REPORT

National Instrument 43-101 Technical Report for the Rubicon Phoenix Gold Project

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Submitted to:

Rubicon Minerals Corporation
Cochenour, Ontario

Submitted by:

Golder Associates Ltd. as Report Assembler of the work prepared by or under the supervision of the Qualified Persons Named as Authors

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NOTICE TO READERS

This National Instrument 43-101 Technical Report for Rubicon Minerals Corporation was prepared and executed by Brian Thomas, P.Geo., Golder Associates Ltd.; Tim Maunula, P.Geo., T. Maunula & Associates Consulting Inc.; John Frostiak, P.Eng., Independent Consultant; and Michael Willett, P.Eng., Rubicon Minerals Corporation (the "Authors"). This report contains the expressions of professional opinions of the Authors based on (i) information available at the time of preparation, (ii) data supplied by Rubicon Minerals Corporation, and (iii) the assumptions, conditions, and qualifications set forth in this report. The quality of information, conclusions, and estimates contained herein are consistent with the stated levels of accuracy as well as the circumstances and constraints under which the mandate was performed. There is no reason for the Authors of this report not to rely on data supplied by Rubicon Minerals Corporation. This report is intended to be used solely by Rubicon Minerals Corporation, subject to the terms and conditions of its contract with Golder Associates Ltd. This contract permits Rubicon Minerals Corporation to file this report as a Technical Report with Canadian securities regulators pursuant to National Instrument 43-101 - *Standards of Disclosure for Mineral Projects*. Except for the purposes legislated under Canadian securities law, any use of this report by any third party is at that party's sole risk.

CAUTIONARY STATEMENT REGARDING FORWARD-LOOKING STATEMENTS AND OTHER CAUTIONARY NOTES

This technical report contains statements that constitute "forward-looking statements" and "forward looking information" (collectively, "forward-looking statements") within the meaning of applicable Canadian and United States securities legislation. Generally, these forward-looking statements can be identified by the use of forward-looking terminology such as "believes", "intends", "may", "will", "should", "plans", "anticipates", "potential", "expects", "estimates", "forecasts", "budget", "likely", "goal" and similar expressions or statements that certain actions, events or results may or may not be achieved or occur in the future. In some cases, forward-looking information may be stated in the present tense, such as in respect of current matters that may be continuing, or that may have a future impact or effect. Forward-looking statements reflect our current expectations and assumptions, and are subject to a number of known and unknown risks, uncertainties and other factors which may cause our actual results, performance or achievements to be materially different from any anticipated future results, performance or achievements expressed or implied by the forward-looking statements. Forward-looking statements include, but are not limited to statements regarding the model reconciliation and test mining and the potential outcomes of each activity, details of the 2018 Exploration Program, the potential to improve the quantities and classification of the 2018 Mineral Resource Estimate, the impact of the new 2018 geological model and information on the Company's understanding of the F2 gold deposit and evaluation of mining methods for the Phoenix Gold Project, the additional exploration work required to further improve and reconcile the geological model for the F2 gold deposit, the anticipated reactivation of the Phoenix Gold Project's mill, the further steps necessary to potentially improve upon the 2018 Mineral Resource Estimates, including targeted infill and step-out drilling to potentially convert Inferred Resources to Indicated Resources, extending the exploration drift on the 610-m level, using the results from the bulk sampling program for reconciliation and validation purposes, the evaluation of the McFinley Deposit and other close proximity targets for potential inclusion in a future Mineral Resources Estimate, and follow-up drilling of the F2 gold deposit at depth and along strike, and the estimated costs of the recommended work programs.

Forward-looking statements are based on the opinions and estimates of management as of the date such statements are made and represent management's best judgment based on facts and assumptions that management considers reasonable. If such opinions and estimates prove to be incorrect, actual and future results may be materially different than expressed in the forward-looking statements.

Forward-looking statements involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements of Rubicon to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements. Such factors include, among others: possible variations in mineralization, grade or recovery or throughput rates; uncertainty of mineral resources, inability to realize exploration potential, mineral grades and mineral recovery estimates; actual results of current exploration activities; actual results of reclamation activities; uncertainty of future operations, delays in completion of exploration

plans for any reason including insufficient capital, delays in permitting, and labour issues; conclusions of future economic or geological evaluations; changes in project parameters as plans continue to be refined; failure of equipment or processes to operate as anticipated; accidents and other risks of the mining industry; delays and other risks related to operations; timing and receipt of regulatory approvals; the ability of Rubicon and other relevant parties to satisfy regulatory requirements; the ability of Rubicon to comply with its obligations under material agreements including financing agreements; the availability of financing for proposed programs and working capital requirements on reasonable terms; the ability of third-party service providers to deliver services on reasonable terms and in a timely manner; risks associated with the ability to retain key executives and key operating personnel; cost of environmental expenditures and potential environmental liabilities; dissatisfaction or disputes with local communities or First Nations or Aboriginal Communities; failure of plant, equipment or processes to operate as anticipated; market conditions and general business, economic, competitive, political and social conditions; our ability to generate sufficient cash flow from operations or obtain adequate financing to fund our capital expenditures and working capital needs and meet our other obligations; the volatility of our stock price, and the ability of our common stock to remain listed and traded on the TSX.

Forward-looking statements contained herein are made as of the date of this technical report and Rubicon disclaims any obligation to update any forward-looking statements, whether as a result of new information, future events or results or otherwise, except as required by applicable securities laws. Readers are advised to carefully review and consider the risk factors identified in the Company's annual information from dated March 22, 2018 under the heading "Risk Factors" and in other continuous disclosure documents of the Company filed at www.sedar.com for a discussion of the factors that could cause Rubicon's actual results, performance and achievements to be materially different from any anticipated future results, performance or achievements expressed or implied by the forward-looking statements. Readers are further cautioned that the foregoing list of assumptions and risk factors is not exhaustive and it is recommended that prospective investors consult the more complete discussion of Rubicon's business, financial condition and prospects that is included in this technical report. The forward-looking statements contained herein are expressly qualified by this cautionary statement.

CAUTIONARY NOTE TO U.S. READERS REGARDING ESTIMATES OF MEASURED, INDICATED AND INFERRED RESOURCES

This technical report uses the terms "Measured" and "Indicated" Mineral Resources and "Inferred" Mineral Resources. The Company advises U.S. investors that while these terms are recognized and required by Canadian securities administrators, they are not recognized by the SEC. The estimation of "Measured" and "Indicated" Mineral Resources involves greater uncertainty as to their existence and economic feasibility than the estimation of Proven and Probable Reserves. The estimation of "Inferred" resources involves far greater uncertainty as to their existence and economic viability than the estimation of other categories of resources. It cannot be assumed that all or any part of a "Measured", "Inferred" or "Indicated" mineral resource will ever be upgraded to a higher category.

Under Canadian rules, estimates of "inferred mineral resources" may not form the basis of feasibility studies, pre-feasibility studies or other economic studies, except in prescribed cases, such as in a preliminary economic assessment under certain circumstances. The SEC normally only permits issuers to report mineralization that does not constitute "reserves" as in-place tonnage and grade without reference to unit measures. Under U.S. standards, mineralization may not be classified as a "reserve" unless the determination has been made that the mineralization could be economically and legally produced or extracted at the time the reserve determination is made. U.S. investors are cautioned not to assume that any part or all of a "measured", "indicated" or "inferred" mineral resource exists or is economically or legally mineable. Information concerning descriptions of mineralization and resources contained herein may not be comparable to information made public by U.S. companies subject to the reporting and disclosure requirements of the SEC.

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1.0 SUMMARY

1.1 Introduction

The Phoenix Gold Project is an underground exploration development project located in the District of Red Lake, Ontario, Canada. It is located approximately 265 km northeast of Winnipeg, Manitoba. Rubicon Minerals Corporation (Rubicon) wholly owns 100 percent (%) of the Phoenix Gold Project.

This Technical Report documents material changes to the Mineral Resource Estimate for the Phoenix Gold Project. This Mineral Resource Estimate and Technical Report were prepared by Golder Associates Ltd. (Golder) following the guidelines of the Canadian Securities Administrators' National Instrument 43-101 and Form 43-101F1 and supersedes all prior Technical Reports prepared for the Phoenix Gold Project.

The updated Mineral Resource Estimate is supported by a revised geological model completed by Golder based on a diamond drilling program that was completed in 2017, including approximately 3,500 m of oriented structural drilling, 20,000 m of oriented infill and step-out drilling, the structural re-logging of 10,000 m of historical core, and detailed structural mapping carried out in 2017. The new geological information provides a better understanding of the structural and lithological controls on the distribution of the gold mineralization, gold grade, and gold continuity, of the deposit. It updates a Mineral Resource Estimate prepared in 2016.

1.2 Property Description and Ownership

1.2.1 Property Description and Location

The Phoenix Gold Project is located in the southwestern part of Bateman Township within the Red Lake mining district of northwestern Ontario, Canada. The total area of the mineral tenure is 510.4 hectares. It is centered on the historical McFinley shaft (now called the Phoenix shaft). The Phoenix Gold Project consists of 31 contiguous Mining Leases, Patented Claims, Mining Licences of Occupation, and 1 Staked Claim.

Rubicon Minerals Corporation is the 100% registered owner of mining rights for all forms of tenure of the Phoenix Property. The surface rights of certain Patented Claims are registered under 0691403 B.C. Ltd, a subsidiary of Rubicon Minerals. The ownership is registered in Land Registry Office #23 (District of Kenora), in the register for the District of Patricia Freehold for the Corporation of the Municipality of Red Lake. Rubicon is also the 100% recorded holder of the one staked claim registered with the Mining and Minerals Division of the Ontario Ministry of Northern Development and Mines (MNDM).

The property is subject to 2% net smelter return (NSR), payable to Franco-Nevada Corporation, on the majority of the water portions of the property, with Rubicon having the option to reduce the NSR by 0.5% by making a one-time payment of US$675,000 at any time, subject to a right of first refusal, whereby, a third party has the initial right to exercise this option. The property is also subject to a 1% NSR on all forms of tenure (Patented, Leased, Mining Licences of Occupation and the staked claim) to RGLD Gold AG, subject to a maximum 4.0% NSR.

To the extent known by the Qualified Persons (QP's), Rubicon has obtained all of the relevant permits required to conduct the proposed work described in this report.

1.2.2 Accessibility, Climate, Local Resources, Infrastructure and Physiography

The Project site is accessible via an 8 km gravel road that branches off the Nungesser Road, just north of the community of Balmertown, part of the Municipality of Red Lake, Ontario. Located in the East Bay of Red Lake, the Project is also easily accessible by water.

The Municipality of Red Lake is serviced by daily flights from Winnipeg and Thunder Bay and also has a local bus service operation three day per week. Red Lake is reached via Highway 105, which branches off the Trans-Canada Highway 17 some 170 km south of Red Lake (at Vermillion Bay, ON). Mining is the primary employer and the population was just over four thousand as of the last census data (2016). The climate is considered subarctic and topography is characteristic of the Canadian Shield, mildly rugged and dominated by glacially scoured southwest trending ridges typically covered with jack pine and mature poplar trees.

The Project site is currently supplied by a 10.4 km power transmission line connected to Hydro One's 44,000 Volts (44kV) M6 feeder in the Red Lake Transformer Station. Mine water supply is from the nearby East Bay of Red Lake. The water is piped underground via a water line for drilling use, muck pile watering, etc. A potable water plant is fully commissioned and operating at the processing plant.

The operating season in the area is 12 months of the year.

1.2.3 History

The Phoenix Gold Property (previously known as the McFinley property) was initially staked by McCallum Red Lake Mines Ltd. in 1922. After a series of ownership changes, Rubicon optioned the property from Dominion Goldfields Corporation in two agreements in 2002. The surface rights of the patented claims are now owned by 0691403 B.C. Ltd., a wholly owned subsidiary of Rubicon. A detailed discussion of the Project History, as well as a general discussion of historical and current exploration and mining activity in the Red Lake region is presented in Item 6 of this Report.

A historical estimate was completed by McFinley internal staff in 1986. This resource estimate does not cover the same volume of ground as the F2 gold deposit and is historic. Previous Resource Estimates completed by external consultants were disclosed by Rubicon in 2010 (GeoEx), 2011 (GeoEx, AMC), 2013 (SRK) and 2016 (SRK) and are no longer current and have been superseded by this 2018 Mineral Resource Estimate.

1.3 Geology and Mineralization

1.3.1 Geological Setting

The following description of the geology of the Red Lake Greenstone Belt was modified from Sanborn-Barrie et al. (2004) and the references therein.

The Phoenix Gold Project is located in the Uchi Subprovince of the Superior Province of the Canadian Precambrian Shield. Within the Uchi Subprovince, the Red Lake Greenstone Belt is host to one of Canada's preeminent gold districts having produced more than 29 million ounces of gold since the 1930s.

The Red Lake Greenstone Belt is subdivided into several rock assemblages recording magmatic and sedimentary activities that occurred from 3.0 to 2.7 billion years before the present. The tholeiitic and komatiitic metabasalts of the Balmer Assemblage are the oldest volcanic rocks in the greenstone belt and its lower and middle portions host the major lode gold deposits in the Red Lake district. The Phoenix Gold Project is hosted

within the northeast-trending Balmer Assemblage, which, in this area, is comprised of three tholeiitic mafic volcanic rock sequences, separated by distinct marker horizons of felsic and ultramafic volcanic rock.

Structurally, the Red Lake Greenstone belt underwent continental collision (the Kenoran Orogeny), ca. 2.72 to 2.71 Ga, which led to multiple episodes of intense hydrothermal alteration, deformation, metamorphism, and gold mineralization (Dube et al. 2004). The belt records several episodes of deformation interpreted to be closely linked with intensive hydrothermal activity and gold mineralization. Current regional interpretations of the Red Lake area identify three main deformation events:

- D1: Regional NW-SE shortening, resulting in NE-SW striking folds, thrust faults, thrust related strike-slip faults, quartz veins and penetrative regional foliation (S1) fabric.
- D2: Regional NE-SW shortening resulting in development of pre- to syn-mineralization oblique strike slip fault systems and a fold overprint of the earlier D1 deformation. During D2 deformation in the East Bay area, oblique dextral strike slip faults re-activated D1 thrust faults and associated D1 strike slip faults along a zone of crustal weakness inherited from earlier D1 faulting.
- D3: Regional-scale folding resulting in open folding of D1 and D2 structural features.

The local geology in the Phoenix Gold Project area comprises a series of N-S trending, steeply dipping to sub vertical alternating panels of talc-altered komatiitic ultramafic flows (Ultramafic Flows) and biotite and silica altered basaltic mafic volcanic flows (High-Ti Basalt). Three main panels of High-Ti Basalt are observed, namely the F2 Basalt, West Limb Basalt and the Hanging Wall Basalt; in addition to these three main basalt panels there are other less continuous or less well-defined panels of basalt located in the deposit area. The volcanic units are intruded by a series of quartz-feldspar porphyry felsic dykes and sills (Felsic Intrusive) as well as less abundant intermediate and mafic dykes and sills. The Felsic Intrusive dykes and sills post-date D1 deformation features and are cross-cut by mineralized D2 deformation features.

The East Bay Deformation Zone (EBDZ) is located within the western portion of the deposit, where it forms a north-south (N-S) orientation, steeply dipping to a sub-vertical high strain zone localized within the Ultramafic Flow unit (Figure 7-5). Within the Phoenix Gold Project area, the EBDZ forms a distinct boundary between the alternating panels of Ultramafic Flows and High-Ti Basalt units to the east of the structure, and Ultramafic Flows without interlayered High-Ti Basalt to the west of the structure.

Underground development completed since 2013 has exposed the gold mineralization for study and approximately 117,500 m of new infill core drilling completed since 2013 has helped better understand the mineralization's relationship to D2 structural features and its distribution. A primary objective of the 2017 drill program was the collection of extensive structural data from logging oriented drill core, in conjunction with detailed underground structural mapping, which was instrumental to the development of a more comprehensive structural and geological model.

1.3.2 Mineralization

Gold mineralization occurs primarily within High-Ti Basalt in the form of mineralized quartz-actinolite veins and also mineralization associated with disseminated sulphides in the basalt, with lesser mineralization in felsic dykes and sills. Previous studies have identified an earlier low-grade gold mineralization event, with a later overprinting higher-grade gold mineralization event.

The early low-grade gold mineralization event appears to have formed pre- to syn-D1 as the mineralization is overprinted by the S1 foliation. The early phase of mineralization is generally low-grade, with gold grades generally less than 4 g/t, and occurs as quartz-actinolite-sulphide veins and stringers and disseminated mineralization associated with quartz-biotite-sulphide alteration in the High-Ti Basalt and Felsic Intrusive units.

The higher grade second mineralization event has been linked to an array of shear-related veins and minor localized shear zones interpreted to have formed as a result of D2 dextral transpression along the EBDZ. The gold mineralization occurs in association with disseminated sulphide mineralization in the High-Ti Basalt and also in gold-bearing quartz-actinolite veins in the High-Ti Basalt and Felsic Intrusive units. The mineralized veins occur in several orientations, with the east striking, steeply-dipping vein arrays being associated with higher grade gold mineralization. East-west (E-W) striking structures are limited to the High-Ti Basalt and Felsic Intrusive; those structures are interpreted as R' shear veins associated with the regional dextral transpression. No regional or through-going deposit-scale E-W structures were identified.

1.4 Exploration Status

1.4.1 Exploration Activities

Since acquiring the Phoenix Gold Project in 2002, Rubicon has conducted extensive exploration programs, including geological mapping, re-logging of selected historical boreholes, digital compilation of available historical data, ground and airborne magnetic surveys, mechanical trenching, channel sampling, a bathymetric survey, airborne geophysical surveys, a deep penetrating Titan 24 geophysical survey, petrographic studies, a topographic survey, data modelling and processing, as well as several drilling programs, along with underground drifting, sampling and mapping.

1.4.2 Drilling

Between 2002 and November 1, 2017, Rubicon has completed 546,184 m of core drilling (235,228 m from the surface and 310,956 m from underground stations) on the Phoenix Gold Project. During this period, 483,707 m of drilling targeted the F2 Gold Deposit. Since November 2015, a total of 68 new core boreholes (22,901 m) have been drilled with the majority of the new boreholes consisting of infill drilling targeting the Main Zone of the F2 gold deposit from underground drilling stations. Approximately half of the 2017 drilling program (10,000m) comprised oriented core for the purpose of collecting structural; orientation measurements and observations.

1.4.3 Sample Preparation, Analyses and Security

Since 2002, Rubicon has used three primary analytical laboratories for assaying of drill core and development samples on the Phoenix Gold Project. Samples collected before 2008 were sent to either to the ALS Minerals (ALS) preparation lab in Thunder Bay, Ontario, or its analytical lab in Vancouver, British Columbia, or to Accurassay Laboratories (Accurassay), Thunder Bay, Ontario. Since January 2008, all primary assays have been conducted by SGS Mineral Services (SGS) in Red Lake, Ontario. Umpire check assays have been completed on between 3% and 5% of these assays since January 2010 and were analyzed by ALS, Accurassay or Actlabs. In 2015, production geology and mill related process samples were analyzed at Rubicon's internal laboratory located in Balmertown.

Prior to 2009, gold was analyzed using the fire assay process (with an atomic absorption or inductively coupled plasma finish) on a 30 gram subsample. If the sample contained greater than 10 grams per tonne (g/t) gold, it was sent for a gravimetric finish. Starting in October 2009, the assay subsample size was increased to 50 grams.

Rubicon's exploration work was conducted under a quality management system involving all stages of exploration, from drilling to data management. All field data were recorded digitally using standardized templates that ensure all relevant information was captured. From 2009 to 2014, borehole data were reviewed by ioGlobal Pty Ltd. for quality assurance and quality control. Since 2014, database management and quality control and quality assurance was managed by qualified Rubicon staff, on-site. Various levels of descriptive input were recorded, with appropriate validation procedures in place.

Rubicon monitored the internal analytical quality control (QC) measures implemented by the primary laboratories it used for analysis. In addition, Rubicon implemented external analytical QC measures starting in 2008 on all sampling conducted at the Phoenix Gold Project. The analytical QA/QC program was designed and monitored by both internal and external QP's. For drill core, analytical control measures used by Rubicon consisted of inserting control samples (blank, grade-matched CRMs, and field duplicates) in all sample batches submitted for assaying.

In addition to in-house monitoring, analytical QC data produced by Rubicon between 2002 and 2007 was reviewed by AMC Mining Consultants (Canada) Ltd in 2011. Analytical QC data collected between 2008 and 2015 was summarized and analyzed in technical reports by SRK Consultants (SRK, 2013b and SRK, 2016). Historical boreholes drilled prior to 2002 do not have known analytical QC data.

It is the TMAC QP's opinion that the sample preparation, security and analytical procedures used by Rubicon are consistent with standard industry practices and that the data is suitable for the 2018 Resource Estimate. The TMAC QP has no material concerns with the geological or analytical procedures used or the quality of the resulting data

1.4.4 Data Verification

The Golder QP completed and supervised a number of data verification checks throughout the duration of the 2018 Resource Estimate. The verification process included a 1 week site visit to the Phoenix Mine property by the resource QP to review the site geology, underground development, chain of custody of drill core samples and observe geological data collection procedures, and confirm metal mineralization through the inspection of drill core and independent sample verification. Other data verification included a spot check comparison of Gold (Au) assays from the drill hole database against original assay records (lab certificates) and a review of QA/QC performance for the 2017 drill program. Golder has also completed additional data analysis and validation as outlined in Item 14.

Golder also performed regular desktop reviews on the core orientation and structural data measurements and observations collected during the 2017 drilling program to ensure the data was being collected in accordance with the Rubicon procedures for oriented core drilling and structural data collection and core logging.

On completion of the data verification process, it is the Golder QP's opinion that the geological data collection and QA/QC procedures used by Rubicon are consistent with standard industry practices and that the geological database is of suitable quality to support the 2018 Mineral Resource Estimate.

1.5 Development and Operations Status

1.5.1 Development Activities

During the course of exploration, Rubicon has developed the property by constructing abundant surface and underground infrastructure including an underground shaft, material handling systems, a mill and a tailings management facility, among many others. Rubicon has also completed trial mining and mill processing on a limited basis. The existing infrastructure is not supported by a current preliminary economic assessment, prefeasibility or feasibility study and therefore the QP's are not considering the Phoenix Gold Project to be an "advanced property" as defined under NI43-101. Descriptions for existing infrastructure and supporting work completed in the past are provided in Item 24 Other Relevant Data and Information, of this report.

1.5.2 Metallurgical Testing

The metallurgical test work, completed on representative samples from the F2 gold deposit to support the conceptual design of a processing plant, was performed in 2012 and described in the 2013 Technical Report summarizing the results of a preliminary economic assessment. No additional metallurgical specific testing was conducted after 2012. The process plant was operated in 2015, during which time 57,793 dry tonnes were milled grading at 3.02 g/t. The gold recovery of 91.9% achieved during 2015 was comparable to the results attained in the initial process development test work. The 2016 Technical Report included results from the 2015 test mining operations. This current Technical Report reflects ounces recovered from a mill cleanup completed after the 2016 report was issued and as a result the reported grade and recovery has increased. Metallurgical improvements can be anticipated in the future when the process plant operates continuously within design parameters at steady state.

1.6 Mineral Resource Estimates

Caution to readers: In this report, the Mineral Resource Estimates for the Rubicon Gold Project contain forward-looking information. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. Material factors that could cause actual results to differ materially from the conclusions and estimates set out in this report include: 1) naturally occurring geological variability 2) geological interpretations 3) differences from the assumed criteria applied by the Qualified Persons to determine the reasonable prospects of economic extraction. The material factors, or assumptions, that were applied in drawing the conclusions, forecasts, and projections set forth in this Item are summarized in this, and other Items of this Technical Report. For this reason, readers should read this Item solely in the context of the full report, and after reading all other Items of this report.

The 2018 Mineral Resource Estimate for the Rubicon Phoenix Project was completed by Mr. Brian Thomas, P.Geo., Senior Resource Geologist with Golder, with senior peer review by Mr. Jerry DeWolfe, P.Geo., Associate and Senior Geological Consultant with Golder. External 3rd party review was completed by Tim Maunula, P.Geo., of TMAC. The effective date of this Mineral Resource Estimate is April 30, 2018.

The Mineral Resource Estimate is based upon data provided by Rubicon from surface and underground diamond drill programs, as well as chip samples and mapping from underground development completed mainly between 2002 and 2017. All data received was in the Phoenix Mine co-ordinate system which is rotated 45

degrees to the east of magnetic North. No other data translations were completed for the purpose of this Mineral Resource Estimate.

The Phoenix Gold Project mineralization was modelled in four zones defined as Zones 1 to 4. A three-dimensional (3D) block model was constructed for the purpose of estimating stratigraphy (i.e. rock type groupings) and Au grades, where stratigraphy was used as a zonal control on Au grade estimates. High-grade, outlier samples were controlled by top-cutting with a maximum distance restriction of 10 m. Resources were reported at a 3.0 g/t break-even cut-off grade and classified according to Canadian Institute of Mining, Metallurgy and Petroleum ("CIM") Definition Standards for Mineral Resources and Mineral Reserves (May 2014). Density values were assigned to the model based on the default mean value of each stratigraphic unit.

The Mineral Resource Estimate for the Phoenix Gold Project is reported in accordance with NI 43-101 and has been estimated in conformity with current CIM "Estimation of Mineral Resource and Mineral Reserves Best Practices" guidelines.

