings at the port during the winter months. Total storage capacity at the facility is approximately 1 million dmt.

The port facility also contains a six-tank, 52.2 ML (13.8 M USG) fuel storage field with fuel shipped to the mine on a 24 hour basis.

18.5 Tailings Storage Facility

A discussion on tailings, and the existing tailings storage facility, is included in Section 20.

18.6 Power

Mine site power requirements are provided by eight diesel fired power generators of 5 MW rated capacity each with power generation capacity bus-limited to 30 MW.

18.7 Water

All contaminated water from the mine area and waste dumps is collected and contained in a tailings impoundment and seasonally discharged through a water treatment plant (refer to discussion in Section 20).

Mill process water is sourced from tailings water reclamation, and is sufficient for current and future use.

Potable water is sourced from Bons Creek and is sufficient for current and forecast needs.

19 MARKET STUDIES AND CONTRACTS

19.1 Market and Commodity Price Projections

The Red Dog mine produces two concentrates: a zinc concentrate and a lead concentrate. Silver is present in the lead concentrate and contributes to the lead concentrate revenue stream. Long-term metal and commodity prices, the projected discount rate, and Canadian to American dollar exchange rate forecasts reflecting industry standards are provided by Teck management. The long-term projections are presented in Table 19-1.

Table 19-1: Commodity Price Projection

Commodity/Item	Unit	Price/Value
Zinc	$/lb	1.00
Lead	$/lb	0.90
Silver	$/ozt	18.00
Copper	$/lb	3.00
Oil (WTI)	$/bbl	75.00
CAD/USD exchange rate		1.20
Discount rate	%	8

19.2 Contracts

The mining and concentrating of the Red Dog ores are done directly by TAK. The sales contracts and marketing of the concentrate are handled by a management contract with Teck as laid out under a development and operating agreement with NANA.

Currently more than 90% of the zinc concentrates and 50% of the lead concentrates are under long-term contracts, while the remainder are sold annually. The long-term Red Dog contracts are based on Long-Term Frame Agreements with an evergreen clause which allows contracts to renew unless either party gives the other notice (generally 1–2 years) of cancellation.

Transportation of the concentrates from the mine site to the port is carried out through existing contracts with NANA–Lynden, a joint venture between NANA and Lynden Transport.

The concentrates are shipped from the Red Dog port facility to smelters in Western Europe, the Far East and the Teck's Trail smelter in Canada. The shipping season spans July to early October to ship out a full year of production. Concentrate is lightered to the ocean freighters under contract to the Foss Corporation. Ocean shipping is arranged through Teck's concentrate sales group for transport through to the smelting complexes.

Concentrate is shipped to storage facilities in Vancouver and Western Europe for disbursement to refineries throughout the year. The refineries in the Far East have minimal storage capacity and tend to number many more customers buying smaller lots, so the pattern of sales more closely matches the arrival of shipments.

Teck's cash flow model considers the three markets separately, and each has specific smelter terms and associated distribution costs. Differences are generally in the penalty terms, basic treatment charges, escalators, and payments for silver in the concentrate. Zinc concentrate rarely receives a significant silver credit, while lead concentrate receives nearly all of the silver revenue. Approximate distribution costs used to establish the metrics for the three markets range from a low of US$101 to a high of US$119 per dry metric tonne (dmt). These include Alaskan distribution costs (road maintenance, trucking, port operation, and barge lightering) of approximately $70/dmt, as well as ocean freight, destination port, and rehandle costs.

Treatment and refining charges are unique for each market and fluctuate with market conditions. Smelter terms used for pit optimization were based on long-term average forecasts developed by Teck marketing, incorporating average projected costs to Trail, Far-East and Europe. Primary treatment terms as considered for this Report were:

- Zinc smelter terms;
  - Zinc treatment charge of US$251.20/dmt;
  - $2,300/dmt Zn price basis;
  - 85% payable, 8 unit deduction;
- Lead smelter terms;
  - Lead treatment charge of US$215.70/dmt;
  - $2,000/dmt Pb price basis;
  - 95% payable, 3 unit deduction;
  - Silver: 95% payable, 41.79 g/dmt deduction, treatment charge of $1.355/ozt.

19.3 Comment on Market Studies and Contracts

The QP considers, following nearly 26 years of continuous production from the Red Dog operations, that the lead and zinc concentrates have been shown to be marketable.

Contracts for concentrate sales are consistent with industry general practices in marketing base metal concentrates. Treatment charges are in line with other base metal operations in North America and worldwide. Distribution costs are reasonable given the overland transport in Arctic conditions and seasonal port operations.

Commodity prices, exchange rate assumptions, and discount rates are set by Teck management, and are generally in line with similar forecasts available from public-domain sources.

20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

20.1 Environmental Studies

Red Dog employs an environmental department which is located at the mine site and is responsible for compliance monitoring, administering environmental permits, interfacing with regulators, and maintaining an environmental management system that is ISO 14001 compliant.

The operation has been in production for over 26 years and during that time many environmental aspects have been studied. There are no environmental considerations that are known and not discussed in this Report that could materially impact Teck's ability to extract the Mineral Resources or Mineral Reserves.