Mineral Resources are not Mineral Reserves and do not necessarily demonstrate economic viability. There is no certainty that all or any part of this Mineral Resource will be converted into mineral reserve.

Inferred Mineral Resources are too speculative geologically to have economic considerations applied to them to enable them to be categorized as mineral reserves. There is no certainty that with additional drilling and test work, Inferred Mineral Resources will be upgraded to Indicated or Measured Mineral Resources.

The base case Mineral Resource Estimate is reported at a cut-off grade of 3.0 g/t Au while other cut-offs are provided in order to demonstrate tonnage and grade sensitivities. All Mineral Resource Estimates are reported from within a 2.0 g/t grade shell to account for mineral continuity and potential mineability which excludes isolated blocks with little potential for mining. The Mineral Resource Estimate excludes mineralization within the crown pillar located between the lake bottom and a depth of 40 m below the lake bottom.

Table 1-1 states the Measured, Indicated and Inferred Mineral Resources for the Phoenix Gold Project, Table 1-2 summarizes the sensitivity of the Mineral Resource Estimate to other potential mining cut-offs and Table 1-3 summarizes the changes from the 2016 Mineral Resource Estimate. The Effective Date of the Current Mineral Resource Estimate is April 30, 2018.

Table 1-1: Phoenix Gold Project 2018 Mineral Resource Estimate

Resource Category	Quantity (000'tonnes)	Grade (g/t Au)	Contained Gold Ounces
Measured (M)	188	6.80	41,000
Indicated (I)	1,186	6.30	240,000
M + I	**1,374**	**6.37**	**281,000**
Inferred	**3,884**	**6.00**	**749,000**

Effective date for this Mineral Resource is April 30, 2018
Mineral Resource Estimate uses a break-even economic cut-off grade of 3.0 g/t Au based on assumptions of a gold price of US$1,300 per ounce, an exchange rate of US$/C$ 0.77, mining cash costs of C$97/t, processing costs of C$20/t, G&A of C$5/t, sustaining capital C$10/t, refining, transport and royalty costs of C$53/ounce, and average gold recoverability of 92%
Mineral Resource Estimate reported from within an envelope accounting for mineral continuity
Mineral Resources are not Mineral Reserves and do not demonstrate economic viability
There is no certainty that all or any part of this Mineral Resource will be converted into Mineral Reserve
All figures are rounded to reflect the relative accuracy of the estimates and totals may not add correctly

Table 1-2: Phoenix Gold Project 2018 Mineral Resource Sensitivities

	Measured + Indicated Classification			Inferred Classification		
Cut-off Grade (g/t Au)	Quantity (000't)	Grade (g/t Au)	Contained Gold Ounces (000)	Quantity (000't)	Grade (g/t Au)	Contained Gold Ounces (000)
2.0	2,167	4.94	344	6,475	4.58	954
2.5	1,729	5.62	313	5,045	5.24	851
***3.0**	**1,373**	**6.37**	**281**	**3,884**	**6.00**	**749**
3.5	1,119	7.08	255	3,146	6.64	672
4.0	909	7.86	230	2,556	7.31	601
4.5	745	8.65	207	2,070	8.04	535
5.0	623	9.42	189	1,725	8.70	483

*Base Case Scenario: Mineral Resource Estimate uses a break-even economic cut-off grade of 3.0 g/t Au

Table 1-3: Summary of Mineral Resource Changes

Cut-off Grade Classification	Quantity (000' tonnes)			Grade (g/t Au)			Contained Gold Ounces		
	2018	2016	Change	2018	2016	Change	2018	2016	Change
***3.0 g/t Au**									
Measured (M)	188	0	N/A	6.80	0	N/A	41,000	0	N/A
Indicated (I)	1,186	719	65%	6.30	5.71	10%	240,000	132,000	82%
Total M+I	**1,374**	**719**	**91%**	**6.37**	**5.71**	**12%**	**281,000**	**132,000**	**113%**
Inferred	**3,884**	**2,491**	**56%**	**6.00**	**5.18**	**16%**	**749,000**	**415,000**	**80%**
3.5 g/t Au									
Measured (M)	155	0	N/A	7.54	0	N/A	38,000	0	N/A
Indicated (I)	964	601	60%	7.01	6.19	13%	217,000	120,000	81%
Total M+I	**1,119**	**601**	**86%**	**7.08**	**6.19**	**14.4%**	**255,000**	**120,000**	**113%**
Inferred	**3,146**	**1,959**	**61%**	**6.64**	**5.71**	**16.3%**	**672,000**	**360,000**	**87%**
4.0 g/t Au									
Measured (M)	129	0	N/A	8.29	0	N/A	35,000	0	N/A
Indicated (I)	779	492	58%	7.78	6.73	16%	195,000	106,000	84%
Total M+I	**909**	**492**	**85%**	**7.86**	**6.73**	**17%**	**230,000**	**106,000**	**117%**
Inferred	**2,556**	**1,519**	**68%**	**7.31**	**6.28**	**16%**	**601,000**	**307,000**	**96%**

*Base Case Scenario: 2018 Mineral Resource Estimate is at the 3.0 g/t Au cut-off. Other scenarios are shown for comparison purposes.

Changes between the 2016 and 2018 Mineral Resource Estimates are mainly due to a reinterpretation of geological and structural controls on mineralization, a lowering of the reporting cut-off grade to 3.0 g/t from 4.0 g/t, representing the potential change from narrow-vein mining to bulk mining methods (longhole), the addition of new data from drill holes, underground mapping and chip samples, along with changes to the estimation methodology.

1.7 QP Conclusions and Recommendations

1.7.1 Conclusions

The 2018 Mineral Resource Estimate was completed according to CIM best practice guidelines and is reported in compliance with NI 43-101 regulations. The Golder QP believes that the current data presented is an accurate and reasonable representation of the Phoenix Gold Project and concludes that the updated database (2017) is of suitable quality to provide the basis of the conclusions and recommendations reached in this Technical Report.

Golder has taken reasonable steps to make the block model and Resource Estimate as representative of the data as possible but given the nature of the deposit there are still material risks to the accuracy of the estimates related to the following:

- the variable and complex nature of the geology and structural controls on mineralization
- the nuggety nature of the gold mineralization
- the impact of outlier grade data
- inconsistent continuity of mineralization
- limited constraints on mineralization locally in the model, in areas where the High-Ti basalt is wider than usual

1.7.2 Recommendations

The data and observations collected during Rubicon's 2017 Exploration Program provided both a further understanding of the structural controls of the mineralization and additional geological information that contributed to the 2018 update of Mineral Resources at the Phoenix Gold Project.

The independent QP's believe that Rubicon can potentially improve upon the 2018 Mineral Resource Estimate through the implementation of a proposed exploration program (subject to any requisite financing) comprising of the following components:

- Targeted infill and step-out drilling is recommended in the mid-to-upper levels of the deposit to potentially convert Inferred Mineral Resources (generally drilling spacing of 40 m centres or more) to Indicated Mineral Resources. In addition, targeted infill and step-out drilling is recommended in areas identified as Exploration Targets (greater than 80 m centres), which potentially could contain between 500,000 and 800,000 t of sparsely drilled mineralized material grading between 5.0 to 7.0 g/t Au, and has reasonable potential to be upgraded to Mineral Resources. As per 2.3(2)(a) of NI 43-101, the potential quantity and grade of Exploration Targets is conceptual in nature, that there has been insufficient exploration to define a mineral resource and that it is uncertain if further exploration will result in the target being delineated as a mineral resource.
- Extend the exploration drift up to 200 m southward on the 610 m level (parallel to the F2 gold deposit) to provide additional drilling platforms that allow proper up-dip and down-dip infill drilling and step-out drilling of the mineralized zones in the southern portion of the deposit.

- Complete a model reconciliation based on the production of 25,000 to 30,000 t from a bulk sample, following Rubicon's test trial mining program that is currently underway. The model reconciliation exercise could further validate the 2018 Mineral Resource Estimate and improve confidence in the established modelling and estimation procedures. The test mining will allow for the collection of important data including stope parameter performance, input costs, and mill operating parameters, which could be implemented in a potential feasibility study of the Project in the future.
- Conduct exploration drilling of the F2 gold deposit, which remains open at depth and along strike. Historical drilling intersected high-grade intercepts to a depth of 1,600 m below surface, well below the bottom of the 2018 Mineral Resource Estimate at 1,350 m elevation. The mineralization is also open at depth and has not been cut-off to date.
- Evaluate the historical data from the McFinley Deposit and close proximity Exploration Targets. Rubicon could evaluate data from the historic McFinley Deposit, located near existing underground development at the Project, using modern standards and parameters that are in accordance to CIM best practise guidelines. This exercise could potentially expand any future Mineral Resource Estimate. Rubicon is also evaluating historical drill data from its close proximity Exploration Targets (Peninsula, CARZ, and Island Zones) located within two km northeast of the Project, which could possibly be included in any future updated Mineral Resource Estimate.

The estimated costs of the recommended work program are presented in Table 1-4.

Table 1-4: Cost Estimates for Recommended Work Programs*

Task	Units	Quantity	Unit Cost* (C$)	Total (C$)
Exploration Drilling				
2018 budgeted drilling				
Infill drilling (between 305 m to 854 m Levels)	metres	14,000	$70	$980,000
Sampling and assay analyses	samples	5,000		$120,000
Infill drilling 610m level exploration drift	metres	10,000	$70	$700,000
Sampling and assay analyses	samples	3,700		$90,000
Subtotal				**$1,890,000**
Underground Development				
Development drifting (on 610 Level)	metres	280	$4,285	$1,200,000
Subtotal				**$1,200,000**
Test Mining and Bulk Sample Processing				
Underground test mining				$9,000,000
Bulk Sample Processing	tonnes	25-30K		$3,000,000
Subtotal				**$12,000,000**
Technical and Other Studies				
43-101 Technical Report				$300,000
Potential Feasibility Study Work in 2018				$300,000
Regional Exploration work				$1,200,000
Subtotal				**$1,800,000**
Contingency (10%)				$1,689,000
Total				**$18,579,000**

*All-inclusive costs

2.0 INTRODUCTION

The Phoenix Gold Project is an underground exploration development Project located in the District of Red Lake, Ontario, Canada. It is located approximately 265 km northeast of Winnipeg, Manitoba. Rubicon Minerals Corporation (Rubicon) wholly owns 100 percent (%) of the Phoenix Gold Project.

This Technical Report was prepared for Rubicon and documents material changes to the Mineral Resource Estimate for the Phoenix Gold Project. This Mineral Resource Estimate and Technical Report were prepared by Golder Associates Ltd. (Golder) following the guidelines of the Canadian Securities Administrators' National Instrument 43-101 and Form 43-101F1 and supersedes all prior Technical Reports prepared for the Phoenix Gold Project.

The Mineral Resource Estimate was completed by Brian Thomas, P.Geo. (Resource Qualified Person [QP]) with contributions and reviews completed by Jerry DeWolfe, P.Geo. (Associate and Senior Geological Consultant) of Golder and Tim Maunula, P.Geo., of TMAC. All three are QP's as defined under NI 43-101.

Brian Thomas completed a QP site visit from June 5 to 9, 2017, and Jerry DeWolfe was onsite on two occasions including February 13 to 17, 2017 and April 17 to April 21, 2017.

During the QP site visit, Mr. Thomas reviewed the site geology, underground development, reviewed and observed geological data collection procedures, and confirmed metal mineralization through the inspection of drill core and independent sample verification. A detailed description of the site visit is included in Section 12.

Jerry DeWolfe coordinated the collection of structural data from oriented drill core and underground structural mapping and monitored the collection and quality of this data.

Tim Maunula completed QP site visits from April 17 to April 21, 2017 and June 5 to 9, 2017. During his QP site visits, Mr. Maunula reviewed and observed the geological data collection and sampling of drill core, underground development and surface geology.

John Frostiak, P.Eng. (Mineral Processing Qualified Person [QP]) as defined under NI 43-101 completed an informal mill tour on March 13, 2018 and two site visits and tours as QP on April 17, 2018 and May 1, 2018. Meetings were held with Michael Willett and Chris Hunter of Rubicon, to confirm that the mineralized material now included in the 2018 Mineral Resource is from the zone which was mined and milled in 2015. A meeting was held with Adrian McNutt (process consultant) on the state of the process plant.

Michael Willett, Director of Projects, P.Eng. (Mining Engineer), is a full-time employee of Rubicon and is stationed at Rubicon's Phoenix Gold Project site, in Red Lake.

The Mineral Resource estimate and supporting data summarized in this Technical Report are considered by the QP's to meet the requirements of NI 43-101.

2.1 Source of Information

The sources of information utilized in the preparation of the Mineral Resource Estimate and Technical Report were provided by Rubicon, Chris Hunter P.Geo., and Denise Saunders P.Geo. under the direction of Mr. Michael Willett P.Eng. This Technical Report and Mineral Resource Estimate is based on the following data and pre-existing reports:

- Rubicon drill hole and chip sample databases containing:

  - Au assays
  - lithology, mineralogy and structural descriptions
  - bulk density measurements
  - collar co-ordinates and down-hole survey data
- Rubicon underground mapping
- underground structural mapping completed by Terrane Geoscience in 2017
- Rubicon internal reports
- assay certificates from SGS Laboratories
- Rubicon metal price and break-even mining cost assumptions
- public reports

Further sources of information, utilized by the authors, and references are listed in Section 27.0.

2.2 Qualified Persons

This Technical Report was prepared by, and under the supervision of the QP's listed in Table 2-1 for each Item of this Technical Report. The following summarizes the dates of the QP's Project site visits:

- Brian Thomas, P.Geo., completed site visit between June 5 and 9, 2017.
- Tim Maunula, P.Geo., completed site visits between April 17 and 21, and June 5 and 9, 2017.
- John Frostiak, P.Eng., completed site visits on March 13, April 17, and May 1, 2018
- Michael Willett, P.Eng., is located at the Phoenix Gold Project site in Red Lake.

Table 2-1: Qualified Persons Responsibility Table

Qualified Person	TITLE, COMPANY	RESPONSIBLE FOR ITEMS
Brian Thomas, P. Geo.	Senior Resource Geologist, Golder Associates Ltd.	1.1, 1.4.4, 1.6, 1.7, 2, 3, 12, 14, 23, 25, 26.1
Tim Maunula, P. Geo.	Principal Geologist, T. Maunula & Associates Consulting Inc.	1.2, 1.3, 1.4.1 to 1.4.3, 4, 5, 6, 7, 8, 9, 10, 11
John Frostiak, P. Eng.	Mining Engineer (mineral processing), Independent consultant	1.5.2, 13, 17, 24.2
Michael Willett, P.Eng.	Director of Projects, Mining Engineer, Rubicon	1.5.1, 15, 16, 18, 19, 20, 21, 22, 24.1, 24.3, 24.4, 26.2, 27

2.2.1 Acknowledgments

Golder and Rubicon would like to thank and acknowledge the following people who have contributed to the preparation of this report and the underlying studies under the supervision of the QP's, including: George Ogilvie, P.Eng., President and CEO of Rubicon, Nick Nikolakakis, CFO of Rubicon, Denise Saunders, P.Geo., Geologist of Rubicon, Chris Hunter, P.Geo., Geologist of Rubicon, Carol St. Louis, Geologist of Rubicon, Lynne Rasmussen, Hons. BSc. Biology, Environmental Coordinator of Rubicon, Dana Dobrescu, Land Manager of Rubicon, and Keith Benn, PhD., P.Geo., of Terracognita Geological Consulting Inc., (in association with T. Maunula & Associates Consulting Inc.); as well as, Jerry DeWolfe P.Geo. of Golder and Stefan Kruse of Terrane Geoscience for their contributions to the structural modelling and interpretations, Greg Warren of Golder for his contributions to the block modelling and grade estimation procedures, Jennifer Simper P.Geo., of Golder for her contributions to the report Figures and data verification, along with Kelsey Patterson, H.B. Comm, of Golder for her contributions to report compilation and formatting.

2.3 Units of Measure and Abbreviations

Unless otherwise noted, the following measurement units, formats and systems are used throughout this Report:

- Measurement Units: all references to measurement units use the System International (SI, or metric) for measurement. The primary linear distance unit, unless otherwise noted, are metres (m).
- General Orientation: all references to orientation and coordinates in this Report are presented as decimal degrees in the Rubicon Mine Grid; the mine grid is oriented with grid north parallel to the orientation of the East Bay Deformation Zone, which results in a +45.0° rotation relative to True North (0.0/360.0° azimuth in Mine Grid equates to 045.0° azimuth True North).
- Currencies outlined in the report are stated in Canadian dollars ($CAD) unless otherwise noted.

The following symbols and abbreviations are used in this Report.

Canadian Institute of Mining, Metallurgy, and Petroleum	CIM
Capital expenditure	CAPEX
Centimetre	cm
Certified reference material	CRM
Circa	circa
Comma-separate values file (electronic file format)	csv
Cubic centimetre	cm^3
Cubic metre	m^3
Cubic metres per hour	m^3/h
Degree	°
Degrees Celsius	°C
Giga-annum (1 billion years)	Ga
Gold	Au
Gram	g
Grams per cubic centimetre	g/cm3
Grams per tonne	g/t
Greater than	>
Hectare (10,000 m2)	ha
High Grade	HG
High Titanium Basalt	High-Ti

Internal rate of return	IRR
Inverse Distance	ID
Kilogram	kg
Kilograms per cubic metre	kg/m^3
Kilograms per square metre	kg/m^2
Kilometre	km
Less than	<
Litre	L
Low Grade	LG
Mega-annum (1 million years)	Ma
Metre	m
Metres above sea level	masl
Millimetre	mm
Million	M
Million tonnes	Mt
Million tonnes per annum	Mtpa
Nearest Neighbour	NN
Operating expense	OPEX
Ordinary Kriging	OK
Ounce (troy ounce - 31.1035 grams)	oz
Ounce per tonne	opt
Parts per billion	ppb
Parts per million	ppm
Percent	%
Percent mass fraction for percent mass	%w/w
Pound(s)	lb
Relative Percentage Difference	RPD
Specific gravity	SG
Square km	km^2
Square metre	m^2
Tonnes per cubic metre	t/m^3
Tonnes per day	t/d
Tonnes per hour	t/h
Universal Transverse Mercator	UTM

Figure 2-1: Units of Measure and Abbreviations

3.0 RELIANCE ON OTHER EXPERTS

For certain items in this Technical Report the QPs authoring those items relied on a report, opinion, or statement of another expert who is not a QP, or on information provided by the issuer, concerning legal, political, environmental, or tax matters relevant to the Technical Report. In each case, the QP hereby disclaims responsibility for such information to the extent of his/her reliance on such reports, opinions, or statements. This reliance applies to information provided by Rubicon for Sections 4.1 (Property Land Tenure), 4.2 (Underlying Agreements), 4.3 (Permits and Authorization) and 4.4 (Environmental Considerations) of this Report. The QPs have relied upon fully, and believe there is a reasonable basis for this reliance on, information provided by Rubicon regarding mineral tenure, surface rights, ownership details, royalties, environmental obligations, and applicable legislation relevant to the Phoenix Gold Project. The QPs have not independently reviewed the information in these sections and have fully relied upon, and disclaim responsibility for, information provided by Rubicon in these sections.

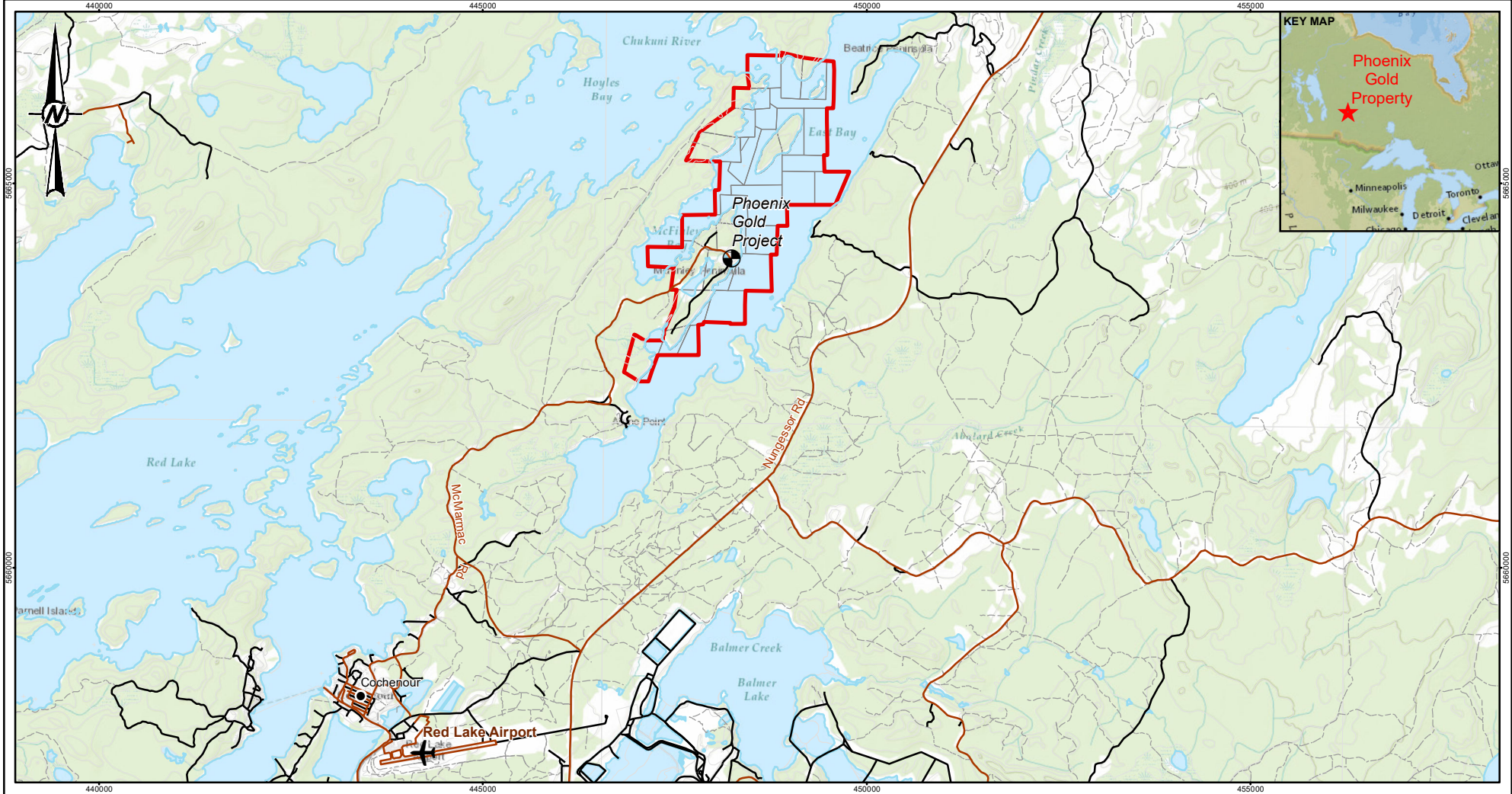
4.0 PROPERTY DESCRIPTION AND LOCATION

The Phoenix Gold Project is located in the southwestern part of Bateman Township within the Red Lake mining district of northwestern Ontario, Canada (Figure 4-1). The Town of Red Lake is approximately 150 km northwest of Dryden, Ontario and 265 km northeast of Winnipeg, Manitoba.

The Phoenix Gold Project is centered on the historical McFinley Shaft (now called the Phoenix Shaft), located at UTM coordinates 448,167E, 5,663,962N (NAD 83 / zone 15N) at an elevation of 369 m (above sea level). The total area of the land tenure is 510.4 hectares.

Rubicon has a 100 percent (%) interest in the Phoenix Gold Project subject to a 2% net smelter return (“NSR”) royalty on the majority of the water portions of the property to Franco-Nevada Corporation and 1% on all land tenure to RGLD Gold AG.

PATH: D:\1671445 Rubicon\3-ArcGIS\MapFiles\1671445_NI43-101_Figures\Fig1-1_Fig4-1_GeneralLocationMap_AnsiA_Land.mxd PRINTED ON: 2018-05-30 AT: 1:48:48 PM



LEGEND

- Phoenix Gold Property
- McFinley Claims
- Phoenix Gold Project
- Red Lake Airport
- Town
- Primary Roads
- Secondary Roads
- Teritary Roads
- Lake

NOTE(S)

REFERENCE(S)
DATUM: NAD 83 UTM ZONE 15

0 1,000 2,000
1:75,000 METRES

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
GENERAL LOCATION MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	4-1

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4.1 Property Land Tenure

The Phoenix Property consists of 31 contiguous Mining Leases, Patented Claims, Mining Licences of Occupation, and a single Staked Claim (Table 4-1 and Figure 4-2) comprising:

- one Mining Lease covering four Kenora Red Lake (KRL) blocks
- sixteen Patented Claims covering land portions of the property
- twenty-five Mining Licences of Occupation covering water portions of the property
- one Staked Claim

A single KRL or K numbered block can consist of a land portion (Patented Claim) and associated water portion (Mining Licences of Occupation containing a separate number) when it covers land and water within its boundaries. A single KRL or K numbered block can also consist of solely land portions or solely water portions of the property.

The perimeter of the Phoenix Property was surveyed by certified Ontario land surveyor Jim Bowman on February 7, 1985. This legal survey defined the Phoenix Property at the time of the original mining lease application on October 20, 1986. This land survey was verified by Rubicon via professional land surveying services of Geomatics Inc. on August 3, 2012.

The mining rights of the Mining Lease and the mining rights of the Patented Claims are registered under Rubicon Minerals Corporation with Ontario's Electronic Land Registration System. The surface rights of the Patented Claims are registered under 0691403 B.C. Ltd, a wholly owned subsidiary of Rubicon, with Ontario's Electronic Land Registration System. The mining rights of the Mining Licences of Occupation and the holder name of the Staked Claim are registered under Rubicon Minerals Corporation with the Mining and Minerals Division of the Ministry of Northern Development and Mines (MNDM).

The Mining Licences of Occupation are subject to a payment of rents shown on the face of each licence. No application for renewal is required.

The Mining Lease is for a standard fixed term. The current term has been extended to October 31, 2028. Prior to expiry of the extended term, an application must be made under the Ontario *Mining Act* for the Minister's consent to extend the leasehold for a further fixed term.

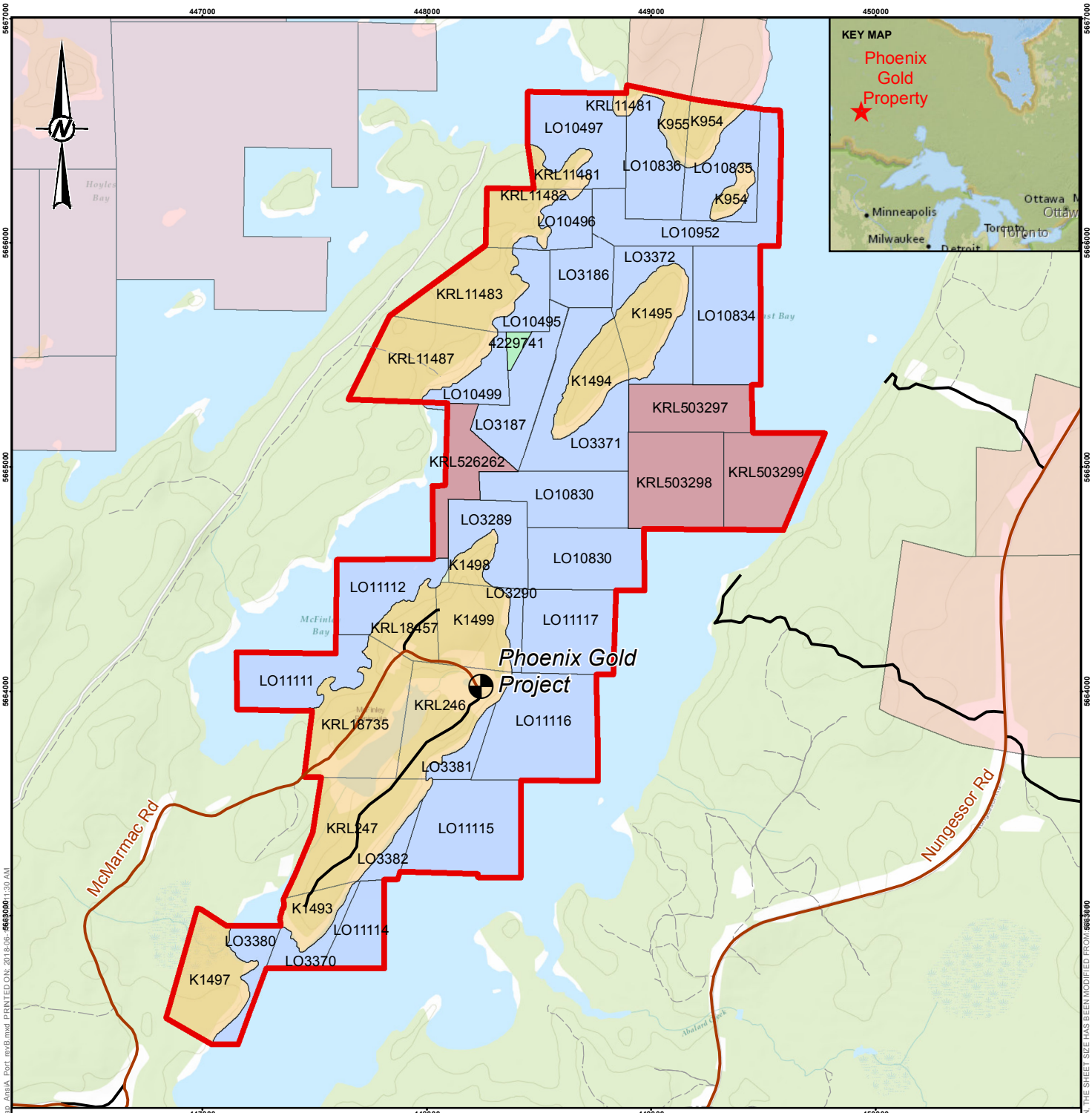
On June 22, 2009, Rubicon Minerals Corporation was registered as the 100% recorded holder for one Staked Claim with the Minerals Division of the Ministry of Northern Development and Mines (MNDM). To maintain the claim in good standing Rubicon is required to carry out eligible assessment work of CAD$400 prior to June 22, 2022.

Table 4-1: Mineral Tenure Information

KRL or K Numbered Block(s)	Number	Start Date	Expiry Date	Hectares
Mining Lease				
KRL503297, KRL503298, KRL503299, KRL526262	108126	November, 1986	October 31, 2028	56.0
Patented Mining Claims (Land Portion) Parcel Number MR				
K1498	992	October 1, 1945	Not Applicable	3.0
K1499	993	October 1, 1945	Not Applicable	11.5
K1493	994	March 1, 1946	Not Applicable	5.1
K1494	995	March 1, 1946	Not Applicable	8.4
K1495	996	March 1, 1946	Not Applicable	10.4
KRL246	997	March 1, 1946	Not Applicable	15.0
KRL247	998	March 1, 1946	Not Applicable	17.9
K1497	999	March 1, 1946	Not Applicable	13.5
KRL11481	1446	November 1, 1941	Not Applicable	4.2
KRL11482	1447	November 1, 1948	Not Applicable	6.9
KRL11483	1448	November 1, 1941	Not Applicable	12.2
KRL11487	1452	November 1, 1941	Not Applicable	15.3
K954 (recorded as KRL 18152)	1977	January 1, 1947	Not Applicable	6.9
K955 (recorded as KRL 18515)	1978	January 1, 1947	Not Applicable	4.3
KRL18457	2449	January 1, 1950	Not Applicable	7.9
KRL18735	2450	January 1, 1950	Not Applicable	20.9
Licenses of Occupation (Water Portion) MLO Number				
KRL2155	3186	August 1, 1945	Not Applicable	9.9
KRL2156	3187	August 1, 1945	Not Applicable	13.7
K1498	3289	October 1, 1945	Not Applicable	11.0
K1499	3290	October 1, 1945	Not Applicable	2.4
K1493	3370	March 1, 1946	Not Applicable	5.0
K1494	3371	March 1, 1946	Not Applicable	18.7

KRL or K Numbered Block(s)	Number	Start Date	Expiry Date	Hectares
K1495	3372	March 1, 1946	Not Applicable	10.1
K1497	3380	March 1, 1946	Not Applicable	6.1
KRL246	3381	March 1, 1946	Not Applicable	4.3
KRL247	3382	March 1, 1946	Not Applicable	4.5
KRL11483	10495	November 1, 1941	Not Applicable	6.7
KRL11482	10496	November 1, 1948	Not Applicable	5.6
KRL11481	10497	November 1, 1941	Not Applicable	14.1
KRL11487	10499	November 1, 1941	Not Applicable	5.7
KRL11038-39 (recorded as KRL18377)	10830	January 1, 1947	Not Applicable	28.7
KRL11031 (recorded as KRL18519	10834	January 1, 1947	Not Applicable	17.9
K954 (recorded as KRL18152)	10835	January 1, 1947	Not Applicable	9.3
K955 (recorded as KRL18515)	10836	January 1, 1947	Not Applicable	10.0
KRL18514	10952	October 1, 1947	Not Applicable	17.5
KRL18735	11111	January 1, 1950	Not Applicable	12.2
KRL18457	11112	January 1, 1950	Not Applicable	11.0
KRL18373	11114	January 1, 1950	Not Applicable	7.7
KRL18374	11115	January 1, 1950	Not Applicable	19.7
KRL18375	11116	January 1, 1950	Not Applicable	22.9
KRL18376	11117	January 1, 1950	Not Applicable	15.0
Staked Claim				
KRL4229741	N/A	June 22, 2009	June 22, 2022	1.0
Total Area				**510.4**

1. The total hectares may not add up due rounding.



LEGEND

- Phoenix Gold Property
- Lease
- Licence of Occupation
- Patented Land
- Staked Claim
- Rubicon Minerals Ground
- Phoenix Gold Project
- Primary Roads
- Secondary Roads
- Teritary Roads
- Lake

0 500 1,000

1:25,000 METRES

NOTE(S)

REFERENCE(S)
DATUM: NAD 83 UTM ZONE 15

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
PHOENIX PROPERTY LAND TENURE

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	4-2

4.2 Underlying Agreements

Rubicon's 100% interest in the property was acquired in two separate agreements entered into with Dominion Goldfields Corporation (Dominion Goldfields) in 2002. The 25 Mining Licences of Occupation and the one Mining Lease were optioned from Dominion Goldfields in January 2002 by agreeing to pay CAD$800,000 in cash, issue 260,000 shares to Dominion Goldfields, and complete US$1,300,000 of exploration work prior to March 31, 2006. During 2004, Rubicon acquired the Mining Licences of Occupation and Mining Lease from Dominion Goldfields after meeting all the required payments and expenditures. The Mining Licences of Occupation and the Mining Lease were subsequently transferred to Rubicon.

The water portions of the property, except the Staked Claim, are subject to a NSR royalty to Franco-Nevada Corporation of 2%. Franco-Nevada Corporation purchased the NSR royalty from Dominion Goldfields (DGC) in August 2011. Advance royalties of US$50,000 are due annually to a maximum of US$1,000,000 prior to commercial production of which a cumulative US$750,000 was paid by Rubicon to January 1, 2018. Rubicon has the option to acquire a 0.5% NSR royalty for US$675,000 at any time, however, this option is subject to a right of first refusal, whereby, a third party has the initial right to exercise this option, in which case the NSR royalty to Franco-Nevada Corporation would be reduced to 1.5%. Upon a positive production decision, Rubicon would be required to make an additional advance royalty payment of US$675,000. Rubicon has confirmed that the annual payments are up to date.

The mining rights of the Patented Claims were optioned from Dominion Goldfields in June 2002 and the rights pertaining to surface claims of the same patented claims were optioned from Dominion Goldfields subsidiary 1519369 Ontario Ltd.

The surface rights of the Patented Claims are owned by 0691403 B.C. Ltd, a wholly owned subsidiary of Rubicon. On October 25, 2011, Rubicon announced that by execution of its right of first refusal under its agreement with DGC, it had acquired and thereby extinguished all royalties on the blocks covering the land portions of the property. On closing the agreement, Rubicon issued a total of 1,216,071 of its common shares to Dominion Goldfields, at a deemed price per share of CAD$3.50, for total consideration of C$4,256,249.

On February 10, 2014, Rubicon entered into a US$75 million gold streaming agreement (the "Streaming Agreement") with Royal Gold Inc. and its affiliate, RGLD Gold AG. On May 12, 2015, Rubicon entered into a US$50 million secured loan agreement (the "Loan Agreement") with CPPIB Credit Investments Inc., a wholly-owned subsidiary of Canada Pension Plan Investment Board.

On December 20, 2016, following the completion of the restructuring of Rubicon, the amount outstanding under the Loan Agreement was reduced to CAD$12 million and the Streaming Agreement was exchanged in part for a 1.0% NSR royalty on all tenure (Patented, Lease, Mining Licences of Occupation and the staked claim) of the Phoenix Property granted to RGLD Gold AG through a royalty agreement (the "Royalty Agreement").

Pursuant to the Loan Agreement (CPPIB) and the Royalty Agreement (RGLD GOLD AG), the mining lease, owned patented claims, licences of occupation and the staked claim of the Phoenix property are subject to charges/mortgages in favour of CPPIB and RGLD Gold AG, respectively.

4.3 Permits and Authorization

Rubicon currently holds all material permits required for it to carry out its drilling, underground exploration, development initiatives, and is substantially permitted for potential future production on the Phoenix Gold Project at an annual average rate of 1,250 tonnes per day (t/d). The industrial sewage Environmental Compliance Approval (ECA) contains several clauses that would need to be fulfilled prior to any potential commencement of commercial production. Further amendments to some of these permits would be required for any potential future increases to the currently authorized production rate. Please note that the Rubicon Gold Project is in the development stage and there are no current Mineral Reserves defined for the Project and that future production is not supported by a current preliminary economic assessment, pre-feasibility or feasibility study.

A full list of permits and applications, including their current statuses, is provided in Section 24.

4.4 Environmental Considerations

The current and potential production phase environmental liabilities associated with the Project site are described in the Phoenix Gold Project Closure Plan (June 2016), filed with the Ontario Ministry of Northern Development and Mines pursuant to Part VII of the *Mining Act*. There are no significant physical stability liabilities associated with the Project site and chemical stability issues are limited to two areas that may require excavation and the removal of contaminated soil. Financial assurance has been provided to the Government of Ontario by Rubicon to rehabilitate all identified features of the Project site in accordance with the *Mining Act*.

4.5 Mining Rights in Ontario

The Phoenix Gold Project is located in the province of Ontario, a jurisdiction that has a well-established permitting process. This process is coordinated between the municipal, provincial and federal regulatory agencies. As is the case for similar mine developments in Canada, the Project is subject to federal and provincial environmental assessment process. Due to the complexity and size of such projects, various federal and provincial agencies have jurisdiction to provide authorizations or permits that enable Project construction to proceed.

Federal agencies that have significant regulatory involvement include the Canadian Environmental Assessment Agency, Environment and Climate Change Canada, Natural Resources Canada, and Fisheries and Oceans Canada.

On the Ontario provincial agency side, the Ministry of Northern Development and Mines, Ministry of Environment and Climate Change, Ministry of Transportation, and the Ministry of Natural Resources and Forestry each have key Project development permit responsibilities.

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

5.1 Accessibility

The Phoenix Gold Project is centered within the Red Lake area of northwestern Ontario, approximately 565 km by road (430 km direct) northwest of Thunder Bay and approximately 475 km by road (265 km direct) east-northeast of Winnipeg, Manitoba. Red Lake can be reached via Highway 105, which branches off the Trans-Canada Highway 17 some 170 km south of Red Lake. Red Lake is also serviced with daily flights from Thunder Bay and Winnipeg. Bus service is available from Dryden, Ontario 3 days per week.

The Project site is accessible via 8 km of all-weather road from Nungesser Road in the community of Balmertown, part the Municipality of Red Lake (Figure 4-1).

5.2 Local Resources and Infrastructure

The Red Lake Municipality is comprised of six communities: Red Lake, Balmertown, Cochenour, Madsen, McKenzie Island, and Starratt Olsen. The Canada Census performed in 2016 indicates a population of 4,107 for the area. Mining is the primary industry and employer; other industries include small scale logging, and tourism focused on hunting and fishing. All services expected in a municipality of this size are present, including a hospital and medical clinic.

The Phoenix Gold Project site is currently supplied by a 10.4 km power transmission line connected to Hydro One's 44,000 Volts (44kV) M6 feeder in the Red Lake Transformer Station. There are two (parallel connected) 18 MVA transformers in the main substation (one main, one back up) as well as 2 MW of diesel, emergency power generation capacity. On site distribution reduces voltage to 4,160 (V) for surface and underground. Further voltage step downs are utilized locally as required for specific equipment installations.

Mine water supply is from the nearby East Bay of Red Lake. The water is piped underground via a water line for drilling use, muck pile watering, etc. A potable water plant is fully commissioned and operating at the processing plant. A second treatment plant is located at the camp area, although this area is not currently operational. Rubicon has all the surface rights required to conduct its potential operations at the Phoenix Gold Project, and has access to local and fly-in, fly-out workers. Workers requiring accommodations in the area are currently housed offsite.

5.3 Climate

The climate in this portion of northwestern Ontario is considered subarctic with temperature extremes generally ranging from winter lows of approximately -45 degrees Celsius (ºC) to summer highs of roughly 30ºC. Average winter temperatures are in the range of -15ºC to -20ºC and average summer temperatures are in the range of 15ºC to 20ºC. Between 1971 and 2000, annual average precipitation was measured at 686mm, with the greatest majority being received as rainfall in the summer and fall months (May to October). Mean annual rainfall measured 515mm with 171mm equivalent annual average snowfall. Average winter snow depths in the region range from 40 to 50 cm. Weather conditions have minimal impact on underground production, allowing operations to proceed all year long.

5.4 Physiography

The topography within much of the Project is mildly rugged. The elevation is commonly less than 15 m above the level of Red Lake. The topography is dominated by glacially scoured southwest trending ridges, swamps, marshes, small streams, and small- to moderate-sized lakes. Rock exposure varies locally, but rarely exceeds 15% of the surface area and is mostly restricted to shoreline exposures. Glacial overburden depth is generally shallow, rarely exceeding 10 m, and primarily consists of ablation till, minor basal till, minor outwash sand and gravel, and silty clay glaciolacustrine sediments.

Vegetation consists of thick boreal forest composed of black spruce, jack pine, trembling aspen, and white birch. Figure 5-1 illustrates the typical landscape around the Phoenix Gold Project and the associated vegetation.

A portion of the Project is covered by the East Bay of Red Lake with McFinley Island, directly to the north of McFinley Peninsula, representing the largest island on the property. Recent seismic surveys indicate average accumulations of 10 to 20 m of lake sediments and overburden on the lake bottom, with the water depth less than 8.5 m within the property boundary. The location of the tailings storage area and other site infrastructure are covered in Section 24.3.

Figure 5-1: Typical Landscape in the Phoenix Gold Project Area (photo courtesy of Rubicon)

6.0 HISTORY

Information in this section is summarized from a previous technical report prepared by AMC Mining Consultants (2011) and references therein.

Gold was originally reported in the Red Lake area in 1897 by R. J. Gilbert of the Northwestern Ontario Development Company (Parrot 1995). The exploration and mining history of the Red Lake mining district dates to 1925, when significant gold was first discovered by prospector L. B. Howey. The gold bearing veins he discovered were developed into Red Lake's first producing mine – the Howey mine.

The Phoenix Gold property (previously known as the McFinley property) was initially staked and owned by McCallum Red Lake Mines Ltd. in 1922. Between 1944 and 1974, the property was owned by McFinley Red Lake Gold Mines Ltd. (McFinley Red Lake Gold Mines). In 1974, Sabina Industries Ltd. (Sabina) earned a 60% interest in the property. McFinley Red Lake Gold Mines changed its name to McFinley Red Lake Mines Ltd. (McFinley Red Lake Mines) in 1975 and in 1983 by a plan of arrangement, Sabina transferred its 60% in the Project to McFinley Red Lake Mines.

In 1984, McFinley Red Lake Mines joint ventured the Project with Phoenix Gold Mines Ltd. (42.9%) and Coniagas Mines Ltd. (7.1%). This 50% joint venture interest was subsequently repurchased by McFinley Red Lake Mines in 1986 with financial backing from Alexandra Mining Company (Bermuda) Ltd.

Financial difficulties experienced by McFinley Red Lake Mines in 1989 subsequently led to a period of inactivity between 1990 and 2002 with the eventual acquisition of the property by creditors in lieu of unpaid debts. Dominion Goldfields Corporation (Dominion Goldfields) was awarded title to the Mining Licences of Occupation and Mining Lease of the Project in 1999 and 2002 through vesting orders from the Superior Court of Ontario. Dominion Goldfields and its wholly-owned subsidiary, 1519369 Ontario Ltd., were subsequently granted ownership of the mining rights and surface rights respectively by a vesting order of the Superior Court of Ontario in 2002.

Rubicon optioned the property from Dominion Goldfields in two agreements in 2002. The surface rights of the Patented Claims are now owned by 0691403 B.C. Ltd, a wholly-owned subsidiary of Rubicon.

6.1 Historical Exploration

The extensive history of exploration activities on the Project have been described in detail in two previous reports prepared by G. M. Hogg (2002a; 2002b). One report covered the Patented Claims, with the second document discussing historical work completed on the Mining Licences of Occupation and Mining Lease, which comprise the Project.

All historical information regarding property ownership, previous exploration work, and Mineral Resources prepared prior to 2002 is summarized below in Table 6-1.

Table 6-1: Exploration History of the Phoenix Gold Project

Year	Description of Work
1922	Original staking in 1922 undertaken to cover a high-grade silver occurrence on the McFinley Peninsula, the first mineral prospect on record in the area. Trenching, sampling, and shallow drilling was undertaken by McCallum Red Lake Mines Ltd. Wide-spread but erratic gold mineralization was noted in cherty metasedimentary rock on both McFinley Peninsula and McFinley Island.
1941 – 1942	Mineral occurrences were drilled as part of the Wartime Minerals Evaluation program.
1944 – 1946	McFinley Red Lake Gold Mines Ltd. carried out ground magnetic surveys, a 48-borehole drilling program consisting of 167 m (548 feet [ft]) of drilling over the McFinley Peninsula, and a 1,487 m (4,877 ft) drilling program from the ice of Red Lake.
1946 – 1955	Fourteen boreholes (M Series) were completed for approximately 1,585 m (5,200 ft) of diamond drilling.
1955 – 1956	Little Long Lac Gold Mines sank a 130 m (428 ft) vertical shaft on claim KRL 246 and completed 414 m (1,358 ft) of exploratory underground development on two levels.
1974 – 1975	Sabina completed 25 diamond boreholes for approximately 3,048 m (10,000 ft) of drilling on the project; ground magnetic and electromagnetic surveys; and 10 boreholes for approximately 735 m (2,410 ft) of diamond drilling over a portion of the lake properties.
1981 – 1983	Sabina and McFinley Red Lake Mines completed a magnetic/electromagnetic geophysical survey over the McFinley Peninsula area, surface bulk sampling, and 3,672 m (12,046 ft) of surface diamond drilling in 33 boreholes.
1983 – 1984	McFinley Red Lake Mines and Sabina completed seven boreholes for approximately 646 m (2,120 ft) of diamond drilling.
1984 – 1985	An agreement with Phoenix Gold Mines Ltd. allowed the opening of the McFinley Shaft (now called the Phoenix Shaft) and completion of a total of 479 m (1,570 ft) of drifting and crosscutting on the 150 ft (46 m) and 400 ft (122 m) levels. Metallurgical work and mineral processing were carried out. Eighty underground boreholes totaling 1,829 m (6,000 ft) and 69 surface boreholes totaling 10,628 m (34,870 ft) of diamond drilling were completed. Funding difficulties resulted in the Project being placed on temporary standby in February 1985.
1985 – 1987	A total of 1,151 m (3,775 ft) of drifting and crosscutting was carried out on the 150 ft (46 m) and 400 ft (122 m) levels. A total of 7,111 m (23,333 ft) of underground drilling, 9.14 m (30 ft) of raising, and an extensive chip-sampling program were completed. A program of 12,763 m (41,874 ft) of diamond drilling was also completed in 61 surface boreholes.

Year	Description of Work
1987 – 1989	In recognition of a nugget effect in sampling results, a decision was made to proceed with a minimum 15,000-ton bulk sample. A 150-t/d mill and tailings management facility was constructed. Underground development (2,890 m/9,482 ft) continued on the 150 ft (46 m) and 400 ft (122 m) levels, a new 275 level (at 84 m) and on a ventilation raise from the 400 ft (122 m) level to surface. Additional sampling, diamond drilling (8,730 m/28,642 ft), and metallurgical testing were completed. Bulk sampling operations commenced in July 1988 with sampling indicating head grades in the range of 0.25 ounces per ton gold (8.23 g/t Au) from prepared stope areas. Mill design problems, lack of income from bulk sampling, and lack of exploration funding forced the closure of the operation after an estimated 2,500 tonnes of material were milled. Total historical development in drifting, crosscutting and raising is estimated to be more than 5,791 m (19,000 ft). Total historical diamond drilling focused on the McFinley Peninsula area is estimated to be 45,110 m (148,000 ft) from surface and 35,814 m (117,500 ft) from underground. An estimated 54,864 m (180,000 ft) of core is stored on the property.
1999 – 2002	Dominion Goldfields foreclosed on the Mining Licences of Occupation and Mining Lease and was awarded title to the lake portion of the Phoenix Gold Project in 1999 and 2002, respectively. Dominion Goldfields and its subsidiary were subsequently awarded title to the Patented Claims of the Project in 2002.

6.2 Previous Mineral Resource Estimates

Historical and past Mineral Resource Estimates presented in this section have been superseded by the Mineral Resource Estimate discussed herein. The information presented in this section is relevant to provide context but is not current and should not to be relied upon. The QP's responsible for the preparation of this Technical Report have not done sufficient work to classify the historical estimate as current Mineral Resources or Mineral Reserves and Rubicon is not treating the historical estimate as current Mineral Resources or Mineral Reserves.