20.2 Tailings Storage Facilities

The tailings storage facility (TSF) is situated in the upper valley of the South Fork of Red Dog Creek. The TSF collects all mill tailing discharge as well as waste rock seepage, pit dewatering and site runoff. A seepage collection pond collects and contains seepage from the Main Dam. The tailings are strongly acid-generating.

The current crest elevations of the Main and Back dams are at 300.5 m (986 ft). Allowing for water cover, storage of runoff, waste rock seepage and mine sump flows, storage of the probable maximum flood, and wave run-up, the crests of the dams are planned to be raised to a final elevation of 306.6 m (1,006 ft). The remaining dam construction phases over the life of the mine are the addition of a 10 foot lift to 303.6 m (996 ft) followed by a second 10 foot lift to 1,006 ft, as required to maintain a minimum operating freeboard of 1.5 m (5 ft). A crest elevation of 1,006 ft will be sufficient to hold the tailings which will be generated by the mine plan.

The current tailing pond holds a maximum of 15.9 billion L (4.2 billion USG) of water. The volume fluctuates seasonally, approximately 4.5 billion L (1.2 billion USG) flows in during the spring freshet and roughly the same amount of treated water is discharged each year.

As at December 2016, the tailings impoundment contained an estimated 45.8 Mt of tailings. The current mine plan projects the total tailings to the end of mine-life at 94.8 Mt.

20.3 Water Treatment

Water treatment is specific to whether the water is contact (affected by the operation) or non-contact (storm water runoff). Contact water is treated using one of several water treatment plants whereas non-contact water is diverted using open channel diversions.

A total of three water treatment plants are used to treat the various tailings pond water streams:

- Recycle water to the milling process;
- Discharge water to the environment;
- Pre-treatment of waste dump seepage water.

Management of the TSF water inventory requires that recycling of water to the mill is maximized. Over time, this causes a build-up of chemical species that adversely affect the flotation circuit performance resulting in lower concentrate recoveries and grades. In order to maintain recoveries, recycle water must be treated prior to reuse in the milling circuit.

A seasonal water treatment plant is operated to treat decant water from the TSF for discharge to the environment. Treated discharge volume is constrained by water quality measurements downstream of Outfall 001 to Red Dog Creek.

A third water treatment plant also operates on a seasonal basis to treat seepage water from waste dumps prior to introduction to the TSF. Pre-treatment of this stream decreases the overall contaminant loading in the TSF.

Three principal diversion channels are used to intercept storm water before it enters the operations:

- Red Dog Creek;
- DD4;
- Aqqaluk pit.

The Red Dog Creek Diversion collects water from the Sulfur, Shelly, Connie, and Upper Middle Fork Red Dog Creek watersheds and carries it past the mine workings to the Lower Middle Fork Red Dog Creek. The DD4 Diversion intercepts water to the west of the TSF and carries it to Lower Middle Fork Red Dog Creek. The Aqqaluk Pit Diversion intercepts water above the Aqqaluk pit and carries it to Sulfur Creek.

20.4 Closure Considerations

20.4.1 Introduction

The 2016 Closure and Reclamation Plan Approval (F20169958) from the State of Alaska Department of Natural Resources and the 2016 Waste Management Permit (2016DB0002) issued by the State of Alaska Department of Environmental Conservation both contain obligations for reclamation, closure and long-term monitoring of the property following closure.

The obligations are laid out in the Red Dog Mine Closure and Reclamation Plan, the Red Dog Mine Waste Management, Reclamation and Closure Monitoring Plan, and the Red Dog Mine Long-Term Permafrost and Groundwater Monitoring Plan for The Tailing Impoundment, all of which are part of the above permits by reference.

To ensure the proper closure and reclamation of the property should TAI be unable to meet its obligations, a Financial Assurance Obligation has been filed with the State of Alaska for $558.35 million.

20.4.2 Tailings Storage Facility

The tailings impoundment will continue to hold water, and as such, the dam will continue to be considered an operating structure. To keep seepage rates through the Main Dam low after closure, a permanent beach approximately 183 m (600 ft) wide will be constructed in front of the dam. Seepage collection at the toe of the dam will continue after closure, but the pumpback system will be reconfigured to send the seepage to the Aqqaluk Pit, preventing the seepage from contaminating the tailings pond. Any seepage from the Back Dam will be collected and piped to the MWD seepage collection system from where it will be transferred to the Aqqaluk Pit.

20.4.3 Waste Rock Facilities

Waste rock facilities will be capped with an engineered cover system of clean compacted shale that is designed to reduce infiltration of surface water into the underlying potentially acid-generating (PAG) waste rock.

20.4.4 Water Management

Contaminated surface waters will be routed to the Aqqaluk Pit for storage. All contaminated water will be treated a water treatment facility that is similar to the one that is currently operated at Red Dog. It is anticipated that water treatment will be required in perpetuity, due mainly to the acid rock drainage (ARD) generated from waste dumps and pits. Treatment will consist of operation of a high density sludge (HDS) plant to remove the metals with lime and filtration to remove suspended solids (TSS) prior to discharge. The annual treatment requirement is estimated at about 4.9 billion L (1.3 billion USG) per year. All of the discharge must occur when there is flow in Red Dog Creek, which limits the discharge season from early May until early October.

An approximately 73 m (240 ft) wide open channel for the Red Dog Creek will be installed to provide sufficient capacity to pass the 1,000 year flood. The alignment will be at the toe of the regraded waste storage facilities with the channel built above grade to ensure sediment would not enter the channel. The channel would be lined with rip-rap to prevent erosion.

20.4.5 Onsite Infrastructure

After operations cease NANA and Teck Alaska will need to decide how much of the site infrastructure will be left in place. All infrastructure not needed for the post-closure requirements or for other NANA or Teck Alaska plans will be decommissioned.

Hazardous material and high value components will be removed and the remainder of the facilities demolished and placed in demolition landfills. Areas where infrastructure is removed will have any metal contaminated soils removed and hauled to the MPD prior to regrading.

20.5 Permitting Considerations

Surface rights held by TAK under the provisions of the NANA lease are sufficient to accommodate mining, processing and infrastructure needs for the Mineral Reserves contained within the Red Dog Mine. Mine operations are licensed through a State of Alaska Mining License. The port facilities and road are operated and maintained by TAK under an agreement with the Alaska Industrial Development and Export Authority as the DeLong Mountain Transportation System.

There are four major permits required to be maintained for Red Dog Mine to conduct work. The major mine permits are:

- Alaska Pollution Discharge and Elimination System (APDES) permit – this permit is required to discharge treated water from the mine site to the environment;
- Alaska Title V Air Permit (AQ290TVP02 Rev 1, exp. 3/17/2019) – this permit is required to emit exhaust from generators and boilers and to control fugitive dust;
- Alaska Closure and Reclamation Plan Approval – this permit is to ensure that a proper closure plan is in place along with financial assurance to conduct the plan should the operator not be able to follow the plan;
- Alaska Waste Management Permit – the permit allows the deposition of waste rock and tailings into permitted disposal areas and monitoring of water from those facilities.

All four of these permits are in good standing.

The DMTS Port also has two major permits, both of which are in good standing:

- Alaska Pollution Discharge and Elimination System (APDES) permit – this permit is required to discharge treated water from the DMTS Port to the environment;
- Alaska Title V Air Permit (AQ0289TVP03, exp. 11/18/2021) – this permit is required to emit exhaust from DMTS Port generators and boilers and to control fugitive dust.

Red Dog has all necessary permits for the mining of the Aqqaluk and Qanaiyaq deposits (Table 20-1).

Table 20-1: Current Permits for the Red Dog Operation

Permit Description	Agency	Issue Effective Date	Expiration Date
ADL 409515 Amendment II - Haul Road Right-of-Way including snow fences	AK Department of Natural Resources	6/20/1997	12/31/2033
ADL 412501 - Tidelands Lease to AIDEA	AK Department of Natural Resources	4/18/1986	4/17/2041
ADL 416267 DD-1 & 2	AK Department of Natural Resources	4/29/1998	9/7/2019
ADL 416946 DD 4	AK Department of Natural Resources	4/11/2003	Awaiting final approval
ADL 417260 151 Road	AK Department of Natural Resources	12/15/2004	Awaiting final approval
ADL 419795 - Material Site 9 (2013 April)	AK Department of Natural Resources	4/8/2013	4/7/2018
ADL 420374 DD-2 Material Sale Contract	AK Department of Natural Resources	4/21/2015	4/20/2020

Permit Description	Agency	Issue Effective Date	Expiration Date
AQ0289MG901 Revision 1 - Portable Crusher #2 Operating Permit for DMTS Road	ADEC- Division of Air	4/1/2014	"...does not expire."
COA to Operate a Dam - Red Dog Tailings Back Dam FY2015-15-AK00303	ADNR-Dam Safety	3/11/2015	12/31/2017
COA to Operate A Dam Tailings Main Dam FY2016-9-AK00201	ADNR-Dam Safety	12/31/2015	12/31/2017
COA to Operate Red Dog Mine Water Diversion Dam FY2015-20-AK00260	ADNR-Dam Safety	4/14/2015	12/31/2019
COA to Operate Red Dog Water Supply Dam FY 2015-18-AK00200	ADNR-Dam Safety	4/14/2015	12/31/2019
Fish Habitat Permits- Bridge and Culvert Maintenance: FG99-III-0034 (Anxiety Ridge Creek) Fish Habitat Permit FG99-III-0034 Amendment #1	ADF&G Division of Habitat	4/12/2010	"Upon Abandonment and Rehabilitation of the Red Dog Haul Road (DMTS) Crossing of Anxiety Ridge Creek"
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0229 (Little Creek)	ADF&G Division of Habitat	12/17/1999	"Upon Abandonment and Rehabilitation of the Road/Bridge and Culvert Crossing of Little Creek"
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0232 (Mud Lake Creek)	ADF&G Division of Habitat	12/18/1999	"Upon Abandonment and Rehabilitation of the Road/Bridge Crossing of Mud Lake Creek"
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0233 (Omikviorok Creek)	ADF&G Division of Habitat	12/18/1999	"Upon Abandonment and Rehabilitation of the Bridge Crossing of Omikviorok Creek"
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0235 (Straight Creek)	ADF&G Division of Habitat	12/18/1999	"Upon Abandonment and Rehabilitation of the Road/Bridge Crossing of Straight Creek"