6.2.1 McFinley Red Lake Mines – 1986

A historical Mineral Resource Estimate was prepared by McFinley Red Lake Mines staff in 1986 (Hogg 2002a; Hogg 2002b). The McFinley Red Lake Mines historical Mineral Resource is located approximately 400 m west of the F2 gold deposit. The estimate refers to the shaft area located on the McFinley Peninsula where historic underground exploration and development, and extensive sampling, were carried out. The shaft area is in stratigraphic units separate to the current F2 gold deposit. The 1986 historical Mineral Resource Estimate was developed using underground sampling results augmented with closely spaced borehole data. The historical resource published in 2002 was 303,006 tonnes (334,007 tons) at a grade of 6.86 grams of gold per tonne [0.20 ounces of Au/ton].

6.2.2 GeoEx Limited – 2010 and 2011

GeoEx Limited (GeoEx) prepared a Mineral Resource Estimate for the F2 gold deposit in 2011 (GeoEx April 11, 2011). The historical Mineral Resource Estimate was calculated using the polygonal resource estimation method, and an Inferred Resource of 5,500,000 tonnes at a grade of 20.34 g/t gold was reported.

6.2.3 AMC Mining Consultants (Canada) Ltd. – 2011

AMC prepared a Mineral Resource Statement (AMC, 2011) for the F2 gold deposit using a block modelling approach based on drilling information available to February 28, 2011 (Table 6-2). The model was not constrained by a crown pillar and was extended to incorporate all drilling data. The Mineral Resource Statement was reported at a cut-off grade of 5.0 g/t gold.

Table 6-2: Mineral Resource Statement, Phoenix Project, AMC Mining Consultant (Canada) Ltd., June 15, 2011

Classification	Million Tonnes	Grade (g/t gold)	Million Ounces of Gold
Indicated	1.028	14.5	0.477
Inferred	4.230	17.0	2.317

Notes:
CIM definitions used for Mineral Resources
Cut-off grade of 5.0 g/t gold applied
Capping value of 270 g/t gold applied to composites
Based on drilling results to February 28, 2011
The 2011 Estimates are not current and should not be relied upon

A total of 511 boreholes were used in the 2011 AMC Mineral Resource Estimate. Rubicon's interpretations of lithologies, mineralization controls, and geology domains were reviewed and accepted by AMC. Twelve mineralized domains were interpreted by AMC using a low gold threshold (0.1 g/t gold) and were further expanded to incorporate all significant mineralized zones.

A composite length of 1.0 m was chosen, and gold composites were capped at 270 g/t gold. The parent block size was 2 m by 8 m by 12 m, and sub blocking was utilized. The model blocks were assigned a gold grade using an inverse distance (power of three) estimator and a three-pass search strategy with search ellipsoids adjusted to the geometry of the modelled gold mineralization. Search parameters for the first pass were 8 m by 24 m by 36 m. for the second and third pass the search volumes were inflated by two and three times, respectively. An average bulk density value of 2.90 tonnes per cubic metre (t/m^3) was used for all rock types.

Blocks were classified considering data support as a main criterion with a manual review creating volumes based on borehole density and number of samples to inform a block.

6.2.4 SRK Consulting (Canada) Inc. – 2013

SRK (2013b) prepared a Mineral Resource Statement for the F2 gold deposit using a block modelling approach based on drilling information available to October 31, 2012. The database included information from 820 core boreholes (355,611 m), all drilled by Rubicon since 2008. The model was not constrained vertically by a crown pillar. The Mineral Resource Statement was reported at a cut-off grade of 4.0 g/t gold (Table 6-3).

Table 6-3: Mineral Resource Statement*, Phoenix Gold Project, Ontario SRK Consulting (Canada) Inc., June 24, 2013

Domain	Resource Category	Quantity (000 t)	Grade (Au (g/t)	Contained Gold 000 Ounces
Main*	Measured	-	-	-
	Indicated	4,120	8.52	1,129
	Measured + Indicated	4,120	8.52	1,129
	Inferred	6,027	9.49	1,839
HW	Measured	-	-	-
	Indicated	-	-	-
	Measured + Indicated	-	-	-
	Inferred	151	5.21	25
External	Measured	-	-	-
	Indicated	-	-	-
	Measured + Indicated	-	-	-
	Inferred	1,274	8.66	355
Combined	Measured	-	-	-
	Indicated	4,120	8.52	1,129
	Measured + Indicated	4,120	8.52	1,129
	Inferred	7,452	9.26	2,219

Notes:
*Mineral Resources are not mineral reserves and do not have a demonstrated economic viability. All figures have been rounded to reflect the relative accuracy of the estimates. Reported at a cut-off grade of 4.0 g/t gold and assuming an underground extraction scenario, a gold price of US$1,500 per ounce, and metallurgical recovery of 92.5%. The Main domain includes the Main 45 domain. The 2013 Estimates are not current and should not be relied upon.

The gold mineralization wireframes were defined using an explicit wireframe interpretation constructed from a sectional interpretation of the drilling data that took into consideration structural geology investigation and modelling undertaken by SRK in collaboration with Rubicon. Resource domains were defined using a 0.5 g/t gold threshold. Within the gold mineralization domains, narrower, higher-grade subdomains were defined using a 3.0 g/t gold threshold. SRK defined 56 gold mineralization domains (31 higher-grade and 25 lower grade domains) that were used to constrain Mineral Resource modelling. These 56 domains were combined into three groups based on their spatial orientation: Main, Main 45, and Hanging Wall (HW). Also, the gold mineralization located outside the modelled domains was evaluated unconstrained.

Four rotated sub-celled block models were generated with block sizes and orientation specific to the mineralization domain grouping. SRK chose a primary 2.5 m by 5 m by 10 m dimension for the Main and Main 45 domains, a 10 m by 20 m by 20 m dimension for the HW domain and a 5 m by 10 m by 20 m dimension for the External domain.

Sample assay data were composited to a 1.0 m length and extracted for geostatistical analysis and variography. The impact of gold outliers was examined on composites using log probability plots and cumulative statistics. SRK evaluated the spatial distributions of the gold mineralization using variograms and correlograms of original capped composited data as well as the normal score transform of the capped composited data. The block model was populated with a gold grade using ordinary kriging. Three estimation runs were used, each considering increasing search neighborhoods and less restrictive search criteria. The first estimation pass considered search neighborhoods adjusted to 80% of the modelled variogram ranges. A uniform specific gravity of 2.87 t/m^3 was applied to the lower grade domains and a value of 2.96 t/m^3 was assigned to the higher grade domains to convert volumes into tonnages.

6.2.5 SRK Consulting (Canada) Inc. – 2016

The 2016 Mineral Resource Estimate (SRK 2016) was based on a revised geological model that considered information from 94,575 m of new infill core drilling information acquired since October 31, 2012, the cut-off date for the previous SRK Mineral Resource evaluation. The Mineral Resource reported included drilling information available to November 1, 2015. In addition, the Mineral Resource Estimate considered information on geological continuity gained from excavated underground workings exposing the gold mineralization on several levels and in test stopes. The 2016 Mineral Resource Estimate represents the third Mineral Resource Statement (the second by SRK) prepared for this Project.

The Mineral Resources were evaluated using a geostatistical block modelling approach constrained by 71 explicit gold mineralization wireframes interpreted using a 3 g/t gold cut-off grade (HG) and enclosed in 19 explicit gold mineralization wireframes derived using a 0.5 g/t gold cut-off grade (LG). The HG domains were constructed as explicit wireframes using interval selections of assay data while the broad LG domains were constructed with polylines on vertical sections. The domains were not modelled as grade interpolants.

Assay statistics were assessed for each domain separately and capping was applied to samples prior to compositing. Capping values were chosen based on a combination of probability plots, decile analysis, capping sensitivity plots, and 3D visualization to determine the capping values. Capping in the HG domains range from 10 to 120 g/t gold, and in the LG domains range from 5 to 45 g/t gold. Gold and capped assay data were composited to a 1.0 m length and extracted for geostatistical analysis and variography.

SRK evaluated the spatial distributions of the gold mineralization using traditional semi-variograms and traditional correlograms of composited data as well as the normal score transform of the composited data.

A block model was generated with a block size of 2.5 m by 5 m by 5 m with subcells at 0.5 m resolution used to honor the geometry of the modelled mineralization. The block model was populated with a gold grade using ordinary kriging. Three estimation runs were used, each considering increasing search neighborhoods and less restrictive search criteria. A spatial restriction was applied to high grade composites to further restrict their influence during estimation.

In the F2 gold deposit, higher grade gold mineralization was associated with crosscutting, east-west trending D2 structures, while the plunge of the gold mineralization within a given domain is controlled by the line of intersection between the domain and the crosscutting structure. Using the dynamic anisotropy function in Datamine Studio 3, polylines were used to assign an estimated dip and dip direction for each cell of that HG domain in the block model based on those intersections.

Based on specific gravity measurement of core samples, a mean specific gravity value for the domain type and lithology was assigned to blocks to convert volumes into tonnages. The specific gravity of lithology and mineralization domains varied from 2.76 to 2.90 t/m^3.

SRK considered that blocks within the HG domains estimated during the first estimation pass, informed from composites from at least three boreholes from five octants and located within the full range of the variogram for that domain, could be classified in the Indicated category within the meaning of the CIM Definition Standards for Mineral Resources and Mineral Reserves (November 2010). SRK considered that for those blocks the level of confidence was sufficient to allow the appropriate application of technical and economic parameters to support mine planning and to allow the evaluation of the economic viability of the deposit. Conversely, all other modelled blocks were classified in the Inferred category as the confidence in the estimates was insufficient to allow for the meaningful application of technical and economic parameters, or to enable an evaluation of economic viability.

SRK considered that the gold mineralization at the Phoenix Gold Project was amenable to underground extraction. SRK reported the Phoenix Gold Project Mineral Resources at a cut-off grade of 4.0 g/t gold. The 2016 Mineral Resource Statement for the Phoenix Gold Project is presented in Table 6-4. Mineralization excavated by underground development, stoping blocks and in a 40 m crown pillar below the lake bottom has been excluded from the Mineral Resource Statement.

Table 6-4: Mineral Resource Statement*, Phoenix Gold Project, Ontario SRK Consulting (Canada) Inc., January 11, 2016

Resource Category	Quantity (000t)	Grade Au (g/t)	Contained Gold (000 ounces)
Measured	-	-	-
Indicated	492	6.73	106
Measured + Indicated	492	6.73	106
Inferred	1,519	6.28	307

* Notes:
All figures are rounded to reflect the relative accuracy of the estimate. Samples have been capped where appropriate. Underground Mineral Resources reported at a cut-off grade of 4.0 g/t gold assuming a metal price of US$1,125 per ounce of gold and a gold recovery of 92.5%. The 2016 Estimates are not current and should not be relied upon.

6.2.6 Mineral Reserve Estimates

There were no historic Mineral Reserves at the Phoenix Gold Project.

6.3 Past Production

There has been limited past production in the form of lateral development and trial longhole stope mining on the property. Mining exploration activities on the property were terminated in 1989 after test-milling of an estimated 2,500 tonnes of material unrelated to the F2 gold deposit.

Development of the Phoenix Gold Project commenced by Rubicon in 2012 with shaft deepening and mill building foundation work, and followed by the establishment of levels and associated infrastructure at the 122 m, 183 m, 244 m, 305 m, 488 m, and 610 m levels.

In 2015, Rubicon started trial stoping on the 305 m level. Subsequent trial stoping followed on the 183 m and 244 m levels. Typical development followed mineralized material, via Alimak raising, lateral sill and sublevel

advance. Test production of three longhole stopes was completed on the 305 m and 244 m levels. The 244-159, 244-977 and 305-030 stopes were mined, skipped to surface, and processed at the Rubicon mill facility on site.

Rubicon processed 57,793 dry tonnes of mineralized material, grading at 3.02 g/t gold. Rubicon achieved an average mill recovery of 91.9% and produced 5,153 ounces of gold. Underground activities were suspended on November 3, 2015 and milling ceased on November 21, 2015.

7.0 GEOLOGICAL SETTING AND MINERALISATION

7.1 Regional Geology

The following description of the geology of the Red Lake Greenstone Belt was modified from Sanborn-Barrie et al. (2004) and the references therein.

The Phoenix Gold Project is located in the Uchi Subprovince of the Superior Province of the Canadian Precambrian Shield. Within the Uchi Subprovince, the Red Lake Greenstone Belt is host to one of Canada's preeminent gold districts having produced more than 29 million ounces of gold since the 1930s.

The Red Lake Greenstone Belt is interpreted to have been formed on the southern margin of the North Caribou Terrane, an ancient Mesoarchean continental block of approximately 3 Ga years that makes up part of the southern Uchi Subprovince (Figure 7-1 & Figure 7-2). The Red Lake Greenstone Belt was formed and evolved as the result of extensive magmatic and sedimentary activity as well as multiple events of intense deformation, metamorphism, hydrothermal alteration and gold mineralization that occurred between 3.0 to 2.7 billion years before present (Ga). Regional metamorphic assemblages indicate that peak metamorphism corresponded to greenschist and amphibolite grades.

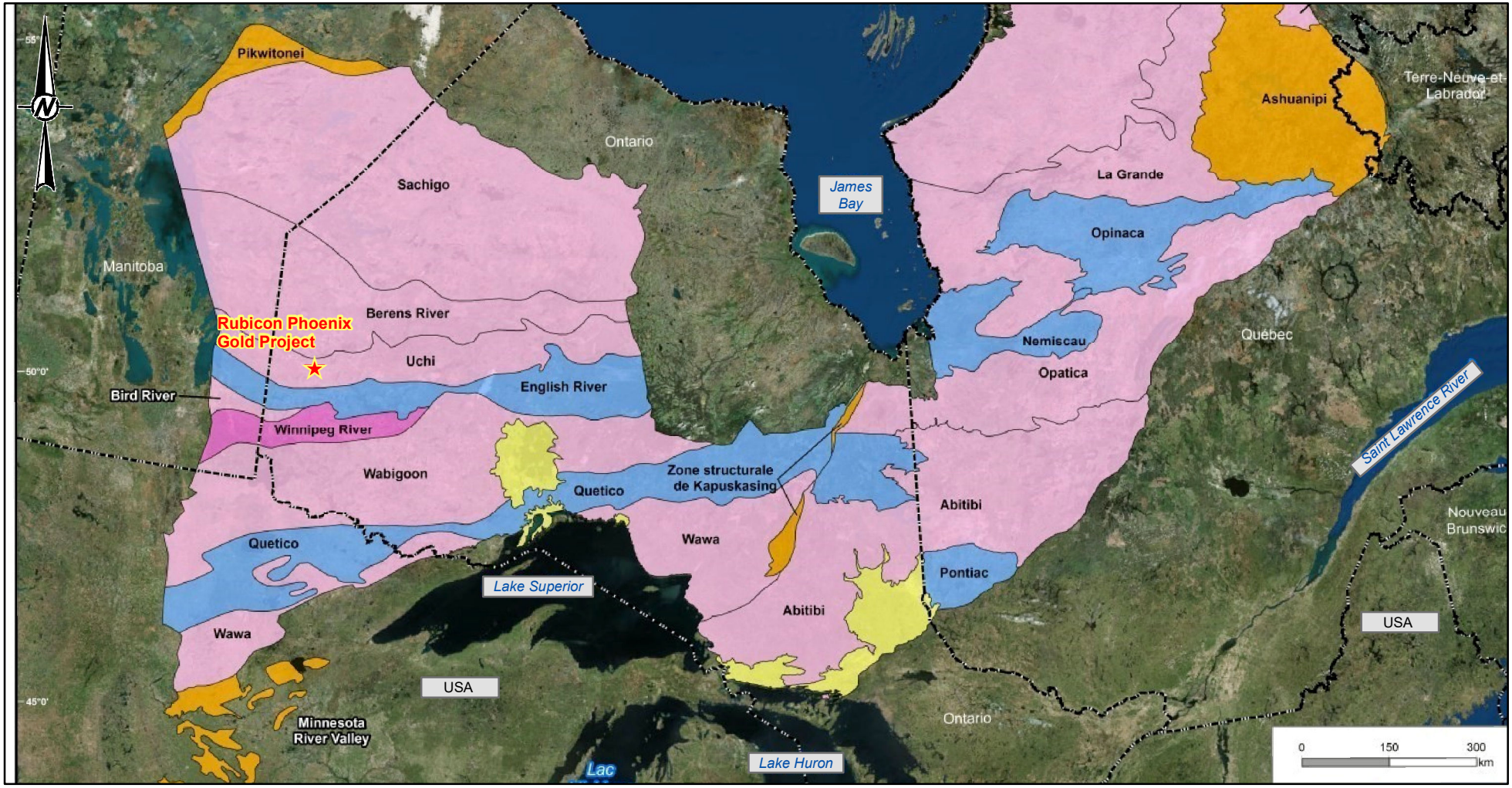
The regional geology of the Red Lake Belt is shown on Figure 7-3 and it is described in the following paragraphs, proceeding from the oldest to the youngest stratigraphic assemblages.

Rocks of the Mesoarchean Balmer Assemblage, the oldest stratigraphic assemblage in the Red Lake Greenstone Belt host all the major gold producers in the Red Lake District. The Balmer Assemblage is dated between circa (ca.) 3000 and 2988 million years before present (Ma) and it includes volcanic units composed of komatiite, komatiitic basalt and tholeiitic basalt as well as lesser amounts of peridotitic and gabbroic intrusive rocks, felsic volcanics, iron formation and clastic sedimentary rocks.

Underlying the northwestern portion of the Red Lake Greenstone Belt is the Ball Assemblage (ca. 2940 Ma to ca. 2925 Ma), consisting predominantly of a thick sequence of metamorphosed intermediate to felsic calc-alkaline volcanic flows and pyroclastic rocks, and lesser amounts of mafic to ultramafic volcanics and peridotitic to gabbroic intrusive rocks.

The Slate Bay Assemblage (ca. 2903 Ma to ca. 2850 Ma) extends the length of the belt and consists of clastic sedimentary rocks including several lithological facies; conglomerates, quartzose arenites, wackes and mudstones. The contact of the Slate Bay Assemblage with the underlying Ball and Balmer assemblages represents an unconformity (Figure 7-3).

PATH: D:\1671445 Rubicon\3-ArcGIS\MapFiles\1671445_NI43-101_Figures\Fig7-1_TectonicSubdivisionMap_AnsiA_Land.mxd PRINTED ON: 2018-06-04 AT: 9:15:36 AM



LEGEND

- Metamorphic Subprovince
- Metasedimentary Subprovince
- Plutonic Subprovince
- Volcano-Plutonic Subprovince
- Southern Province

NOTE(S)

REFERENCE(S)
SOURCE: GQ.MINES.GOUV.QC.CA

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
SUPERIOR PROVINCE SUBDIVISIONS MAP

PROJECT NO.	CONTROL	REV.	FIGURE
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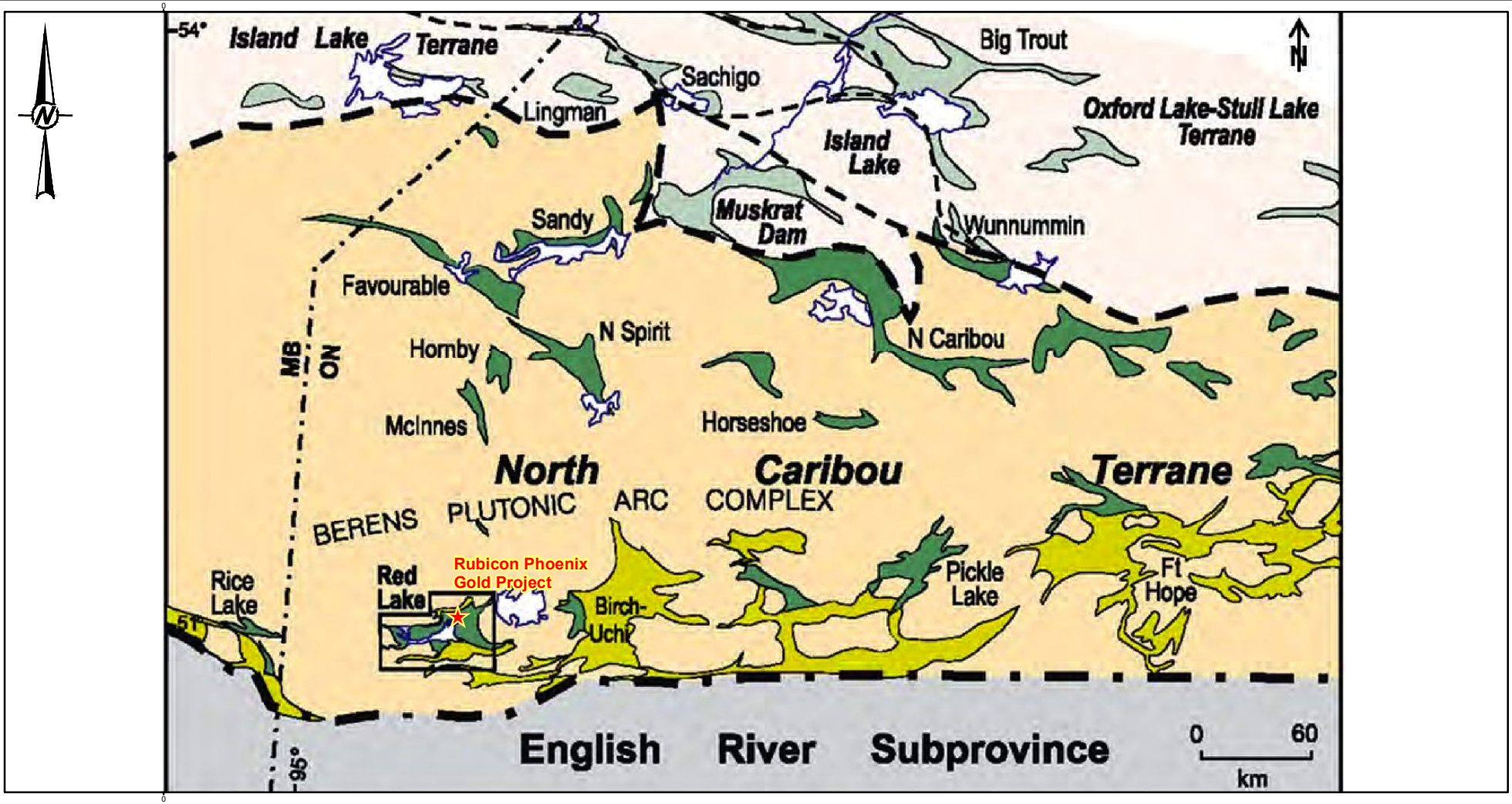

LEGEND

North Caribou Terrane

- Mesoarchean Volcanic Rocks
- Neoarchean Volcanic Rocks
- Undifferentiated Granitoid Rocks

Island Lake-Oxford-Stull Terranes

- Supracrustal Rocks - undifferentiated
- Plutonic Rocks – undifferentiated

English River Subprovince

- Migmatitic Sedimentary Rocks & Associated Granitoids

NOTE(S)

REFERENCE(S)
SOURCE: SANBORN-BARRIE ET AL. (2004)

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
GEOLOGY OF THE NORTH CARIBOU TERRANE OF THE SUPERIOR PROVINCE

PROJECT NO.	CONTROL	REV.	FIGURE
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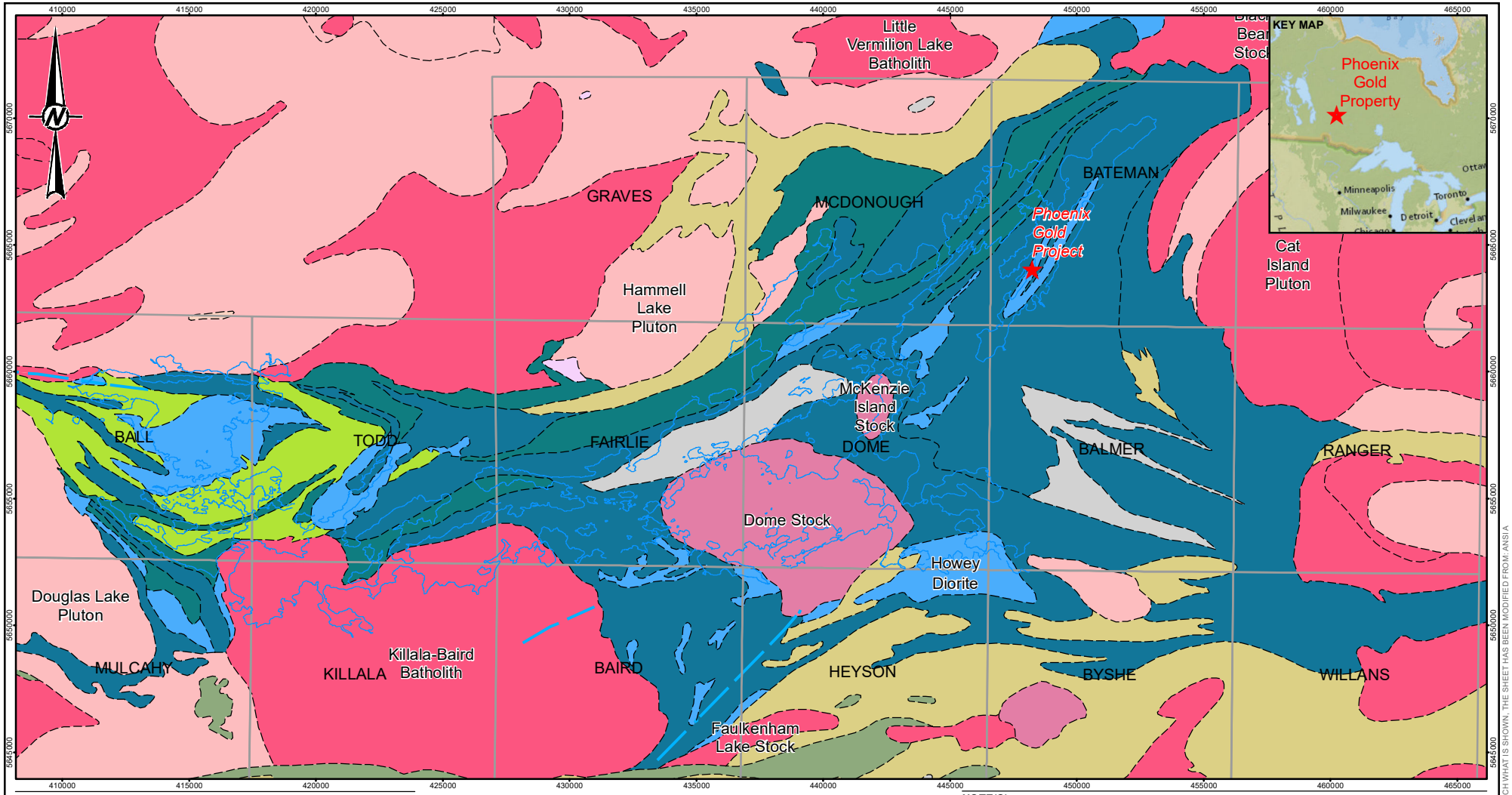

NEOARCHEAN

- Late- to post tectonic granite
- Pre-/syntectonic felsic intrusions
- Synvolcanic intermediate intrusions

Supracrustal Assemblages

- Graves
- Huston (cglm/wacke/argl)
- *unconformity*
- Confederation (McNeely, Heyson)

MESOARCHEAN

- Ultramafic, diorite

Supracrustal Assemblages

- Trout Bay
- Bruce Channel
- Slate Bay
- *unconformity*
- Ball
- Balmer

0 5,000 10,000

1:225,000 METRES

NOTE(S)

SOURCE: MODIFIED FROM DUBE ET AL. (2004)
HTTP://WWW.GEOLOGYONTARIO.MNDM.GOV.ON.CA/INDEX.HTML

REFERENCE(S)

DATUM: NAD 83 UTM ZONE 15

CLIENT

RUBICON MINERALS

CONSULTANT

GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT

PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE

REGIONAL GEOLOGY MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	7-3

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The Bruce Channel Assemblage (ca. 2894 Ma) is composed of a thin sequence of calc-alkaline dacitic to rhyodacitic pyroclastic rocks overlain by an upward-fining sequence of clastic sedimentary rocks and chert-magnetite iron formation. Trace element profiles of the calc-alkaline volcanic rocks relative to the Balmer Assemblage are interpreted to indicate crustal growth at a juvenile continental margin.