Permit Description	Agency	Issue Effective Date	Expiration Date
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0237 (Aufeis Creek)	ADF&G Division of Habitat	12/20/1999	Upon Abandonment and Rehabilitation of the Bridge Crossing of Aufeis Creek
Fish Habitat Permits- Bridge Maintenance: FG-99-III-0239 (New Heart Creek)	ADF&G Division of Habitat	12/20/1999	"Upon Abandonment and Rehabilitation of the Road/Bridge Crossing of New Heart Creek"
Fish Habitat Permits- Bridge/Culvert Maintenance: FG-99-III-0230 (Tutak Creek)	ADF&G Division of Habitat	12/17/1999	"Upon Abandonment and Rehabilitation of the Bridge/Culvert Crossing of Tutak Creek"
Fish Habitat Permits- Bridge/Culvert Maintenance: FG-99-III-0231 (Ailuuraq Creek)	ADF&G Division of Habitat	12/17/1999	"Upon Abandonment and Rehabilitation of the Bridge/Culvert Crossing of Ailuuraq Creek"
Fish Habitat Permits- Culvert Maintenance: FG-99-III-0228 (Evaingiknuk Creek)	ADF&G Division of Habitat	12/17/1999	Upon Abandonment and Rehabilitation of the Road Crossing of Evaingiknuk Creek"
Fish Habitat Permits- Culvert Maintenance: FG-99-III-0234 (East Fork Straight Creek)	ADF&G Division of Habitat	12/18/1999	Upon Abandonment and Rehabilitation of the Road/Culvert Crossing of East Fork Straight Creek"
Fish Habitat Permits- Culvert Maintenance: FG-99-III-0236 (Deadman Creek)	ADF&G Division of Habitat	12/20/1999	Upon Abandonment and Rehabilitation of the Road/Culvert Crossing of Deadman Creek
Fish Habitat Permits- Culvert Maintenance: FG-99-III-0238 (East Fork New Heart Creek)	ADF&G Division of Habitat	12/20/1999	Upon Abandonment and Rehabilitation of the Road/Culvert Crossing of East Fork New Heart Creek

Permit Description	Agency	Issue Effective Date	Expiration Date
Fish Habitat Permits- Culvert Maintenance: FG-99-III-0240 (West Fork New Heart Creek)	ADF&G Division of Habitat	12/20/1999	Upon Abandonment and Rehabilitation of the Road/Culvert Crossing of West Fork New Heart Creek
Fish Habitat Permits-Gabion Barrier: FG-97-III-0053 (Middle Fork Red Dog Creek)	ADF&G Division of Habitat	2/17/1997	Upon Abandonment and Reclamation
Fish Habitat Permits-Instream Equipment Work for Removal of Snow and Ice from Anadromous Water bodies: FG-90-III-0098-4 (Snow/Ice Cleanout in Spring)	ADF&G Division of Habitat	Amendment #4: 3/15/2010	Amendment #4 expires "Upon Abandonment and Rehabilitation of the Red Dog Haul Road."
Food Service Permit - #324750110 – Mine PAC	ADEC- Division of Environmental Health	Annual permit	
Food Service Permit - #324750112 – Con PAC	ADEC- Division of Environmental Health	Annual permit	
Food Service Permit - #324750115 - Port	ADEC- Division of Environmental Health	Annual permit	
LAS 1453 Bons Creek Reservoir Certificate	AK Department of Natural Resources	3/11/2005	Does not expire
LAS 25095 Main Stem Red Dog Creek	AK Department of Natural Resources	6/1/2007	5/31/2022
LAS 25096 South Fork Red Dog Creek	AK Department of Natural Resources	6/1/2007	5/31/2022
LAS 27050 - MS10 Met Tower	AK Department of Natural Resources	12/2/2008	12/1/2018
Mine Wetland Permit POA-1984-12-M49 Tailings Pond to 986 Ft	US Army Corps of Engineers	11/18/2013	9/30/2018
Mine Wetland Permit: POA-1984-12-M45 & M46 Aqqaluk Pit	US Army Corps of Engineers	3/12/2010	11/30/2019
NRC Materials License 50-23289-01, Amendment 16	Nuclear Regulatory Commission	12/24/2000	3/31/2024
Port Solid Waste Permit No. SW3A011-21	ADEC- Division of Environmental Health	5/1/2016	5/1/2021
Port Wetland Permit: POA-1983-359-M38 Appl/Dock Dredge Time Extension	US Army Corps of Engineers	6/7/2010	6/30/2020
Port Wetland Permit: POA-1983-359-M39 Annual Port Dredging	US Army Corps of Engineers	12/14/2012	12/31/2020
Public Safety Permit 16-031 (Wildlife Hazing)	ADF&G Division of Habitat	1/22/2016	1/31/2017

Permit Description	Agency	Issue Effective Date	Expiration Date
Title 9 Master Plan Permit No: 107-03-10	Northwest Arctic Borough	12/9/2009	12/31/2031
TWUP F2013-136 DMTS Port Road Watering	AK Department of Natural Resources	6/18/2015	6/16/2020
TWUP F2013-137 Red Dog Creek	AK Department of Natural Resources	7/2/2015	7/1/2020

The following permit has been applied for renewal:

- Alaska Pollution Discharge and Elimination System (APDES) permit (Mine), AK-0038652.