The Trout Bay Assemblage (ca. 2853 Ma) is exposed in the southwest portion of the Red Lake Greenstone Belt. It is a volcano-sedimentary sequence consisting of a lower tholeiitic basalt unit overlain by clastic sedimentary rocks that are interbedded with an intermediate tuff unit and a chert-magnetite-iron formation.

Deposition of the Confederation Assemblage followed a pause in volcanic activity of approximately 100 million years. The Confederation Assemblage represents a time of widespread Neoarchean calc-alkaline volcanism (ca. 2748 to ca. 2739 Ma). The McNeely sequence is the oldest unit of the Confederation Assemblage; it formed during shallow marine to subaerial arc volcanism and was deposited upon the existing Mesoarchean continental margin. The McNeely sequence is overlain by and interstratified with the tholeiitic Heyson volcanic sequence that is thought to have formed during a period of intra-arc extension. In the Madsen area, an angular unconformity at the base of the Confederation Assemblage is indicated by opposing facing directions of units belonging to the Confederation and Balmer assemblages, suggesting the Balmer Assemblage was overturned prior to the deposition of the Confederation Assemblage.

The Huston Assemblage (dated between ca. 2742 and ca. 2733 Ma) is represented by fine to coarse-grained clastic sedimentary units including conglomerate, wacke, siltstone and argillite that unconformably to conformably overlie the McNeely sequence of the Confederation Assemblage. The Huston Assemblage has been compared to the Timiskaming conglomerates commonly associated with gold mineralization in the Timmins camp of the Abitibi Greenstone Belt (Dubé et al. 2003).

The Graves Assemblage (ca. 2733 Ma) represents a period of calc-alkaline volcanism dominated by andesitic to dacitic pyroclastic tuff. The rocks of this assemblage overlie and are locally transitional with the underlying Huston Assemblage.

Plutonic rocks in the Red Lake Greenstone Belt are temporally and in some cases petrologically correlated with the periods of magmatism recorded by the volcanic units belonging to the above-described assemblages. The plutonic units include mafic to ultramafic intrusions associated with the Balmer and Ball Assemblages, gabbroic sills with chemical affinities to the basalts of the Trout Bay Assemblage, small volumes of felsic dykes and diorite intrusions associated with the Confederation Assemblage, and intermediate to felsic plutons, batholiths and stocks coeval with the Graves Assemblage. Post-volcanism plutonic activity is represented by granitoid rocks such as the McKenzie Island stock, Dome stock, and Abino granodiorite (ca. 2720 Ma to ca. 2718 Ma) that host past producing gold mines. The last magmatic event recorded in the belt occurred ca. 2700 Ma and is represented by a series of potassium-feldspar megacrystic granodiorite batholiths, including the Killala- Baird Batholith, as well as some other granitoid plutons and dykes. Structurally, the Red Lake Greenstone belt underwent continental collision (the Kenoran Orogeny), ca. 2.72 Ga to 2.71 Ga, which led to multiple episodes of intense hydrothermal alteration, deformation, metamorphism, and gold mineralization (Dube et al. 2003). The belt records several episodes of deformation interpreted to be closely linked with intensive hydrothermal activity and gold mineralization. Current regional interpretations of the Red Lake area identify three main deformation events:

- D1: Regional NW-SE shortening, resulting in NE-SW striking folds, thrust faults, thrust related strike-slip faults, quartz veins and penetrative regional foliation (S1) fabric.

- D2: Regional NE-SW shortening resulting in development of pre- to syn-mineralization oblique strike slip fault systems and a fold overprint of the earlier D1 deformation. During D2 deformation in the East Bay area, oblique dextral strike slip faults re-activated D1 thrust faults and associated D1 strike slip faults along a zone of crustal weakness inherited from earlier D1 faulting.
- D3: Regional-scale folding resulting in open folding of D1 and D2 structural features.

7.2 Phoenix Property Geology

The stratigraphy in the East Bay area (Figure 7-4), where the Phoenix Gold Project is located, comprises submarine tholeiitic basalt, komatiite and komatiitic basalt with minor felsic intrusive volcanic rock, iron formation and fine-grained clastic metasedimentary rocks all of which constitute the Balmer Assemblage. Extensive mapping, trenching, core drilling, and geophysical surveys have defined a consistent geological sequence that can be correlated along the length of the property for over 4 km. A summary of the stratigraphic units found within the Project area is shown in Table 7-1 and Figure 7-4.

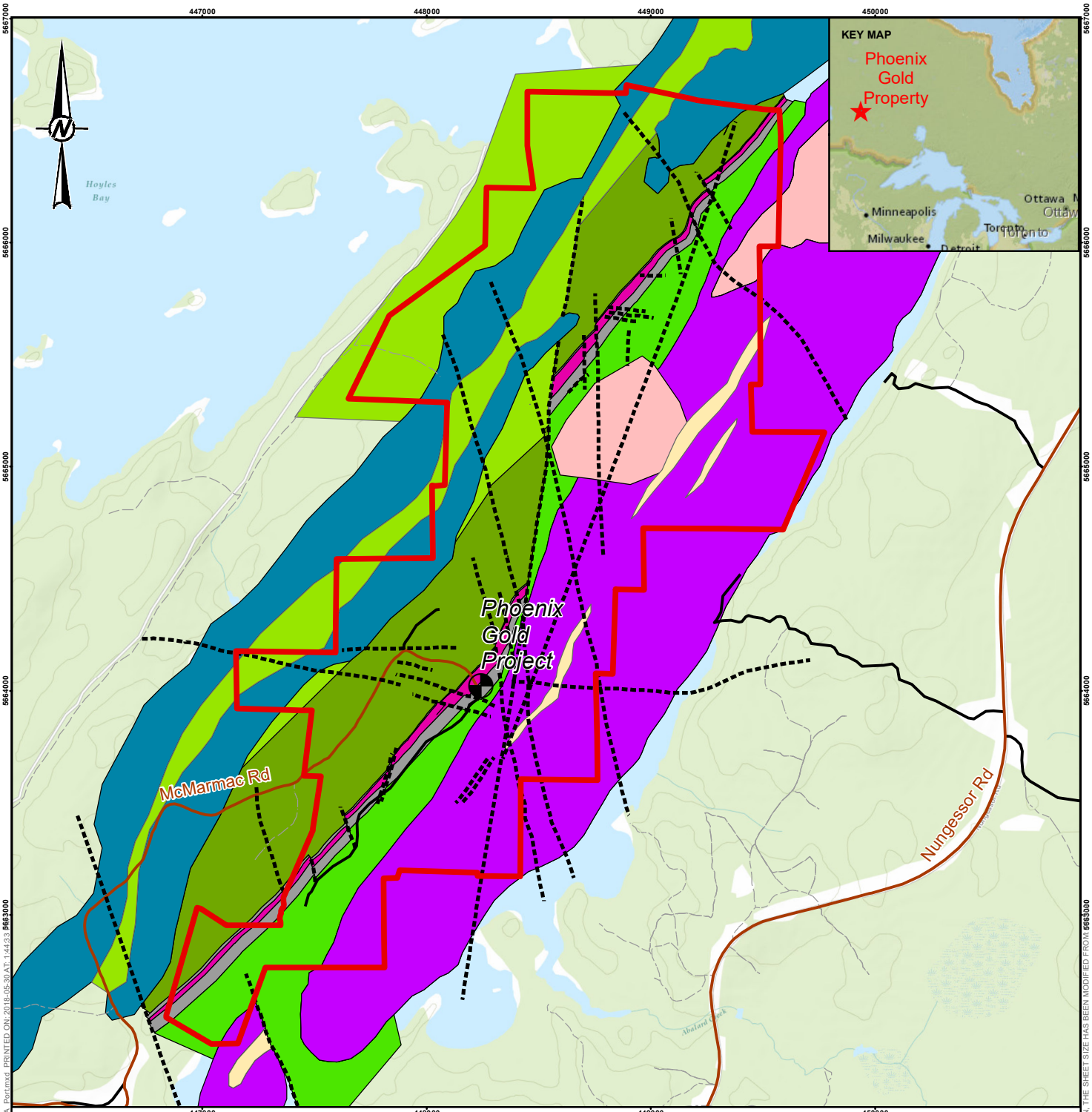
Table 7-1: Summary of Phoenix Gold Project Area Stratigraphy

Sequence	Stratigraphy
West Peninsula Sequence	Pillowed to massive basalts with banded iron formation (BIF), graphitic BIF and chert, banded silty to arenaceous sedimentary rocks and significant pyrite/pyrrhotite.
Central Basalt Sequence	Pillowed and massive tholeiitic basalts with flow top breccias occasional BIF and (graphitic) argillite.
Intrusive Komatiite Sequence	Massive, spinifex, and columnar jointed basaltic komatiite bounded by Hanging Wall BIF to the east and by Main BIF to the west. BIF possible in central part of sequence.
McFinley Sequence	Bounded to the west by Hanging Wall BIF and to the east by the Footwall BIF. At least five horizons of silica/oxide (carb.) facies BIF within pillowed and amygdaloidal basalt.
Hanging Wall Basalt Sequence	Pillowed to massive, amygdaloidal basalts. Variably carbonate altered, variable foliation.
East Bay Serpentinite[1]	Extrusive and intrusive ultramafic rocks. Variable talcose alteration.
High-Titanium Basalt[2] (High-Ti Basalt)	Variable biotite alteration, sulphides (pyrite, pyrrhotite). Silica flooding, quartz breccia, and quartz veining throughout. The High-Ti Basalt is the principal host to gold mineralization in the F2 gold deposit.

[1] Labelled as Ultra Mafic on figure 7-4; [2] Unit is observed underground does not outcrop at surface.

The Balmer Assemblage basalt flows are tholeiitic and distinguished from other basaltic sequences in the Red Lake belt by their relatively high TiO_2 contents (commonly greater than 2 wt.%), and as a result the unit is termed High-Ti Basalt by Rubicon.

The local geology in the Phoenix Gold Project area comprises a series of N-S trending, steeply dipping to sub-vertical alternating panels of talc-altered komatiitic ultramafic flows (Ultramafic Flows; shown in magenta in Figure 7-5) and biotite and silica altered basaltic mafic volcanic flows (High-Ti Basalt; shown in green in Figure 7-5). Three main panels of High-Ti Basalt are observed, namely the F2 Basalt Zone, West Limb Basalt Zone and the Hanging Wall Basalt Zone; in addition to these three main basalt panels there are other less continuous or less well-defined panels of basalt located in the deposit area. The volcanic units are intruded by a series of quartz-feldspar porphyry felsic dykes and sills (Felsic Intrusive; shown in yellow in Figure 7-5) as well as less abundant intermediate and mafic dykes and sills. The Felsic Intrusive dykes and sills post-date D1 deformation features and are cross-cut by mineralized D2 deformation features.



LEGEND

- Phoenix Gold Property
- Primary Roads
- Secondary Roads
- Teritary Roads
- Lake
- Central Basalt
- Footwall Basalt
- Felsic Intrusive
- Hanging Wall Basalt
- Komatite (Intrusive)
- McFinley Sequence
- Main Iron Formation
- Meta-Gabbro
- Ultra Mafic
- West Penisula Sequence
- Fault

0 500 1,000

1:25,000 METRES

NOTE(S)

REFERENCE(S)
DATUM: NAD 83 UTM ZONE 15

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
PHOENIX GOLD PROJECT GEOLOGY MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	7-4

The East Bay Deformation Zone (EBDZ) is located within the western portion of the deposit, where it forms a north-south (N-S) orientation, steeply dipping to sub-vertical high strain zone localized within the Ultramafic Flow unit (Figure 7-5). Within the Phoenix Gold Project area, the EBDZ forms a distinct boundary between the alternating panels of Ultramafic Flows and High-Ti Basalt units to the east of the structure, and Ultramafic Flows without interlayered High-Ti Basalt to the west of the structure.

The EBDZ may have developed as a D1 thrust fault that was subsequently steepened. Alternatively, the EBDZ may have been initiated as a steeply dipping D1 strike-slip fault. A full re-interpretation of the regional D1 tectonic history is beyond the scope of this Study. The D1 EBDZ fault was later reactivated as a regional dextral shear zone during D2.

The dominant structural fabric present in the Phoenix Gold Project area is an N-S orientation which is steeply dipping to sub-vertical penetrative tectonic foliation (S1) developed during D1 deformation. The S1 foliation is well developed in the talc-rich ultramafic rocks but is generally absent or not observable in the basalt and felsic intrusive units.

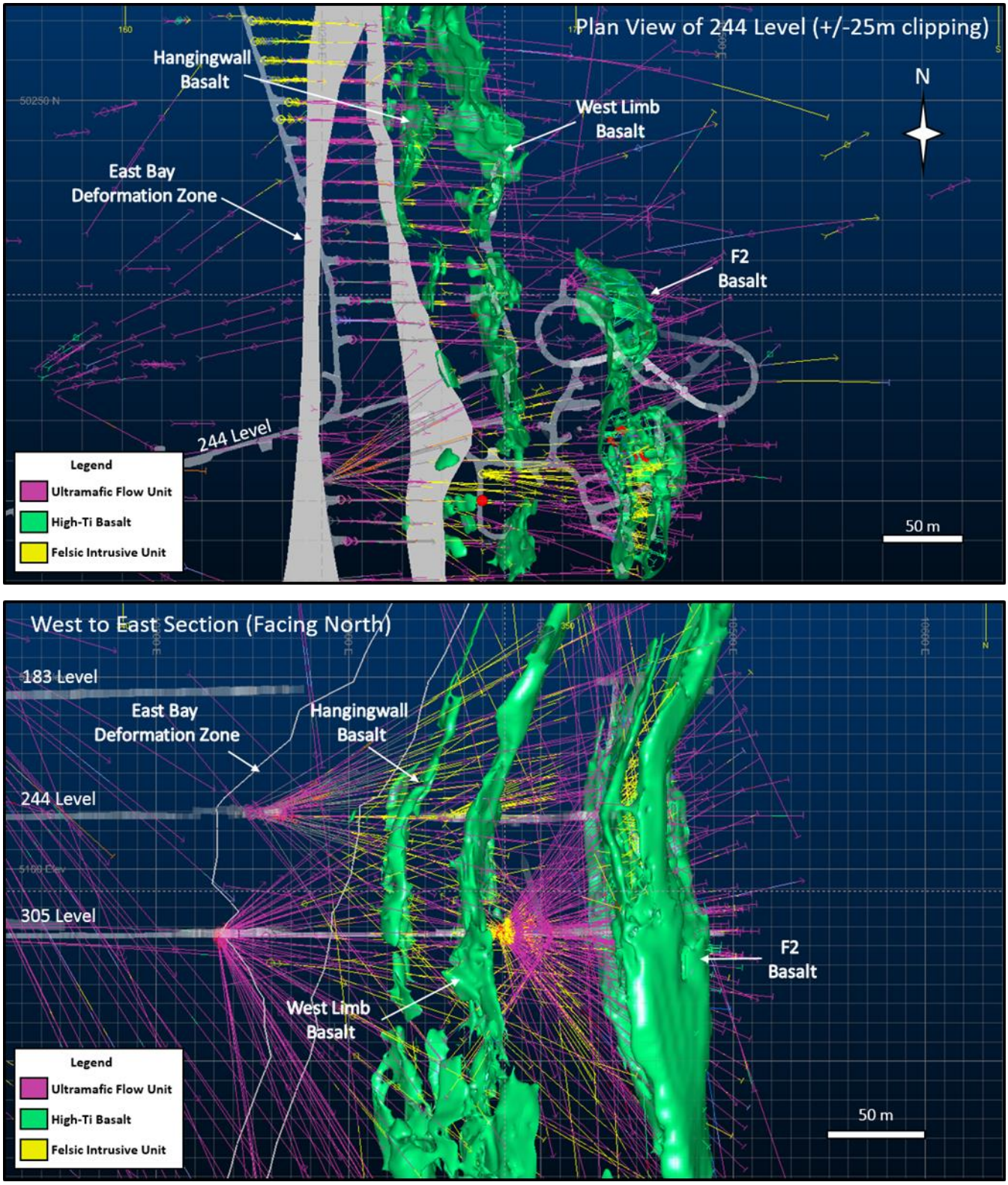


Figure 7-5: Phoenix Gold Project plan and section views

D2 features present in the Phoenix Gold Project area are predominantly mineralized quartz-actinolite veins and discontinuous shear zones and brittle faults produced by dextral transpression along the reactivated EBDZ.

D3 regional folding resulted in gentle folding of the Phoenix Gold Project area stratigraphy along a sub-horizontal N-S oriented fold axis.

7.3 Phoenix Gold Project Mineralization

Gold mineralization occurs primarily within High-Ti Basalt in the form of mineralized quartz-actinolite veins and also occurs in association with disseminated sulphides in the High-Ti Basalt, with lesser mineralization in felsic dykes and sills. Previous studies (SRK 2013a) have identified an earlier low-grade gold mineralization event, with a later overprinting higher-grade gold mineralization event.

The early low-grade gold mineralization event appears to have formed pre- to syn-D1 as the mineralization is overprinted by the S1 foliation. The early phase of mineralization is generally low-grade, with gold grades generally less than 4 g/t, and occurs as quartz-actinolite-sulphide veins and stringers and as disseminated mineralization associated with quartz-biotite-sulphide alteration in the High-Ti Basalt and Felsic Intrusive units.

The higher-grade second mineralization event has been linked to an array of shear-related veins and minor localized shear zones interpreted to have formed as a result of D2 dextral transpression along the EBDZ. The gold mineralization occurs in association with disseminated sulphide mineralization in the High-Ti Basalt and also in gold-bearing quartz-actinolite veins in the High-Ti Basalt and Felsic Intrusive units. The mineralized veins occur in several orientations, with the east striking, steeply-dipping vein arrays being associated with higher grade gold mineralization. East-west (E-W) striking structures are limited to the High-Ti Basalt and Felsic Intrusive; those structures are interpreted as R' shear veins associated with the regional dextral transpression. No regional or through-going deposit-scale E-W structures were identified.

7.4 Deposit Scale Structural Analysis

Golder combined statistical and graphical orientation analysis with 3D geological and structural modelling to evaluate the data and observations from the 2017 structural study for the purpose of updating the structural interpretation and model for the Project. The 2017 structural study focused on the evaluation of structural impacts on the geometry and distribution of the host units to the mineralization, namely the High-Ti Basalt and the Felsic Intrusive, as well as evaluated controls on the distribution of gold mineralization with an aim to identifying potential high-grade domains.

The underground mapping, 2017 drilling program and structural modelling demonstrate that although E-W oriented faults and shear zones do occur within the deposit, they are generally more localized and discontinuous in both their lateral and vertical extents than previously interpreted. They do not appear to represent deposit-scale features. The E-W oriented faults and shear zones are not necessary to explain the geometry and continuity of the N-S oriented High-Ti Basalt and Ultramafic Flow panels and the Felsic Intrusive dykes and sills.

The three main panels of basalt in the deposit, namely the F2 Basalt Zone, the West Limb Basalt Zone and the Hanging Wall Basalt Zone are all N-S striking, steeply dipping panels (Figure 7-5). Although they can be followed along strike and down-dip, they are not single continuous panels of basalt but rather they can be broken out into numerous segments in both the N-S and down-dip direction.

The High-Ti Basalt units have the appearance of a more or less well-developed chocolate-tablet boudinage structure. A N-S oriented stretching, associated with deformation along the EBDZ during the D1 deformation event, and with regional dextral movement during reactivation of the EBDZ during the D2 deformation event, is interpreted to have resulted in boudinage of the High-Ti Basalt units, with the primary horizontal stretching direction parallel to the N-S orientation of the EBDZ. A component of dextral-transpression, possibly relating to emplacement of large plutonic stocks to the northeast (NE) and southwest (SW) of the area, is interpreted to impart a lesser vertical component of stretching, such that the High-Ti Basalt and Felsic Intrusive units are also boudinaged in the vertical plane.

7.5 Quartz Vein Analysis & Interpretation

Quartz veins are scarce within the Ultramafic Flow units in comparison to the veins observed in the High-Ti Basalt and Felsic Intrusive units. Quartz veins occurring in the Ultramafic Flow units generally occur in isolated areas, are thin (several cm in width) and generally pinch out with lengths less than several metres. The quartz veins in the Ultramafic Flow units generally lack associated gold mineralization.

Quartz veins are common in the High-Ti Basalt, where they often occur as vein arrays comprising multiple parallel and closely spaced veins. The veins are generally present throughout most of the High-Ti Basalt, with concentrated mineralized areas where vein abundance increases significantly.

Quartz veins are present in the Felsic Intrusive units but are not as common as in the High-Ti Basalt and do not generally have the same associated elevated gold grades as observed in the High-Ti Basalt. It is likely that while the Felsic Intrusive unit and the High-Ti Basalt both underwent brittle deformation resulting in the development of structural traps controlling the emplacement of quartz-actinolite veins, the quartz-feldspar porphyry did not provide the same chemical trap as the more iron rich (relative to the Felsic Intrusive units) High-Ti Basalt did to allow for significant gold mineralization to develop.