The State of Alaska Waste Management Permit allows the deposition of waste rock and tailings into permitted disposal areas, and monitoring of water from those facilities during operations and closure.

Continued operation of the tailings dam, the water supply dam and the Red Dog Creek diversion dam will require ongoing permitting from the State of Alaska Department of Natural Resources, Dam Safety Division. Perpetual water treatment and discharge of treated water will require ongoing Alaska Pollution Discharge and Elimination System (APDES) permitting. Continued generation of power following closure will require ongoing State of Alaska Title V air permitting.

20.6 Social Considerations

The Red Dog Operation is located on land that is part of a 1980 land settlement claim by the NANA Regional Corporation which represents 14,000 Iñupiat Eskimos of which approximately 45% percent live in 11 surrounding villages.

NANA and TAK partnered to develop the Red Dog mine under an innovative operating agreement in 1982. Under this Agreement, TAK runs the mining operations, while NANA is the land and resource owner and contributes Iñupiat business values. The mine is managed to protect the region’s natural resources for future generations and not infringe upon Iñupiat culture and lifeways. NANA’s profits from the mine are used to improve the quality of life for Iñupiat people by maximizing economic growth, protecting and enhancing Iñupiat lands, and promoting healthy communities.

Nearly 55% of the mine’s employees are NANA shareholders, and TAK offers opportunities for training and education to Iñupiat youth.

An important provision of the Agreement deals with employment. Employment opportunities must first be offered to NANA natives who are qualified, as provided in the Agreement, for the available jobs. Teck has hired and trained numerous local Native technical personnel and strives to maintain as many local people on staff as possible. At the end of 2016, the mine employed 442 people, of whom 236 are NANA shareholders.

21 CAPITAL AND OPERATING COSTS

21.1 Capital Costs

21.1.1 Basis of Estimate

Capital cost estimates have been prepared for expenditures required to maintain production which include funding for infrastructure, mobile equipment replacement, and deposit development (diamond drilling, metallurgical testing, geotechnical models). As all permits for operation have been obtained, future permit renewals are considered operating costs and are included in operating costs. Similarly, sustaining costs are classed as operating costs and are included as a component of the operating costs.

General infrastructure costs are based on forecast budgets and on previous experience from 26 years of mine operations. Most of costs for the TSF are to provide the storage capacity increases required to accommodate the tailing produced from the ore and are thus considered sustaining costs and included in the operating cost. Closure costs are based on forecast budgets.

Major mobile equipment cost is based on quotes from suppliers with replacement scheduled when operating hours reach threshold limits; however, the replacement of the majority of this equipment is considered a sustaining cost and is thus included in the operating cost. Minor mobile equipment cost is based on previous experience from 26 years of mine operations.

Development costs are based on forecast budgets.

21.1.2 Capital Cost Estimate

Over the remaining life of the open pit mines, total capital cost is projected at $589 million. Capital costs are projected by area as follows:

- Development: $15 million;
- Mobile equipment: $29 million;
- Plant infrastructure: $221 million;
- Water management: $168 million;
- Port infrastructure: $38 million;
- G&A: $3 million;
- Closure: $85 million;
- Contingency: $30 million.

The costs equate to an overall LOM average cost per tonne milled of $9.30.

21.2 Operating Costs

21.2.1 Basis of Estimate

Operating costs were developed based on a combination of fixed and variable cost standards applied to mine, mill, and general and administrative aspects to forecast total mine site operating costs. These costs were used to establish ore cutoffs. Estimates were based on historical consumption rates, historical productivity and forecast budgets.

Mill operating costs include costs associated with grinding, reagents, dewatering, water treatment, mill modifications, labour (operating), and mill related power generation costs. Milling costs are adjusted for variation in grindability in each ore block compared to the average of these parameters for all the ore blocks in each pit. Power cost is adjusted based on the calculated SAG specific energy and grinding cost is adjusted based on the calculated throughput.

Indirect costs are composed of overheads for mining and milling, e.g. technical services and management, and overheads for employees, e.g. camp room and board, work rotation flights, and MSHA training. The general and administrative (G&A) costs are those for the service departments, e.g. Human Resources, Information Services, Environmental, Accounting, Management, Safety & Health, and Community Relations.

Sustaining costs are included in the costs of mining and milling.

21.2.2 Operating Cost Estimate

Over the remaining life of the open pit mines, the following average operating costs are projected, by key area:

- Waste mining: $3.00/dmt;
- Ore mining: $3.15/dmt;
- Milling: $29.15/dmt;
- Indirect: $7.05/dmt;
- G&A: $17.70/dmt.

22 ECONOMIC ANALYSIS

Teck is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 of NI 43-101F1 for technical reports on properties currently in production and where no major expansion is planned.

23 ADJACENT PROPERTIES

This section is not relevant to this Report.

24 OTHER RELEVANT DATA AND INFORMATION

This section is not relevant to this Report.

25 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs, as authors of this Report, have reviewed the data for the Project and have made the following conclusions and interpretations.