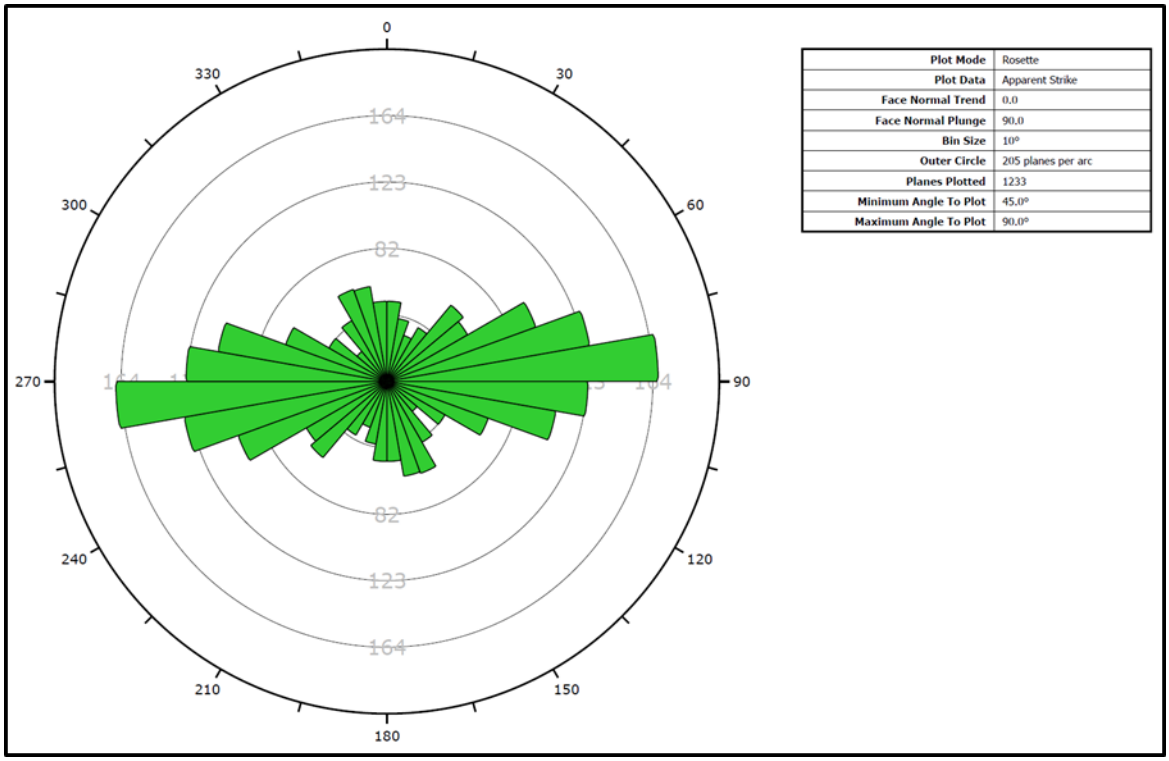
The quartz veins in the High-Ti Basalt and the Felsic Intrusive dykes and sills are interpreted as shear and extensional veins developed during brittle deformation of the units during D2 dextral transpression. The various orientations of vein arrays are interpreted as the following dextral shear-related vein sets:

- Riedel Prime Shear Veins (R’): the most common vein orientation, striking E-W, dipping sub-vertical, orientated at a high angle to the orientation of the EBDZ and showing sinistral shear sense indicators, antithetic to the dextral movement of the EBDZ.
- Riedel Shear Veins (R): striking N-S steeply dipping to sub-vertical, oriented at low angle clockwise to the orientation of the EBDZ, with dextral shear sense indicators synthetic to the dextral movement of the EBDZ.
- P Shear Veins: striking NW-SE steeply dipping to sub-vertical, oriented at low angle counter-clockwise to the orientation of the EBDZ, with dextral shear sense indicators synthetic to the dextral movement of the EBDZ.

- Low-angle Veins: shallow-dipping to sub-horizontal extensional veins oriented approximately orthogonal to the shear veins, with vertical extensional fabrics.

The vein-set relative abundances and orientations are shown on Figure 7-6, with the E-W striking R' shear veins occurring in significantly greater numbers than the other vein types.

The R', R and P shear veins all host gold mineralization, with the highest gold grade generally occurring within the E-W oriented R' veins.



Note: Data used for rose plots was limited to data with orientation confidence greater than 5, which translates to core orientation lock angles of less than 10 degrees.

Figure 7-6: Rose Plot of Quartz-Actinolite Veins

The higher-grade gold mineralization in the F2 Basalt Zone is observed to be spatially associated with Quartz-Breccia Zones that share the same geometry as the R' Shear Veins. The Quartz-Breccia Zones are interpreted to have developed as multiple opening and sealing events of the E-W striking sub-vertical R' shear veins. A possible explanation for the development of the R' Shear Vein related Breccia Zones is that their sinistral sense of shear is opposed to the dextral bulk sense of shear. As a result, the R' shear veins will not accommodate significant displacement, but they may develop into zones of intense deformation, where repeated fracturing and comminution of the vein and entrained and surrounding wall rock material results in the creation of high porosity and permeability zones for mineralizing fluids.

In areas where the Quartz-Breccia is thick and is associated with a surrounding envelope of increased abundance of mineralized quartz-actinolite vein arrays, they impart a clear E-W component to the high-grade mineralization.

The Quartz-Breccia zones have minor sinistral movement indicated by limited shear sense indicators that include shear fabrics, minor offsets and alignment/imbrication of wall rock fragments entrained in the Quartz-Breccia zones. A Quartz-Breccia zone exposed in development on the 305L of the mine exhibits what appears to be well-developed sinistral releasing bend geometry.

The Quartz-Breccia Zones do not appear to be thoroughgoing (cutting across all units) E-W shear zones or shear veins, but rather they are discontinuous, occurring primarily within the thickest parts of the F2 Basalt Zone. The 305 m level Quartz-Breccia zone clearly cuts across the multiple panels of basalt and a thin sliver of ultramafic sandwiched between them. This is attributed to ductile strain partitioning favoured in the more plastic Ultramafic Flow units.

Quartz-Breccia Zones have been identified in the West Limb Basalt and the Hanging Wall Basalt zones but the best developed zones identified to date have been found in the F2 Basalt Zone. Evaluation for Quartz-Breccia Zones in the other panels should be a high priority in future exploration and infill drilling.

The final deformation event observed in the deposit resulted in the entire sequence of Ultramafic Flow, High-Ti Basalt and Felsic Intrusive units having been gently folded into a broad, open fold with an N-S oriented, sub-horizontal fold axis during D3 deformation event. The broad open folding of the stratigraphy is apparent when viewing the deposit on a W-E (north facing) section (see north facing section portion of Figure 7-5). This subtle change in geometry is also observed in the orientation of the quartz-actinolite veins as they undergo a slight change in orientation and their dips shallow slightly with depth below the 610 m level.

7.6 Updated Structural Interpretation for the Phoenix Gold Project

Based on an analysis of the data and observations obtained during the 2017 structural oriented core drilling and mapping programs, the Golder's conceptual model of the revised structural interpretation is presented in Figure 7-7. The updated structural interpretation and model include the following key elements:

- The EBDZ has been remodelled to show it as a broader zone of high strain in the Ultramafic Flow unit rather than as a discrete feature that is then offset by E-W brittle faulting per the previous model.
- Strain partitioning during D1 and D2 deformation events resulted in ductile deformation of the talc-rich Ultramafic Flow units and brittle-ductile deformation of the more resistant High-Ti Basalt and Felsic Intrusive units.
- Ductile behaviour of the Ultramafic Flow unit resulted in the generation of the pervasive N-S (oriented, steeply dipping to sub vertical S1 penetrative foliation during D1 deformation.
- Brittle-ductile behavior of the High-Ti Basalt units resulted in the boudinage of these units with the primary stretching direction paralleling the N-S orientation with a lesser vertical component of stretching such that the boudin necks that bound the High-Ti Basalt panels are arranged in both N-S shallowly dipping and subvertical orientations.
- The High-Ti Basalt is modeled as a series of N-S oriented panels that have been boudinaged during D1 and D2 deformation events so that they form N-S elongated lenses that pinch out at the north and south ends. In some instances, there are gaps of tens of metres between boudinaged basalt panels. This geometry is shown in both the N-S planar view and the vertical view (see Figure 7-7).

- Ultramafic Flows and High-Ti Basalt units were intruded by dykes and sills of the Felsic Intrusive unit pre- to syn-mineralization.
- Arrays of quartz-actinolite veins with associated gold mineralization were developed in the more competent High-Ti Basalt and to a lesser degree in the Felsic Intrusive. The R', R and P shear veins all host gold mineralization, with the highest gold grades generally occurring within the E-W oriented R' veins.
- The best gold grades occur in the thickest portions of the High-Ti Basalt, where the unit presented both favourable structural traps for developing gold-bearing veins and chemical traps where disseminated sulphides and associated gold mineralization are developed. These areas should be the focus/targets of future exploration efforts.
- The entire sequence of Ultramafic Flow, High-Ti Basalt and Felsic Intrusive units were then folded into a broad gentle fold with a N-S oriented, sub-horizontal fold axis during D3 deformation event.
- Some deposit scale and macro scale evidence for pre-D3 folding was observed in the Ultramafic Flow units; however, at present Golder interprets these features to be a result of foliation orientation variability due to dragging associated with the regional D2 dextral deformation and to warping of the foliation in boudin neck regions rather than a result of deposit-scale steeply plunging isoclinal folding.

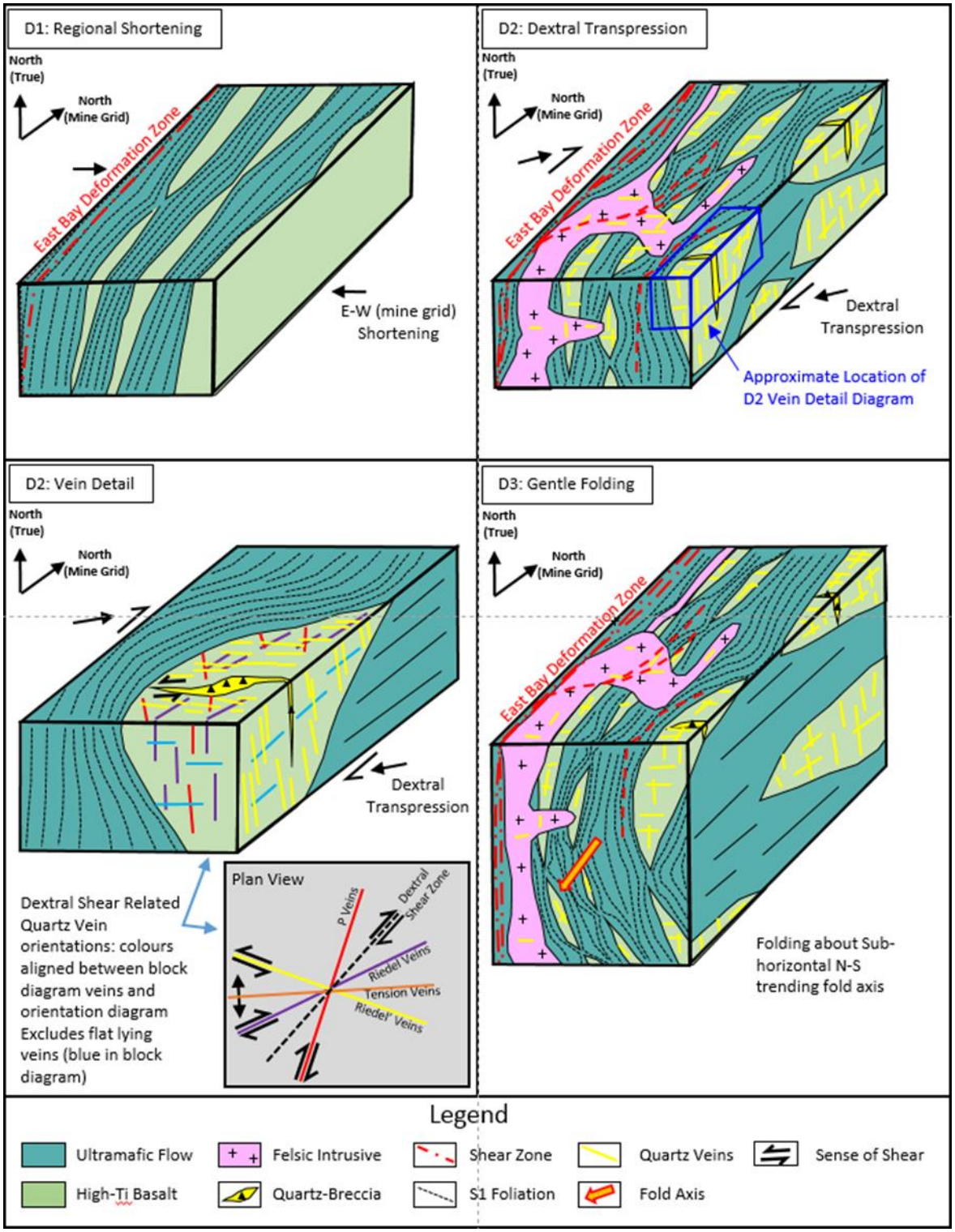


Figure 7-7: Updated Conceptual Structural Model for the Phoenix Gold Project Area

8.0 DEPOSIT TYPES

The style of veining, the lithological setting, and the structural relationship with shear zones at the F2 gold deposit are compatible with Orogenic-style gold mineralization (also referred to as mesothermal, or Archean greenstone-hosted quartz-carbonate vein gold mineralization or Archean Lode Gold). This style of gold deposit is typically associated with regional folding and arrays of major shear zones and is formed by circulation of gold-bearing hydrothermal fluids in structurally-enhanced permeable zones. The deposits are characterized by strong lithological and structural controls and are hosted in deformed and metamorphosed volcanic, sedimentary and granitoid rocks occurring across a range of crustal depths (Groves et al., 1998).

Orogenic gold deposits are widely distributed in the Neoarchean greenstone belts of the Superior, Churchill, and Slave provinces, and also occur in younger terranes such as the Canadian Cordillera and the Appalachian terranes. In Canada, the most important concentration of Orogenic gold deposits occurs in the greenstone belts of the south-central Superior Province.

In the Red Lake district, most of the gold production is derived from Orogenic-style high-grade quartz-carbonate veins that are associated with deformation of the Balmer Assemblage mafic and ultramafic volcanic rocks (Sanborn-Barrie et al., 2004). At the Campbell-Red Lake Mines, located to the south of the Phoenix Property, the main source of gold is within quartz-carbonate veins associated with the Campbell and Dickenson fault zones that are locally controlled by F2 folding (Dubé et al. 2001). A spatial relationship exists between the ultramafic rocks and gold mineralization, with the majority of gold mineralization at the Cochenour-Willans and Campbell-Red Lake gold mines occurring within a few hundred metres of ultramafic bodies. Dubé et al. (2001) suggested that a competency contrast between the mafic (basalt) and ultramafic (komatiitic basalt) units was important in the formation of extensional carbonate veins in fold hinge zones during deformation. The carbonate veins were then partially replaced as the result of interactions with gold-rich siliceous fluids.

The F2 gold deposit shares attributes of other Orogenic gold deposits of the Red Lake district. These include the association of auriferous quartz-carbonate veins with regional scale D2 deformation zones (D2 shear zones and related brittle-ductile structural features) and the favourable lithological setting of Balmer Assemblage mafic and ultramafic volcanic rocks.

9.0 EXPLORATION

9.1 Historical Exploration Work

The history of exploration activities from 1922 to 2002 conducted by previous owners is discussed in Section 6.1 Exploration and is summarized in Table 6-1.

9.2 Exploration by Rubicon

Since acquiring the Phoenix Gold Project in 2002, Rubicon has conducted an extensive exploration program that has included geological mapping, re-logging of selected historic boreholes, digital compilation of available historical data, ground and airborne magnetic surveys, mechanical trenching, channel sampling, a bathymetric survey, an induced polarization Titan 24 survey, petrographic studies, a topographic survey, and data modelling and processing, as well as numerous drilling programs. A summary of the exploration activities undertaken at the Phoenix Gold Project between 2002 and 2017 by Rubicon is shown in Table 9-1.

Table 9-1: Summary of Exploration Activities by Rubicon from 2002 to 2015

Year	Description of Work
2002	■ Geological mapping ■ Cataloguing, numbering and re-boxing of historical core cross-piled on property (over 60,000 m) Digital compilation of historical data ■ High resolution airborne magnetic survey ■ 22,000 m^2 of mechanical trenching and power washing (in 2002 and 2004) Channel sampling (876 samples between 2002 and 2004) Overwater bathymetric survey of Red Lake within property boundary ■ 1,900 m of drilling on the Phoenix Peninsula
2003	■ Re-logging of selected historical boreholes (approximately 23,000 m from 161 boreholes) Digital compilation of historical data ■ Phase 1 drilling program with 9,600 m of winter drilling including ice drilling ■ Phase 2 drilling program consisting of 3,000 m drilled on the Phoenix Peninsula
2004	■ Continued mechanical trenching, power washing and channel sampling ■ Winter drilling program with 13,300 m drilled
2005	■ 11,800 m of surface drilling
2006	■ 1,614 m of surface drilling
2007	■ 13,444 m of surface drilling
2008	■ First phase of Titan 24 DCIP and MT survey ■ 43,800 m of surface drilling
2009	■ Second and final phase of airborne Titan 24 survey completed ■ Preliminary petrographic study ■ Surface (44,675 m) and underground (25,512 m) core drilling
2010	■ Topographic survey utilizing airborne LiDAR technology (light detection and ranging) Surface (37,823 m) and underground (82,068 m) core drilling
2011	■ Surface (5,462 m) and underground (74,337 m) core drilling
2012	■ Surface (40,900 m) and underground (17,627 m) core drilling (to cut-off date of Nov 1, 2012)
2013	■ Underground core drilling (876 m) to support shaft development
2014	■ Underground core drilling (40,574 m), infill and step out drilling in central portion of deposit ■ Surface core drilling (6,064 m) used to investigate the crown pillar
2015	■ Underground core drilling (47,061 m), infill used as production support for trial stoping ■ Exploration surface core drilling (9,553 m) targeting the Carbonate (Carz) Zone

A core re-logging program initiated in 2002 formed a solid basis for understanding the nature of mineralization hosted within the hanging wall volcanic units of the East Bay Deformation Zone.

The airborne magnetometer survey flown by Fugro Airborne Surveys in 2002 provided the data necessary to allow re-interpretation of the local geology within the Phoenix property boundary including the extrapolation of known geological contacts, the identification of local structural offsets, and the identification of large target areas such as magnetic lows which potentially represent the destruction of magnetite through hydrothermal alteration processes.

The 2008 Titan 24 DCIP survey by Quantec Geoscience was completed after the 2008 discovery of the F2 gold deposit (see Figure 10-1). The Titan 24 survey successfully detected several known near-surface gold zones; the survey is also interpreted to have detected alteration that is spatially associated with the F2 gold deposit (Figure 10-1). The defined chargeability anomaly is over 1,500 m long and appears to correlate with a zone of strongly altered host rocks and sulphide minerals that are associated with gold mineralization that extends from the southern limit of the F2 gold deposit to the Pen Zone. The F2 Titan chargeability anomaly is one of a number of similar anomalies defined by the same survey along 3 km of prospective stratigraphy extending to the northeast on the property. The chargeability anomalies range from vertical depths of 200 m to over 800 m and constitute high priority regional targets.

Preliminary petrographic analysis performed by Vancouver Petrographics in 2009 on select representative core samples from the F2 gold deposit indicated that 90% to 95% of the native gold occurs in quartz as equant grains, mainly from 20-100 microns in size. Petrography identified that such fragments should be liberated relatively easily. Finer grains of native gold (mainly 5-20 microns), both in fragments of meta-andesite and less commonly in quartz, will be more difficult to liberate. Most likely the recovery of gold would not increase greatly with grinding below 15 microns.

10.0 DRILLING

10.1 Historical Drilling

The history of exploration from 1922 to 2002 is discussed in Section 6. Drilling conducted by previous owners is summarized in Table 6-1. The historical core boreholes are mainly located outside the main resource area. However, some core boreholes targeted the Hanging Wall Basalt Zone (Part of F2 gold deposit) between 1984 and 1987 and have been used for geology and resource modelling.

10.2 Drilling by Rubicon

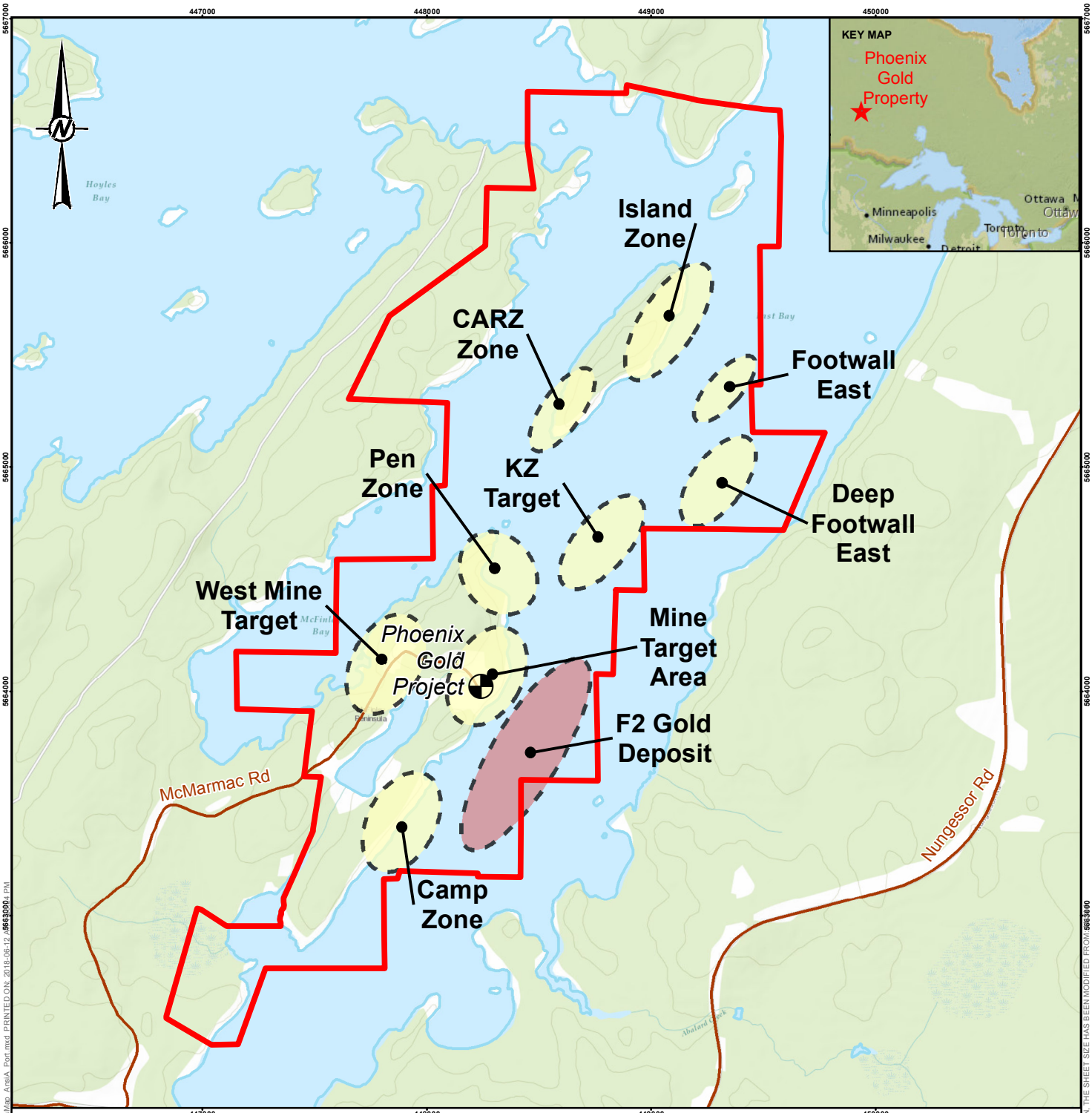
Since 2002 and up to November 1, 2017, Rubicon has completed 546,184 m of core drilling (235,228 m of surface drilling and 310,956 m of underground drilling) on the Phoenix Gold Project (Table 10-1). Of this drilling, 483,707 m were drilled on the F2 gold deposit. Since the previous Mineral Resource Statement (SRK 2013b), infill and step-out drilling focused on the resource areas, testing the northern and southern extensions of the gold mineralization, to assist with preparing trial stoping development in the core of the F2 Basalt Zone, and to investigate the crown pillar. Between November 1, 2012 and November 1, 2015, Rubicon drilled 429 boreholes (94,575 m). With the 2017 restart of the Phoenix Gold Project, Rubicon undertook an ambitious underground exploration drilling campaign with 22,901 m of NQ oriented core drilled primarily from 305, 610 & 685 levels.

Table 10-1: Phoenix Drilling

Year	Surface Holes		Underground Holes		Total Holes	
	Count	Metres	Count	Metres	Count	Metres
2002 - 2005	188	41,480	-	-	188	41,480
2006	11	1,614	-	-	11	1,614
2007	24	13,444	-	-	24	13,444
2008	62	43,766	-	-	62	43,766
2009	69	44,675	42	25,512	111	70,187
2010	49	37,823	199	82,068	248	119,891
2011	6	5,462	296	74,337	302	79,799
2012	90	40,900	36	17,627	126	58,527
2013	-		4	876	4	876
2014	38	6,064	127	40,574	165	46,638
2015	-	-	260	47,061	260	47,061
2016	-	-	-	-	-	-
2017	-		68	22,901	68	22,901
TOTAL	**537**	**235,228**	**1,032**	**310,956**	**1,569**	**546,184**

The majority of core drilling by Rubicon has targeted areas outside of the historical McFinley Red Lake Mines areas that were historically perceived to have exploration potential. Key target areas on the Phoenix Gold Project are presented in Figure 10-1.

The distribution of the surface drilling targeting the F2 gold deposit is shown in Figure 10-4. Surface drilling was completed generally along east-west sections. However, borehole azimuth and plunge varied widely because much of the drilling was completed on the lake using a barge or on winter drill platforms. Surface drilling completed to November 1, 2012 improved the definition of the gold mineralization at a borehole spacing of approximately 50 m or better, locally. Underground drilling targeted the gold mineralization from the 122 m, 183 m, 244 m, and 305 m levels along east-west sections (normal to interpreted trace of the gold mineralization). Given the limited underground drilling stations available, fan drilling was necessary to target north, south and depth extensions of the interpreted gold mineralization. The additional underground drilling reduced the spacing between boreholes in the core of the F2 deposit to approximately 10 m or less (Figure 10-3).



LEGEND

- Phoenix Gold Property
- First Priority Area
- Second Priority Area
- Primary Roads
- Lake

0 500 1,000

1:25,000 METRES

NOTE(S)
SOURCE: RUBICON 2018

REFERENCE(S)
DATUM: NAD 83 UTM ZONE 15

CLIENT
RUBICON MINERALS

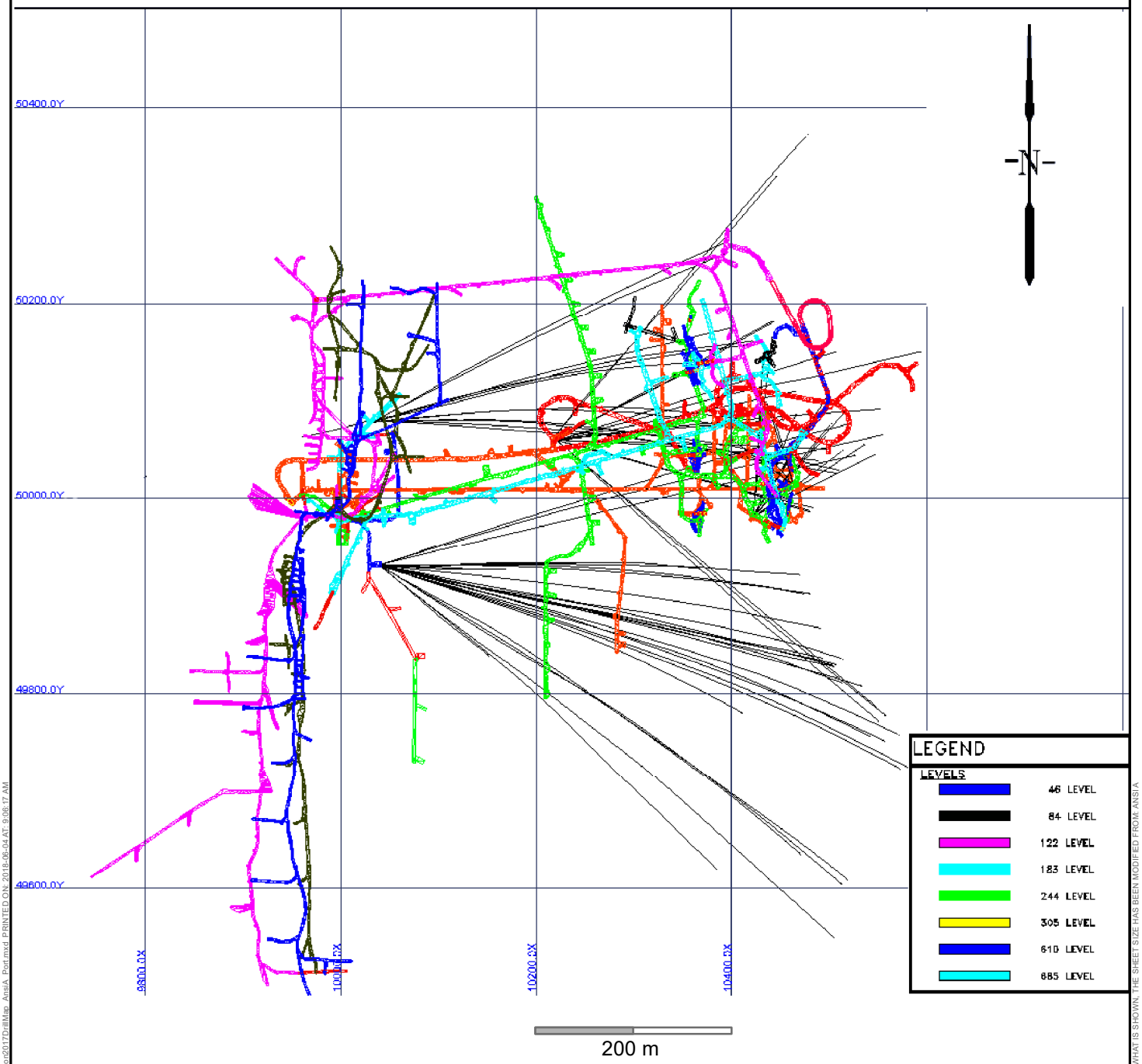
CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-12
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
KEY TARGET AREAS ON THE PHOENIX GOLD PROJECT

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	10-1



REFERENCE(S)
DATUM: PHONEIX MINE GRID
SOURCE: RUBICON MINERALS CORP.

CLIENT
RUBICON MINERALS

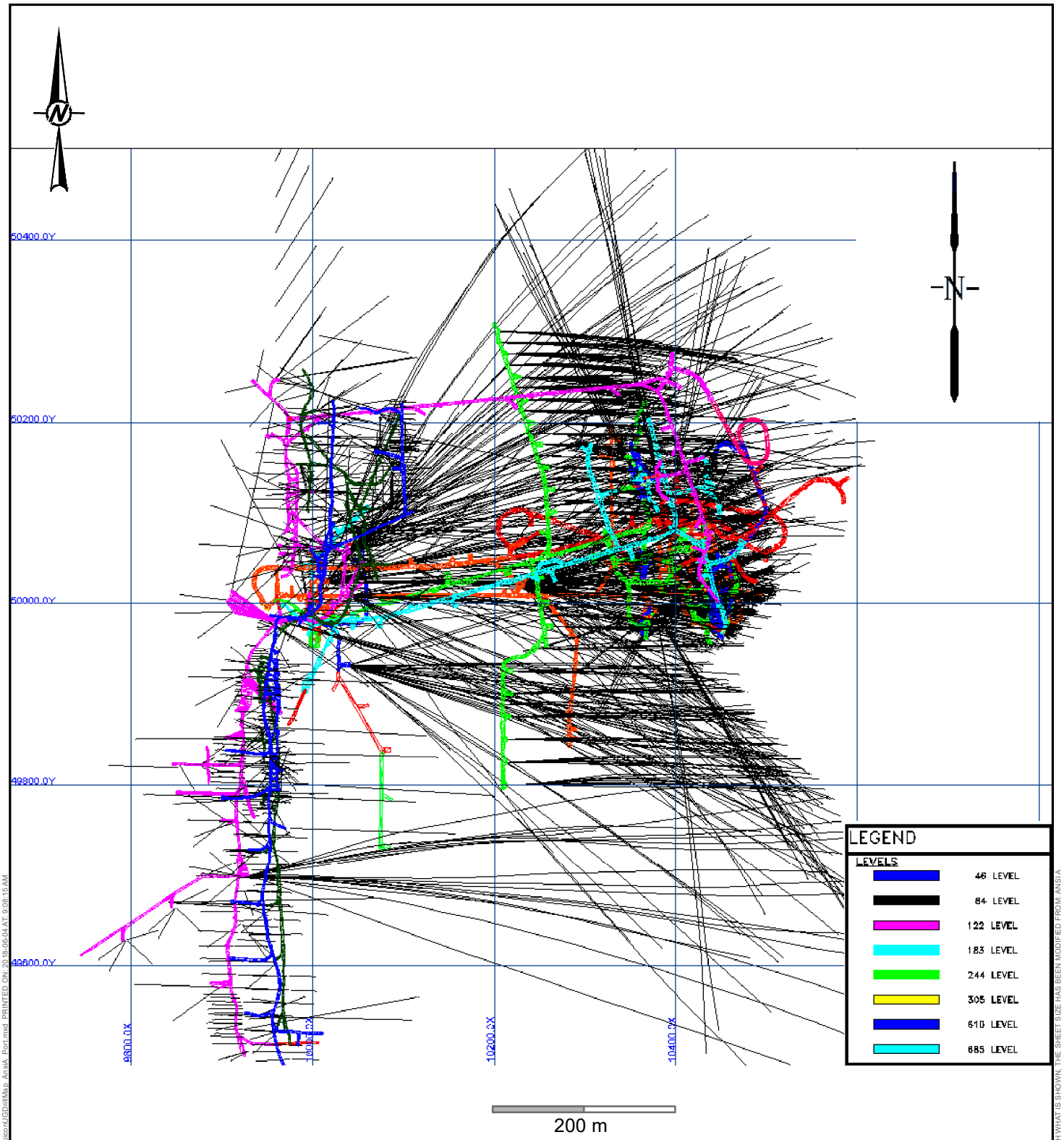
CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
2017 DRILL HOLES

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	10-2



REFERENCE(S)
DATUM: PHONEIX MINE GRID
SOURCE: RUBICON MINERALS CORP.

CLIENT
RUBICON MINERALS

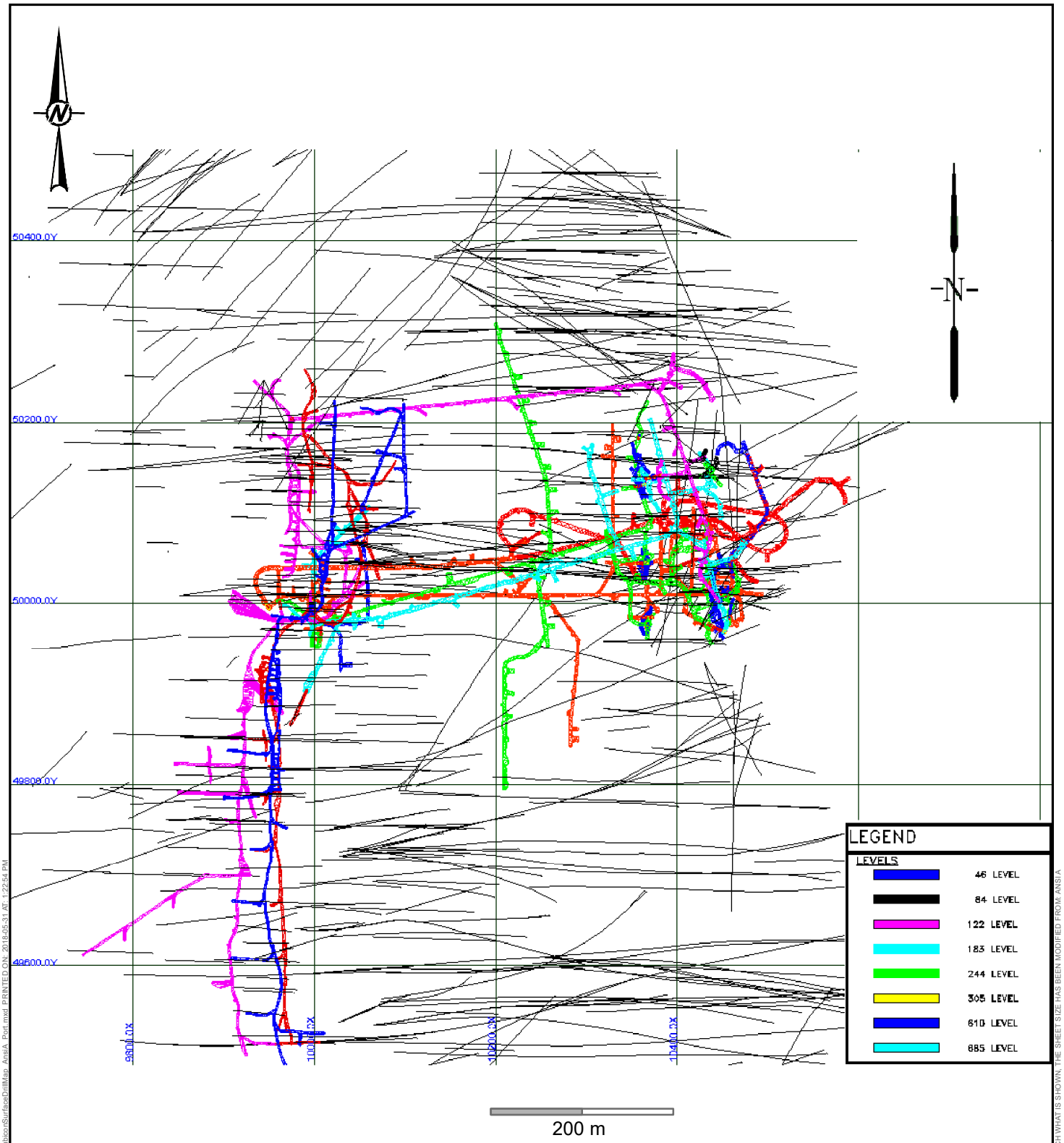
CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
UNDERGROUND DRILL HOLES

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	10-3



REFERENCE(S)
DATUM: PHOENIX MINE GRID
SOURCE: RUBICON MINERALS CORP.

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
SURFACE DRILL HOLES

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	10-4

In 2011, 302 core boreholes were drilled (79,799 m), including 5,462 m from surface and 74,337 m from underground. Underground core drilling was conducted on the 305 m level, from seven separate drill stations, 305-02 through 305-08. The majority of the drilling was focused on the F2 gold deposit zone with a number of boreholes testing the extension of the zone along strike (refer to Figure 10-3).

The 2011 drilling campaign continued to define the northeast-trending F1 gold mineralization associated with silicification, quartz veining, and strong alteration within, and adjacent to, favourable host rock types. Gold mineralization also occurs in northwest-trending structures that are generally confined within, or immediately adjacent to, northeast-trending bounding geological units and parallel to the regional F2 fold trend direction. Typically, this mineralization occurs as local quartz veining and brecciation.

In 2012, 126 boreholes (58,527 m) were drilled up to November 1. Underground core drilling was conducted from the 305 m, 244 m, and 122 m levels, from four separate drill stations (305-02, 305-03, 244-09 and 122-03). Surface drilling was carried out on the ice during the winter months, as well as from land. The drilling was focused on the up-plunge extension of the F2 core zone as well as a series of deep targets. Although the main focus of the 2012 drilling campaign was infill, it also expanded the known strike length of the system by 71 m and the depth by 105 m.

In 2013, four underground geotechnical core boreholes were completed (876 m) to test the lower area of the shaft.

The 2014 to 2015 drilling program on the F2 gold deposit focused on testing the gold mineralization along strike, north and south of the core area of drilling and to assist with planning the test stoping areas (Figure 13-4) (no stopes labeled or identified on figure). An exploration drift was developed on the 244 m level parallel to the main zone of gold mineralization. The program was completed with 25 m spaced pierce points both vertically and horizontally throughout. The program was designed to test between 5248 m elevation to 4943 m elevation (122-427 m levels), targeting the High-Ti Basalt units. Phase two of the program was designed to infill, where needed, to 12.5-metre spacing. Drilling along the northern portion of the deposit identified several higher-grade targets. Drilling in the far southern portion of the F2 gold deposit confirmed the extension of the High-Ti Basalt with gold mineralization showing that the gold system is open to the south.

In 2015, Rubicon also drilled 21 surface core boreholes (9,553 m) targeting historical high-grade drilling results on the Carbonate Zone (CARZ - refer to figure 10.1 for location).

For the 2017 program, 22,901 m of underground NQ-sized core was drilled primarily on 305 m, 610 m and 685 m levels as shown in Figure 10-2. The exploration focused on the down-dip / down-plunge extensions of the known F2 Basalt Zone, West Limb Basalt Zone and Hanging Wall Basalt Zone units. As well, approximately 3,500 m drilling program targeted East-West oriented Breccia Zones on 244 m and 305 m levels by drilling generally North-South oriented holes.

All of the core in 2017 was drilled as “oriented core” using the Boart-Longyear TruCore™ tool, in order to obtain true Alpha and Beta angles on structures and veining. In addition, approximately 10,000 m of previously logged core was re-logged to verify previous lithological, mineralization, and structural interpretations.

10.2.1 Drilling Procedures

All proposed land and ice borehole collars were surveyed with a handheld global positioning system (GPS) instrument with an accuracy of ±3 m. Two foresight pickets were also surveyed, and drills were set up under the direct supervision of a Rubicon geologist or geological technician. Collars for barge boreholes were also surveyed with a handheld GPS instrument and then marked with a buoy; the same foresight procedure was carried out. Changes in actual borehole location from planned locations, due to local ice conditions or other technical reasons were noted with the true easting and northing coordinates. Final collar locations were surveyed with a differential GPS unit (sub-metre accuracy) and recorded in the database. All surveys currently use the mine grid, which lies at an orientation of +45 degrees to the UTM grid.

The majority of the core drilling performed prior to 2013 has been carried out by Hy-Tech Drilling of Smithers, British Columbia using Tech-4000 diamond core drills both from surface (on land, ice or barge) having a depth capacity of 2,500 m, and from underground having a depth capacity of 1,500 m. Layne Christensen Canada Limited of Sudbury, Ontario was also contracted to complete deep boreholes using their skid-mounted CS 4002, which has a depth capacity of 2,500 m. Orbit Garant Drilling of Val-d'Or, Quebec was contracted to complete underground drilling using either a B-20 or Orbit 1500, which have a depth capacity of 1,500 m. Each drilling program was supervised by a Rubicon geologist. In general, NQ (50.8 mm diameter) or NQ (47.6 mm diameter) core was drilled.

From 2013 to 2015, Boart Longyear was the drilling contractor. Boart utilized LM 75 electric drill rigs that have the ability to drill a 1,000 m hole at various core sizes. Boart Longyear also had several air powered drills, used for close proximity definition boreholes. All drilling was supervised by a Rubicon geologist. Drilling was completed with NQ (47.6 mm core diameter), BQTK (40.7 mm core diameter) or AQTK (35.5 mm core diameter) size core.

For the 2017 drill program and continuing into 2018, Rubicon again contracted with Boart Longyear for underground exploration drilling, utilizing two LM90 electric drills to core NQ (50.6 mm core diameter) core. The majority of the core was oriented using Boart Longyear's True-Core tool to provide true Alpha & Beta readings. All drilling was supervised by a Rubicon senior-level geologist, logged on-site by Rubicon geologists and sent for assay at SGS Labs Red Lake.

Casing for boreholes collared on land were left in place, plugged, cemented, and covered with aluminum caps with the borehole number etched or stamped into the cap. Prior to 2012, boreholes that were drilled from the ice or barge were plugged with a Van Ruth plug at 30 m down the borehole from the base of the casing, and then cemented to the top of the borehole. All casing was removed from these boreholes. Since January 2012, all boreholes drilled from the ice or barges were cemented from the bottom of the hole to the base of the casing. All boreholes that were drilled from underground were purposely left ungrouted if the borehole produced water at a rate of less than 5 liters per minute (L/min). If the borehole produced water at a rate greater than 5 L/min, the hole was pressure grouted from the bottom to top and sealed with a Van Ruth grout plug.

10.2.2 Collar and Down-Hole Survey

For the 2017 program, Rubicon utilized the Boart Longyear Devi-Shot downhole survey instrument measuring azimuth, inclination, magnetic field strength, and temperature at 30 m intervals. All collars were surveyed by Rubicon surveyors and a select set of holes were Gyro surveyed by Reflex Instruments contractors to verify the downhole results.

Rubicon discovered an error with underground core borehole collar locations. In April 2013 and January 2015, Total Precision Survey (TPS) using a gyro and plumb-bob, corrected the vertical reference line (survey control points at the shaft) resulting in both a translation and rotational shift to the underground excavations from the old survey to the new survey. The collars for many underground holes required correction due to an adjustment of the underground survey control points. The TPS work in 2013 and in 2015 resulted in a shift/rotation of the 84 m, 122 m, 244 m, and 305 m levels. The result was that all boreholes surveyed after April 2013 had the “corrected” mine grid coordinates while holes surveyed prior to April 2013 (mostly on 305 m level) had “uncorrected” mine grid coordinates. The shift in the corrected collar coordinates ranges from approximately 0.25 m to 3.0 m.

Rubicon performed a check “closed loop” survey on the 122 m, 244 m, and 305 m levels, to confirm accuracy and correct the location of the underground excavations. The closed loop survey data was verified by TPS and an Ontario Land Surveyor to be within first and second order accuracy in November, 2015.

11.0 SAMPLING PREPARATION, ANALYSES, AND SECURITY

11.1 Sample Preparation and Security

Since 2002, upon arrival at the core storage facility, the core was washed, core orientation and measurements were performed (when applicable on oriented core), it was visually logged, and it was marked up and tagged for sampling. Downhole depths, geological and structural features, and sample locations were marked on the core using china markers. The 2017 drill program relied on collection of detailed structural data from oriented drill core to enhance geological modelling. The logging of oriented drill core involved collection of Alpha and Beta angles for each structural feature, relative to an orientation line scribed along the bottom of the drill core. The location of the orientation line was placed based on Boart Longyear’s TruCore™ drill core orientation system, and was only scribed on sections of core where there was high confidence in both the initial orientation mark and the interlocking quality of the core segments within and between sequential coring runs.

Since 2007, digital photos have been taken of the core to preserve a digital record of all drill core on the Phoenix Gold Project. Until 2017, the digital photos were taken of the core before logging was completed, using a hand-held camera from an elevated position over the core logging table. At the edge of each photo, a small whiteboard was included recording the drill hole identification, down hole depth range and date of the photo. The photos typically captured 3-4 boxes of core laid out on the logging table and lightly misted with water to enhance colour contrasts in different lithological units. Since January 2017, Rubicon has utilized a customized camera stand to take the photos from a fixed 1 m height above the core table, and ensured the camera angle was consistently parallel to the plane of the tabletop. The photo procedure was altered at this time such that the photos were now taken after core logging was completed, thereby preserving all notations written on the core. Detailed photos were also taken of interesting geological or structural features, when warranted.

Samples were moved directly from the core shack to the cutting shack where they were cut in half and placed in plastic bags. Approximately 10 individually bagged samples were placed in a large rice bag that was sealed with a security zip tie containing a uniquely numbered tamper-proof security seal. All sampling was performed by Rubicon geologists or consultants/contractors, under the supervision of both internal QP’s and reviewed/monitored by external QP’s.

From 2002 to 2007, samples were shipped by courier to either ALS Minerals or Accurassay in Thunder Bay. Since 2008, samples were delivered directly from the mine site to the SGS Canada Inc. (SGS) laboratory in Red Lake by

Rubicon staff. Each sample number and security seal was recorded and then verified by SGS with a written acknowledgment upon receipt.

In 2014, the core shipping procedure was streamlined. Core samples were cut and individually packaged for shipping. Rubicon sampling personnel then sorted and placed the core samples in a larger shipping crate, allowing more samples to be shipped with fewer chain of custody forms. Generally, all samples from an individual drill hole would be placed in a crate, sealed with a tamper proof security seal and shipped to the lab. Each sample number and security seal was recorded and then verified by SGS with a written acknowledgment upon receipt.

In 2017, the core shipping procedure was modified such that individual shipments were no longer comprised of all samples from an individual drill hole. Instead, shipments were dispatched strictly in sequential sample tag order, in lots of 75 samples, each of which correlated to three complete QC batches and one complete lab furnace batch. Generally, three lots of 75 samples were included in each shipment. The implementation of smaller lab batches resulted in faster turnaround times on assay results and improved tracking of correlation between QC samples and affected core samples.

Analytical protocols were developed in 2003 and revised in 2009 and 2011 in consultation with Barry Smee, PhD, P.Geo., an independent geochemist (Smee, 2009 and 2011).

Individual samples received by the laboratory typically ranged from 0.5 to 2 kg in mass. When necessary, samples were dried prior to any sample preparation in the laboratory. The entire sample was crushed to 2 mm in an oscillating steel jaw crusher and either an approximate 250 g split, or, in the case of metallic screen fire assay, the whole sample was pulverized in a chrome steel ring mill. The coarse reject was bagged and returned to the Phoenix site for secure storage. Prior to 2009, the samples were crushed to 90% -8 mesh, split into 250- to 450 g subsamples using a Jones Riffle Splitter and subsequently pulverized to 90% -150 mesh in a shatter box using a steel puck. Silica cleaning between each sample was also performed to prevent any cross-contamination. All samples were sent for fire assay and the pulps remained on-site.

Beginning in October 2009, new sample preparation protocols were implemented in accordance with recommendations from Smee (2009). These included crushing the samples to 85% -2 mm before taking a 500 g split for pulverization. The subsample was then pulverized to 95% -150 mesh, from which a 50 g split was taken for fire assay analysis. Silica cleaning between each sample was also performed to prevent any cross-contamination. All samples were sent to an external lab for fire assay and the pulps remained on-site.

In 2017, sample pulps selected for umpire check assay analyses were sorted at the Rubicon core site and shipped via Purolator or Manitoulin Transport in security-tag sealed containers to Actlabs' facility in Thunder Bay, Ontario for analysis. Sample manifests, listing the sample numbers were emailed to the lab, prior to shipping, and a receipt of the samples was received for each shipment, with confirmation that the security seals were intact upon delivery. Blank, duplicate and certified reference material (CRM) samples from the original testing were included in the suite of umpire check assay samples, as well as additional sealed packets of CRMs to ensure laboratory bias checks were unaffected by any potential preparation contamination at the original lab.

The logged and sampled core is securely stored at the Project site and as well as in a secured storage yard in Cochenour surrounded by a six-foot high chain link fence with a padlocked gate. There is only one road into the mine site, which has a gate with 24-hour security and restricted access. The pulps and rejects were returned from SGS and are securely stored on the Project site for long-term storage.

11.2 Sample Analyses

Since 2002, Rubicon has used three primary independent analytical laboratories for gold analysis on the Phoenix Gold Project. From 2002 to 2007, samples were sent to either the ALS Minerals (ALS) preparation laboratory in Thunder Bay, Ontario, or its analytical laboratory in Vancouver, British Columbia, or to Accurassay Laboratories (Accurassay), Thunder Bay, Ontario. From 2008 to 2017, samples were submitted to SGS Minerals in Red Lake, Ontario for preparation and analysis. From January 2010 to October 2012, and in 2014 and 2015 (no samples were taken in 2013), umpire check assays were conducted by ALS and Accurassay, respectively. Rubicon Lab and Actlabs, the latter of which is independent, were utilized for a small portion of assaying on the project; the former for analysis of production geology and mill related process samples in 2015, and the latter for umpire check assays in 2017.