25.2 Mineral Tenure, Surface Rights, Royalties

Mineral tenure held was valid at the Report effective date. The open pit mining operations at Aqqaluk and Qanaiyaq are within a mining lease between NANA as lessor and TAK as lessee. The Aŋarraaq and Aktigiruq deposits are on a group of State mining claims known as the Noatak Block.

A Development and Operating Agreement signed with NANA on October 11, 1982 governs the terms of the mining operation. Under the terms of the Agreement, TAK leases the mine and concentrator properties and other adjacent lands from NANA, operates the mine and markets the concentrate produced.

Surface rights held by TAK under the provisions of the NANA Agreement are sufficient to accommodate the life-of-mine mining, processing and infrastructure needs. If TAK does not adhere to the operating agreement, NANA may terminate the Agreement. There are no indications that either party is in breach of the Agreement as at the Report effective date.

TAK's royalty payment in 2016 is 30%; the next escalation will be in the 4th quarter of 2017. In addition to the royalties payable to NANA, the Red Dog Mine is subject to US state and federal income taxes, and payments to the Northwest Arctic Borough.

25.3 Environment, Social and Permits

The operation has been in production for over 26 years and during that time many environmental aspects have been studied. There are no environmental issues that are known that could materially impact Teck's ability to extract the Mineral Resources or Mineral Reserves.

There are four major permits required to be maintained for Red Dog Mine to conduct work in the mining area. An additional two permits are required for port operation. At the Report effective date, these were in good standing. There are also 45 minor permits required to be maintained in support of operations. These are renewed as applicable.

Mine operations are licensed through a State of Alaska Mining License. The port facilities and road are operated and maintained by TAK under an agreement with the Alaska Industrial Development and Export Authority as the DeLong Mountain Transportation System.

Failure to follow the terms of the major permits would place the operation in jeopardy from both regulatory fines and penalties or civil lawsuits, and in cases of negligence, the potential of a forced shut down. At the Report effective date, the Red Dog Operations were operating within the terms of all of the permits.

To date, mining activities have maintained the social license to operate.

25.4 Geology and Mineralization

The Red Dog deposits are considered to be examples of clastic-dominated sediment hosted lead–zinc deposits.

Major deposits in the district include the Red Dog mine area deposits (Qanaiyaq, Main, Aqqaluk and Paalaaq), Aŋarraaq, Aktigiruq and Su. All of these deposits are strata-bound massive sulphide bodies hosted by Mississippian shales of the Ikalukrok unit within the Kuna Formation.

The geological understanding of the settings, lithologies, and structural and alteration controls on mineralization in the different deposit areas is sufficient to support estimation of Mineral Resources and Mineral Reserves. The geological knowledge of the area is also considered sufficiently acceptable to reliably inform open pit mine planning.

The mineralization style and setting is well understood and can support declaration of Mineral Resources and Mineral Reserves.

25.5 Exploration, Drilling, Sample Preparation, Analysis & Data Verification

Historical exploration activities prior to the commencement of mining in 1989 were extensive, and included geological mapping, geochemical and geophysical surveys, core and RC drilling, metallurgical testwork, mining technical studies, and research papers. Since 1977, Teck, and its predecessor entities, have drilled 394,244.7 m in 2,019 holes in the Red Dog district.

Core drilling practices, collection of recovery and density data, and collar and down-hole surveying methods are consistent with industry standard practices and are acceptable for use in Mineral Resource and Mineral Reserve estimation.

Geological and geotechnical logging are consistent with industry standard practices and can be used in support of Mineral Resource and Mineral Reserve estimation.

Sample collection and core handling is undertaken in accordance with industry standard practices and are acceptable for use in Mineral Resource and Mineral Reserve estimation.

A combination of independent and non-independent laboratories have been used for sample preparation and analysis. Non-independent and non-certified laboratories include Cominco’s ERL (pre-mine startup), and the Red Dog mine laboratory (sample preparation and analysis from 1990 to 2012). Independent certified laboratories used have included Acme (check analysis from 2010–2011) and BV (sample preparation and sample analysis from 2013 to date). Methods and procedures used are consistent with industry standard practices and produce sufficiently accurate and precise data which are suitable for use in Mineral Resource and Mineral Reserve estimation.

Regular data verification is undertaken on the Project database by Teck personnel. Regular data verification programs have also been undertaken by third-party consultants. The results of this work indicate that the data collected from the Project acceptably support the geological interpretations and the database quality, and therefore support the use of the data in Mineral Resource and Mineral Reserve estimation, and in mine planning.

25.6 Metallurgical Testwork

Metallurgical test work and associated analytical procedures were appropriate to the mineralization type, appropriate to establish the optimal processing routes, and were performed using samples that are typical of the mineralization styles found within the Project.

Samples selected for testing were representative of the various types and styles of mineralization. Samples were selected from a range of depths within the deposit. Sufficient samples were taken so that tests were performed on sufficient sample mass.

Metallurgical recovery forecasts to date have been confirmed by production data.

No deleterious elements that are not amenable to mitigation strategies such as blending have been identified to date. The key deleterious elements include iron in the form of pyrite, silica, and weathering intensity.

25.7 Mineral Resource Estimates

The Mineral Resource estimates were prepared by Teck staff. Estimates follow an industry-standard methodology, consisting of creation of geological domains, compositing, grade capping, variography, three-phase interpolation methodology, and model checking. Estimates are assigned confidence categories based on drill spacing. Reasonable prospects of eventual economic extraction are met for those deposits amenable to open pit mining methods by constraining the estimates within a conceptual pit shell. For those deposits amenable to underground mining, the estimates are constrained using a conceptual set of stope designs based on the long-hole stoping mining method.

Mineral Resources are reported exclusive of Mineral Reserves, using the 2014 CIM Definition Standards for Mineral Resources and Mineral Reserves. Mineral Resources have been estimated for the Aqqaluk, Qanaiyaq, Paalaaq and Aŋarraaq deposits.

25.8 Mineral Reserve Estimates

Mineral Resources have been converted to Mineral Reserves at the Aqqaluk and Qanaiyaq deposits, and are contained within design pits. The current Mineral Reserve estimates are based on the most current knowledge, permit status and engineering and operational constraints. Mineral Reserves have been estimated using standard practices for the industry, and conform to the 2014 CIM Definition Standards for Mineral Resources and Mineral Reserves.

25.9 Life-of-Mine Plan

The Red Dog mine currently operates two open pits using conventional open pit drill and blast and truck and loader technology. The pits are mined with a TAK-owned and maintained fleet of equipment.

There are three phases remaining in the Aqqaluk pit and two phases planned for the Qanaiyaq pit. The Qanaiyaq pit is planned to operate from 2017–2027; the operational Aqqaluk pit will be mined out in 2031. The final year of process life will also treat the low-grade stockpile. Waste rock is stored in the mined-out Main and Qanaiyaq pits.

Open pit designs use geotechnical structural analysis, structural domains based on rock types, and rock mass quality ratings for the principal lithologies. Golder Associates are the engineer of record for the project and have approved the pit designs.

Water inflows that must be managed are as the result of seepage in the Aqqaluk pit, and for both pits, the results of the annual freshet.

25.10 Recovery Plan

The process circuit is conventional, and uses three stages of grinding and froth flotation technology to recover sphalerite and galena to zinc and lead concentrates respectively.

Concentrate is stored on site then hauled by truck to the port site facility on the Chukchi Sea. The concentrates are stored at the port and then shipped to the contracted smelting facilities during the restricted shipping season.

25.11 Infrastructure

The Red Dog mine has been operational since 1989. The infrastructure is well established for the current and planned production levels. Outstanding infrastructure required to be built to support the remaining mine life as described in this Report is the VIP2 expansion to the mill and the final two staged lifts of the tailings dams.

25.12 Markets and Contracts

The QP considers, following nearly 26 years of continuous production from the Red Dog operations, that the lead and zinc concentrates have been shown to be marketable. Contracts in place are considered to be in line with industry norms.

Commodity prices, exchange rate assumptions, and discount rates are set by Teck management, and are generally in line with similar forecasts that are available from public-domain sources.

Capital cost estimates are based on quotes, forecast budgets, and previous experience. Over the remaining life of the open pit mines, the following are projected, by key area:

- Mining: $44 million;

- Milling: $221 million;
- Water management: $168 million;
- Other (G&A, port facilities, closure): $126 million;
- Contingency: $30 million.

The costs equate to an overall LOM average cost per tonne milled of $9.30.

25.13 Operating Costs

Operating costs were developed based on a combination of fixed and variable cost standards applied to mine, mill, and general and administrative aspects to forecast total mine site operating costs.

Over the remaining life of the open pit mines, the following operating costs are projected, by key area:

- Waste mining: $3.00/dmt;
- Ore Mining: $3.15/dmt;
- Milling: $29.15/dmt;
- Indirect: $7.05/dmt;
- G&A: $17.70/dmt.

25.14 Economic Analysis Supporting Mineral Reserve Declaration

Teck is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no major expansion is planned.

An economic analysis to support presentation of Mineral Reserves was conducted. Under the assumptions presented in this Report, the operations show a positive cashflow, and can support Mineral Reserve estimation.

26 RECOMMENDATIONS

A two-phase work program is recommended. The first phase should consist of mine site based activities that will result in workflow improvements, and reviews to provide a better understanding of some of the current Project data. The second phase should include additional metallurgical test work, supporting mining studies and exploration activities.

26.1 Phase 1

The phase 1 work program recommendations include:

- Monitoring of Qanaiyaq recovery data. The 2016 drill program indicated recoveries that ranged from 25% and 96%, with a mean recovery of 65% (per drill hole). A review should be conducted to evaluate any effects of low recovery on overall grades, and determine if the geological modelling approach should be modified to mitigate any concerns identified;
- Review of duplicate sampling methodologies. A study should be conducted to determine if the current quarter-core duplicate sampling procedure should be amended.

The work is estimated at about $5,000 to $10,000, depending on whether it is undertaken in-house, or contracted to third-party consultants.

26.2 Phase 2

Additional metallurgical test work should be carried out for the Paalaaq and Aŋarraaq deposits, in support of Mineral Reserve estimates. Metallurgical test work should include mineralogical characterization, comminution and flotation test work to advance geo-metallurgical understanding of the deposits. This work is estimated at $300,000, depending on the degree of advancement targeted in Phase 2.

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Appendix A – Land Tenure

The Red Dog Project consists of the following leased land and mining claims. All costs shown in US dollars.

Property and Location	Agreement Type and Terms	# of Claims	Effective Date	Acres	2017 Holding $	2017 Work
NANA Lands						
	Development and Operating Agreement		12-Oct-82			
2-11, 13-36, T32N, R18W; 5-8, 17-20, 29-32, T31N, R17W; all T31N, R18W; 6, T30N, R17W; 1-9, T30N, R18W; 1-18, T30N, R19W, KRM						
Red Dog Mining Lease(Exhibit A lands)				21,595		
Additional Exploration Area (Exhibit B lands)	added to Mining Lease in 1989			43,004		
State Mining Claims (TA)						
CC		183	19-Feb-99	7,320	$31,110	$0
1-12, 14-23, 26-29, 34-35, T32N, R19W; 2, 11, T31N, R19W; 12-14, 20-21, 23-35, T32N, R20W; 25, 36, T32N, 21W	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs	588	26-Jun-99	23,520	$99,960	$0
3-6, 9-10, 14-16, 21-23, T31N, R20W; 1, T31N, R21W, KRM	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
KOR	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs	48	21-Jun-89	1,920	$8,160	$0
1, 12-14, 23-26, 35-36, T31N, R19W; 36, T32N, R19W, KRM	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State	7	31-Mar-95	280	$1,190	$0
		8	9-Dec-95	320	$1,360	$0
		104	24-Apr-98	4,160	$17,680	$0
LIM	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs	28	1-Sep-99	1,120	$4,760	$0

Property and Location	Agreement Type and Terms	# of Claims	Effective Date	Acres	2017 Holding $	2017 Work
	1-5; $70 yrs 6-10; $170 yrs>10 yrs					
1-2, T31N, R21W; 26, 35, T32N, R21W, KRM	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
PUN	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs					
15-16, 21-23, 26-28, T32N, R20W, KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State	2	2003	320	$1,360	$0
	MTRSC conversions of 44 Su & CC claims	2	2005	320	$1,360	$0
	TA completed 8/28/12	4	1998	640	$2,720	$0
		4	2013	640	$560	
SU	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs					
15, 22, 23, T32N, R20W, KRM	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
	Su 21, TA'd to the State on 6/10/97	1	11-Jun-97	40	$170	$0
	Su 25-28,32,36	6	1-Jul-13	240	$210	
	Su 19,20	2	1-Aug-14	80	$70	
SUDS	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs	85	1-Jul-99	3,400	$14,450	$0
11-14, 23-26, 36, T32N, R19W, KRM	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State		10-Apr-94			
WLF	Estates = Surface & Minerals Term = renew annually	469	31-Aug-99	18,760	$79,730	$0

Property and Location	Agreement Type and Terms	# of Claims	Effective Date	Acres	2017 Holding $	2017 Work
	Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs					
1,2,T30N,R20W; 3-10,14-22, 27-34, T31N, R19W	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State	397	1-Sep-99	15,880	$67,490	$0
1-3, 10-15, 20, 24-29, 33-36,T31N,R20W; 19-20, 27-34, T32N,R19W; 24,25,35-36,T32N, R20W, KRM						
LIMB	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs	7	5-Jun-11	1,120	$1,960	$0
2,3 T31N, R21W; 34-35, T32N, R21W, KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
WLR	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs	6	5-Jun-11	960	$1,680	$0
19-20, 29-30, T31N, R20W, KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
IKA	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs	25	5-Jun-11	4,000	$7,000	$10,000
19,30-31,T30N, R19W, 24-26, 35-36, T30N, R20W, KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
IKAL	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs	55	26-Sep-16	8,800	$7,700	N/A
9-16, 21-23, 27-34, T30N, R20W,KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu					

Property and Location	Agreement Type and Terms	# of Claims	Effective Date	Acres	2017 Holding $	2017 Work
	of work; Royalty = 3% Net Income to State					
LIMW	Estates = Surface & Minerals Term = renew annually Rental=$140/clm/yr for yrs 1-5; $280 yrs 6-10; $680 yrs>10 yrs	50	24-Sep-16	8,000	$7,000	N/A
3-6, T31N, R21W; 1, T31N, R22W; 26-34, T32N, r21W; 25, 36, T32N, R22W, KRM	Work = $400/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
JAH	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs	148	20-Nov-99	5,920	$25,160	$14,800
1,12-13,23-24,26-29,T28N,R20W; 6,7,18,T28N, R19W; 2-4,9-10,15-17,20-21,28-29,32-33,T29N, R19W; 34-36,T30N,R19W; 10-19,30-31,T30N,R18W; 7,18,T30N,R17W, KRM.	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
GOS	Estates = Surface & Minerals Term = renew annually Rental=$35/clm/yr for yrs 1-5; $70 yrs 6-10; $170 yrs>10 yrs	250	18-Nov-99	10,000	$42,500	$25,000
1-24, T33N, R19W, KRM.	Work = $100/clm/yr w/ 4-yr carryfrwd or Pay in lieu of work; Royalty = 3% Net Income to State					
Totals		***2,479***		***182,358***	***$430,525***	***$49,800***
				hectares		
				73,800		
	Recording fees total				***$5,185***	