The four commercial laboratories are accredited to ISO/IEC Guideline 17025 by the Standards Council of Canada for conducting certain testing procedures, including all the procedures used by Rubicon to prepare and assay for gold. Although the Rubicon Lab was not accredited, the quantity of drill hole data from this lab was not considered by the QP to be material and was accepted for resource estimation. Chip samples processed at the Rubicon Lab were evaluated for bias as described in Section 14.

Dr. Barry Smee, P.Geo., Consulting Geochemist, audited the sample preparation facilities of SGS in Red Lake, Ontario on behalf of Rubicon in 2009 and 2011. Recommendations from his audit were provided to SGS and corrective measures were implemented (Smee., 2009 and 2011).

11.2.1 ALS Minerals (From 2002 – 2007)

Beginning in 2002, sample preparation was completed at ALS in Thunder Bay, and the pulps were shipped to ALS in North Vancouver, BC for analysis. Gold concentrations were determined by fire assay fusion of a 50 g subsample with an atomic absorption spectroscopy (AAS) finish, as the standard analytical procedure.

The gold-metallics assay, also known as screen fire assaying, required 100% pulverization of the sample and screening of the sample through a 150 mesh (100 micron) screen. Material remaining on the screen was retained and analyzed in its entirety by fire assay fusion followed by cupellation and a gravimetric finish. The -150 mesh (pass) fraction was homogenized and two 50 g subsamples were analyzed by standard fire assay procedures. In this way, the magnitude of the coarse gold effect can be evaluated via the levels of the +150 mesh material.

Representative samples for each geological rock unit and, generally, at least one sample every 20 m, were selected for four-acid digestion followed by multi-element assaying using inductively-coupled plasma atomic emission spectroscopy (ICP-AES). Copper, lead, and zinc values exceeding ICP-AES limits were re-assayed using wet chemistry. Only a few samples were assayed for whole rock major elements using X-ray fluorescence spectrometry (XRF).

Results were reported electronically to the Project site in Red Lake and to the head office in Vancouver to multiple recipients with assay certificates filed and catalogued at Rubicon's head office in Vancouver.

Umpire check assays completed at ALS in 2010 to 2012 utilized standard fire assay procedure on a 50 g subsample. If the sample contained greater than 10 g/t gold, it was re-assayed with a gravimetric finish.

11.2.2 Accurassay Laboratories (From 2002 – 2007, 2014 – 2015)

Gold was determined by fire assay using a 30 g fire assay charge. This procedure used lead collection with a silver inquart. The beads were then digested and an AAS or ICP-AES finish was used. All gold assays greater than 10 g/t were automatically re-assayed by fire assay with a gravimetric finish. A Sartorius micro-balance was used with a sensitivity of 1 microgram (six decimal places) giving a 5 parts per billion (ppb) detection limit.

Screen metallics analyses included the crushing of the entire sample to 90% -10 mesh and using a Jones Riffle Splitter to split the sample to a 1-kg subsample. The entire subsample was then pulverized and subsequently sieved through a series of meshes (80, 150, 200, 230, 400 mesh). Each fraction was then assayed for gold (maximum 50-g). Results were reported as a calculated weighted average of gold in the entire sample. Core samples were also assayed for a suite of 32 trace elements using a multi-acid digestion followed by ICP-AES. As with ALS, results were reported electronically to the Project site in Red Lake with assay certificates filed and catalogued at Rubicon's head office in Vancouver.

For the umpire check assays from 2014 to 2015, gold was determined by fire assay using a 50 g fire assay charge. If the sample contained greater than 10 g/t gold, it was re-assayed with a gravimetric finish.

11.2.3 SGS Mineral Services (From 2008 - 2017)

At SGS, prior to 2009, gold was analyzed using the fire assay process on a 30 g subsample. If the sample contained greater than 10 g/t gold, it was re-assayed using a gravimetric finish. Starting in October 2009, the subsample size was increased to 50 g on the recommendations of Smee (2009). All gold assays greater than 10 g/t were automatically re-assayed with gravimetric finish.

A select suite of sample pulps were also assayed for a suite of 50 trace elements by the SGS Laboratory in Toronto, Ontario, using a multi-acid digestion and ICP-AES.

Results were reported electronically to the Project site in Red Lake and to the head office in Vancouver to multiple recipients with assay certificates filed and catalogued at Rubicon's head office in Vancouver and added to the master Microsoft Access database stored on the Vancouver and Red Lake servers.

In 2014, the database management was moved from Vancouver to the Project site. Approved assay certificates from SGS were received at Rubicon Red Lake site in digital format since that time.

11.2.4 Rubicon Assay Laboratory (2015)

In 2015, Rubicon purchased and operated an assay laboratory located in Balmertown, approximately 8 km from the Phoenix Gold Project. This laboratory processed all production geology and mill related processing samples. A total of 1894 samples from 63 production-related Bazooka drill holes and 1,566 chip samples taken from 411 sampling locations were processed at this lab. Gold concentrations were determined by fire assay fusion of a 30 g subsample with an AAS finish as the standard analytical procedure.

11.2.5 Actlabs (2017)

For the umpire check assay samples analyzed at Actlabs, gold was analyzed by fire assay with AAS finish on a 50 g charge from pulps that had previously been prepared and analyzed by SGS Lab in Red Lake. Following the same analytical protocols as the original lab, all samples that returned a result greater than 10 g/t were automatically repeated by fire assay with gravimetric finish.

11.2.6 Handling of Multiple Assay Values for One Sample

In cases where multiple assays were completed on an individual sample, gold values produced by the metallic fire assay were deemed to supersede fire assay gold values owing to the larger size of the sample analyzed and/or the better reproducibility in samples with coarse gold. When samples were analyzed multiple times by the same method (i.e. duplicate or umpire check assay analyses), the original assay was incorporated in the model. Replicate analyses were used only as QC checks to validate the original result.

11.2.7 Data Management

Data are verified and double checked by senior geologists at site for data entry verification, error analysis, and adherence to strict analytical quality control protocols. Borehole data collected from 2009 to 2014 was managed by ioGlobal Pty Ltd. (“ioGlobal”) and reviewed for quality assurance and quality control. In 2014, database management was returned to the Phoenix site, under the supervision of the Chief Mine Geologist.

11.3 Sample Analyses of Metallurgical Testwork

11.3.1 G&T Metallurgical Services

Metallurgical testwork was completed at the G&T Metallurgical Services Ltd. (G&T) facility in Kamloops, British Columbia. Gold was measured by fire assay method using a 30 g assay charge. When requested, metallic sieve preparation method was also used. Although not accredited, the laboratory has a complete written procedure and participates in a Proficiency Testing Program accredited by the Standards Council of Canada. This facility also performed assays for iron and arsenic content using a multi-acid digestion and ICP-AES method, and assays for sulphur and carbon by combustion furnace.

G&T also performed different metallurgical testing for the characterization of the mineralized material. All tests performed were done using industry recognized methods for the testwork. In 2013, the facility was visited by Soutex personnel (SRK, 2013b). Soutex noted that the facility has well-documented controlled procedures for all types of testing. The quality management includes ISO-9001 accreditation.

11.3.2 ALS Minerals

All the assays related to the treatment of the bulk samples at SMC (Canada) Ltd.’s (SMC) McAlpine mill in Cobalt, Ontario during the summer and fall of 2011 were sent to ALS accredited laboratories. Gold assays were done with fire assay on a 30 g assay charge. All head grade samples and tailings samples were prepared with screen metallic sieve preparation done on the whole received sample. All gold concentrate samples were assayed without

screen metallic sieve preparation. The samples were expedited and received at the Val d'Or facility and the assays were performed in ALS laboratory in North Vancouver. A series of blank, duplicate and CRM samples were also sent to the laboratory for quality control.

11.4 Specific Gravity Data

The specific gravity database includes 6,666 records generated by Rubicon from measurements on core from 470 boreholes (Table 11-1). Specific gravity measurements were taken from representative core sample intervals (approximately 0.1 to 0.2 m in length). Specific gravity was measured using a water dispersion method. The samples were weighed in air, and then the uncoated sample was placed in a basket suspended in water and weighed again. Table 11-1 summarizes the measurements by rock type.

Table 11-1: Specific Gravity Data by Lithology Type

Rock Code	Description	Count	Specific Gravity			
			Average	STD	Minimum	Maximum
E1H	High-Ti basalt	1,396	2.96	0.10	2.20	3.72
E0T	Talc rich unit	1,600	2.90	0.05	2.61	3.15
I3	Felsic intrusive rocks	847	2.67	0.07	2.36	3.08
E0	Ultramafic flow	1,264	2.92	0.08	2.50	3.76
E0B	Komatiitic basalt	370	2.98	0.07	2.61	3.24
E1A	Basalt	198	2.89	0.09	2.67	3.54
AGZ	Altered Green Zone	97	2.93	0.09	2.69	3.20
Other	Other	894	2.88	0.12	1.85	3.45
Total		**6,666**				

*STD = standard deviation

In 2017, a suite of samples was selected for specific gravity testing at Actlabs, to confirm the measurements taken by Rubicon. Sample pulps were shipped to Actlabs and analyzed using method RX17 for specific gravity on pulp, which is measured using the relative volumes of solids to water and air in a given volume. The 2017 specific gravity results and the difference from 2016 values are summarized in Table 11-2. The results for High-Ti Basalt were further subdivided into unmineralized (unmin: < 2.99 g/t gold), low-grade (low: 3.00 to 9.99 g/t gold) and high-grade (high: >10 g/t gold) sources. The difference noted in the specific gravity values of Komatiitic Basalt from 2016 and 2017 measurements is attributed to the inclusion of samples in the 2017 dataset which were logged as Komatiitic Basalt but were actually mixed Komatiitic Basalt/High-Ti Basalt units.

Table 11-2: 2017 Specific Gravity from pulps by Lithology Type

Rock Code	Description	Count	Specific Gravity				Difference
			Average	STD	Minimum	Maximum	
E1H	High-Ti basalt (overall)*	24	2.95	0.09	2.80	3.18	0.01
	**High-Ti Basalt (unmin & low)*	*19*	*2.93*	*0.08*	*2.80*	*3.11*	
	**High-Ti Basalt (high)*	*5*	*3.02*	*0.12*	*2.85*	*3.18*	
E0T	Talc rich unit	6	2.94	0.07	2.84	3.05	-0.04
I3	Felsic intrusive rocks	1	2.62	-	2.62	2.62	0.05
E0	Ultramafic flow	0	-	-	-	-	
E0B	Komatiitic basalt	8	2.91	0.11	2.70	3.02	0.07
E1A	Basalt	0	-	-	-	-	
AGZ	Altered green zone	0	-	-	-	-	
Other	Other (V2_BX veins)	5	2.87	0.10	2.79	3.04	0.01
Total		**44**					

* STD = standard deviation
Difference = 2016 SG – 2017 SG

11.5 Quality Assurance and Quality Control Programs

Quality control (QC) measures are typically set in place to ensure the reliability and trustworthiness of exploration data. These measures include written field procedures and independent verifications of aspects such as drilling, surveying, sampling and assaying, data management and database integrity. Appropriate documentation of quality control measures and regular analysis of quality control data are important as a safeguard for Project data and form the basis for the quality assurance (QA) program implemented during exploration.

Analytical QC measures typically involve internal and external laboratory procedures implemented to monitor the precision and accuracy of the sample preparation and assay data. They are also important to identify potential sample sequencing errors and to monitor for contamination of samples.

Sampling and analytical QA/QC protocols typically involve taking duplicate samples and inserting quality control samples (CRMs and blanks) to monitor the reliability of the assay results throughout the drill program. Umpire check assays are normally performed to evaluate the primary lab for bias and involves re-assaying a set proportion of sample rejects and pulps at a secondary umpire laboratory.

11.5.1 Rubicon Sampling 2008 - 2015

Rubicon monitored the internal analytical QC measures implemented by the primary laboratories it used for analysis. In addition, Rubicon implemented external analytical QC measures starting in 2008 on all sampling conducted at the Phoenix Gold Project. The analytical QA/QC program was designed and monitored by both internal and external QP's. For drill core, analytical control measures used by Rubicon consisted of inserting control samples (blank, grade-matched CRMs, and field duplicates) in all sample batches submitted for assaying. For 2015 production-related sampling, including Bazooka drill core, chip sampling and muck sampling, the external QC measures consisted of commercially sourced CRMs only.

No drilling took place in 2013 or 2016 with associated geochemical sampling.

From 2008 to 2010, the blank samples consisted of store-bought white garden stone (quartz or quartzite). In 2010, Rubicon used material sourced from a granite boulder located near Red Lake. From February 2011 to July 2015, Rubicon used granite slab purchased from Nelson Granite in Vermillion Bay, Ontario. Beginning August 2015, a locally-sourced granite from Red Lake was used after submitting a number of samples to verify that it was barren in gold.

Field duplicates consisted of half core and have been taken since June 2009.

Twenty-nine different commercial CRMs, with various gold grades, were sourced from CDN Resource Laboratories Ltd. (CDN) to monitor sampling accuracy between 2008 and 2015. Control samples used range from 0.121 to 29.21 g/t gold (Table 11-3).

Table 11-3: Specifications of CDN CRMs Used by Rubicon on the Phoenix Gold Project between 2008 and 2015

Gold CRM	Recommended Value (g/t Au)	Standard Deviation (g/t)	Number of Samples
CDN-GS-P1	0.121	0.011	58
CDN-GS-P5B	0.44	0.02	90
CDN-GS-P7A	0.77	0.03	93
CDN-GS-P8	0.78	0.03	178
CDN-GS-10	0.82	0.05	3
CDN-GS-1J	0.946	0.051	170
CDN-GS-1H	0.972	0.054	297
ZCDN-GS-1G	1.14	0.05	91
CDN-GS-1E	1.16	0.03	1,649
CDN-GS-1L	1.16	0.05	186
CDN-GS-1P5A	1.37	0.06	16
CDN-GS-1P5B	1.46	0.06	83
CDN-GS-1P5L	1.53	0.07	5
CDN-GS-9	1.75	0.07	123
CDN-GS-2B	2.03	0.06	77
CDN-GS-2A	2.04	0.095	5
CDN-GS-2C	2.06	0.075	243
CDN-GS-3E	2.97	0.135	107
CDN-GS-3D	3.41	0.125	180
CDN-GS-5C	4.74	0.14	1
CDN-GS-5E	4.83	0.185	1,244
CDN-GS-5J	4.96	0.21	162
CDN-GS-5A	5.1	0.135	10
CDN-GS-5F	5.3	0.18	431
CDN-GS-6A	5.69	0.24	478
CDN-GS-7A	7.2	0.3	121
CDN-GS-6	9.99	0.25	8
CDN-GS-11A	11.21	0.435	17
CDN-GS-30B	29.21	0.615	170

Control samples (including blanks, gold CRM samples, and field duplicates) were inserted every 25 samples. In addition, umpire check assays were performed on approximately 3-5% of samples.

In addition to in-house monitoring, analytical QC data produced by Rubicon between 2002 and 2007 was reviewed in a report by AMC (AMC, 2011). Analytical QC data collected between 2008 and October 2012 was summarized and analyzed in a 2013 technical report by SRK Consultants (SRK, 2013b). Analytical QC data for the drilling completed between 2014 and 2015 was reviewed and summarized in a technical report by SRK Consultants (SRK, 2016). Historical boreholes drilled prior to 2002 do not have known analytical QC data.

11.5.2 Rubicon Sampling 2017

Rubicon monitored the internal analytical QC measures implemented by the primary laboratories it used for analysis. In addition, Rubicon implemented external analytical QC measures on all sampling conducted at the Phoenix Gold Project since the previous technical report. The analytical QA/QC program was designed and monitored by both internal and external QP's. For drill core sampling, analytical QC measures by Rubicon consisted of inserting control samples in all sample batches submitted for assaying. For most 2017 production-related sampling, including chip sampling and test hole sampling, the external QC measures consisted of commercially sourced CRMs only, testing both high- and low-grade ranges. Rubicon also monitored internal laboratory blank and duplicate analyses for production-related sampling. For 2017 muck sampling, Rubicon relied entirely on the laboratory's internal QC measures, with the exception of high-grade analyses, which were covered under Rubicon's blanket policy requiring the laboratory to insert a blind external CRM with all gravimetric analyses.

Blank samples were inserted to monitor sample cross contamination during the sample preparation process as well as to identify potential sample sequencing issues. The blank used in 2017 consisted of a locally sourced granite from Red Lake that had previously been tested to verify that it was barren in gold. Blanks were inserted a minimum of 1 per 25 samples, preferentially placed after samples expected to return higher assay values, especially when visible gold had been observed in the core. Multiple blanks were inserted in batches when numerous high-grade samples were noted by the geologist. A total of 549 blank samples were used in the 2017 program.

CRMs were used to monitor the accuracy of the gold assays and to check for laboratory bias when samples were sent for umpire check assays. The selection of the CRM sample in each batch was made by the geologist to match the expected grade of the samples analyzed by fire assay – AAS. Additionally, the lab was required to insert a blind high-grade standard whenever a gravimetric analysis was completed on samples that assayed greater than 10 g/t by the AAS method. Seven commercial gold CRMs sourced from CDN Resource Laboratories Ltd. (CDN) were used in sampling on the 2017 program, ranging from 1.16 to 29.21 g/t gold (Table 11-4)

Table 11-4: Specifications of CDN CRMs Used by Rubicon on the Phoenix Gold Project in 2017

Gold CRM	Recommended Value (g/t Au)	Standard Deviation (g/t)	Number of Samples
CDN-GS-1L	1.16	0.05	20
CDN-GS-1P5L	1.53	0.07	369
CDN-GS-4E	4.19	0.11	99
CDN-GS-6A	5.69	0.24	37
CDN-GS-7F	6.90	0.21	17
CDN-GS-11A	11.21	0.47	6
CDN-GS-30B	29.21	0.62	20

Replicate samples included coarse reject and pulp duplicates as a check on laboratory precision in assaying. Two replicate samples were completed in every batch of 25, one from the pulps and one from the coarse rejects. Approximately, 1050 replicate analyses were completed in 2017.

Rubicon conducted umpire check assay programs throughout the course of the program. In 2012, 5% of the sample pulps were re-assayed by ALS. In 2015, 3% of the sample pulps were re-assayed by Accurassay (2014-2015). In 2017, 5% of the sample pulps were re-assayed at Actlabs.

Analytical results were verified by monitoring analytical results of QC samples inserted with the samples submitted for assaying. The QC data was monitored concurrently with data collection, allowing immediate resolution of any issues identified. Both internal and blind quality control samples were plotted on Shewhart control charts on a regular basis to identify outliers and trends in the control samples, which would indicate potential issues with the assay data. Paired data (field duplicates and umpire check assays) were analyzed using bias charts, quantile-quantile, relative difference plots, and Thompson-Howarth precision plots. Examples of the QC monitoring charts are shown in Figures 11-1 through 11-2.

For the 2017 drill programs, the blind CRMs (or standards) were within the range of accepted values with no significant trend or bias noted. Several examples of Shewhart control charts used for monitoring the blind standards are illustrated in Figures 11-1a and 11-1b below. These charts record all QC samples, including blind CRM failures. Outliers were noted and explanations provided on the respective charts. All QC failures for batches having significant gold assay values were reassayed. For batches having no significant gold values, when the CRM result failed on the low side, the core was reviewed and if no significant results were expected for the samples in that batch, a geological override was applied and the assay values were accepted. Thirty-four (34) of the total 568 CRM samples failed their initial assay and of these, 26 were reassayed successfully and 8 were resolved with a geological override. In general, outliers for the blind CRMs tended to be biased toward low values. No significant cross contamination of samples was noted in the analytical process (Figure 11-1c). When the blind preparation blank assayed greater than the 0.1 g/t cut-off, the entire batch was reassayed from the coarse reject to obtain acceptable results. Two example internal laboratory CRM charts (Figures 11-1d and 11-1e) are also presented. These charts plot all CRM results, including failed CRMs that were ultimately reassayed by the lab.

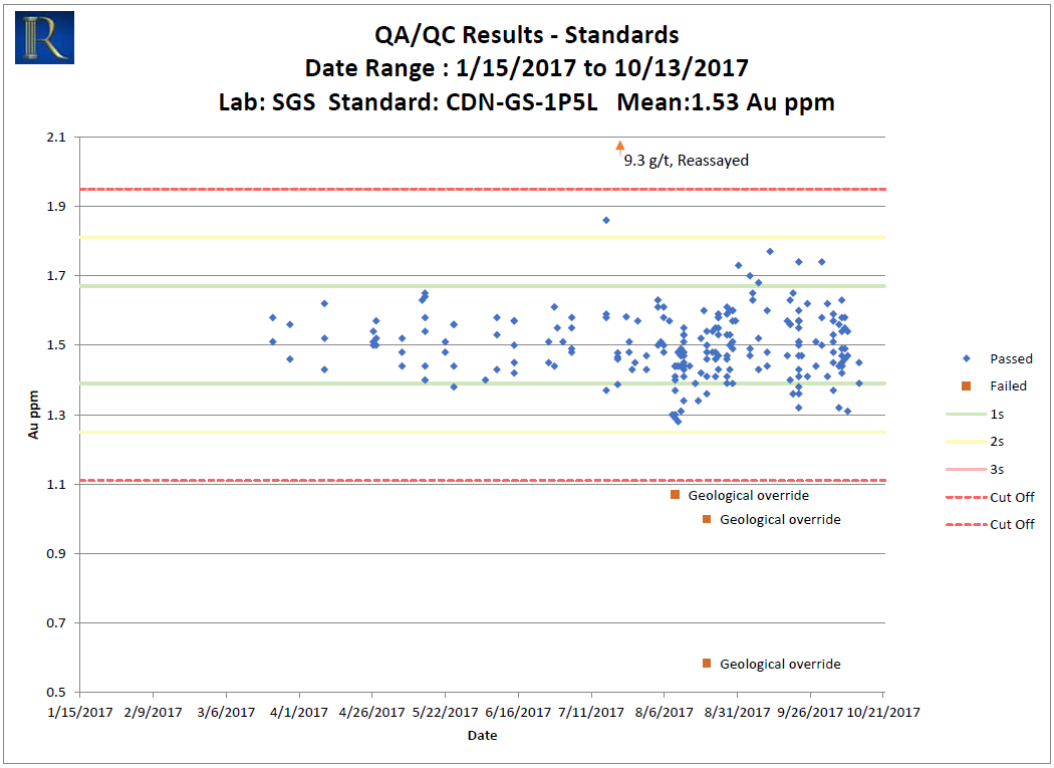


Figure 11-1a: Example Shewhart Control Chart for CDN-GS-1P5L

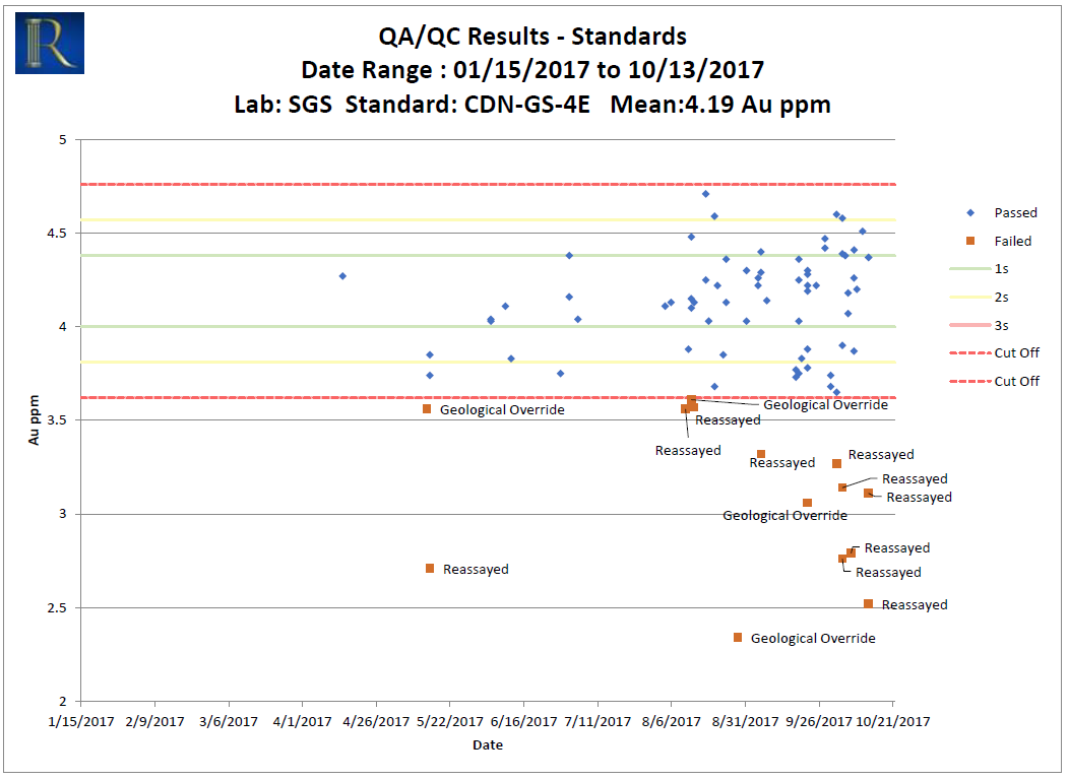


Figure 11-1b: Example Shewhart Control Chart for CRM CDN-GS-4E

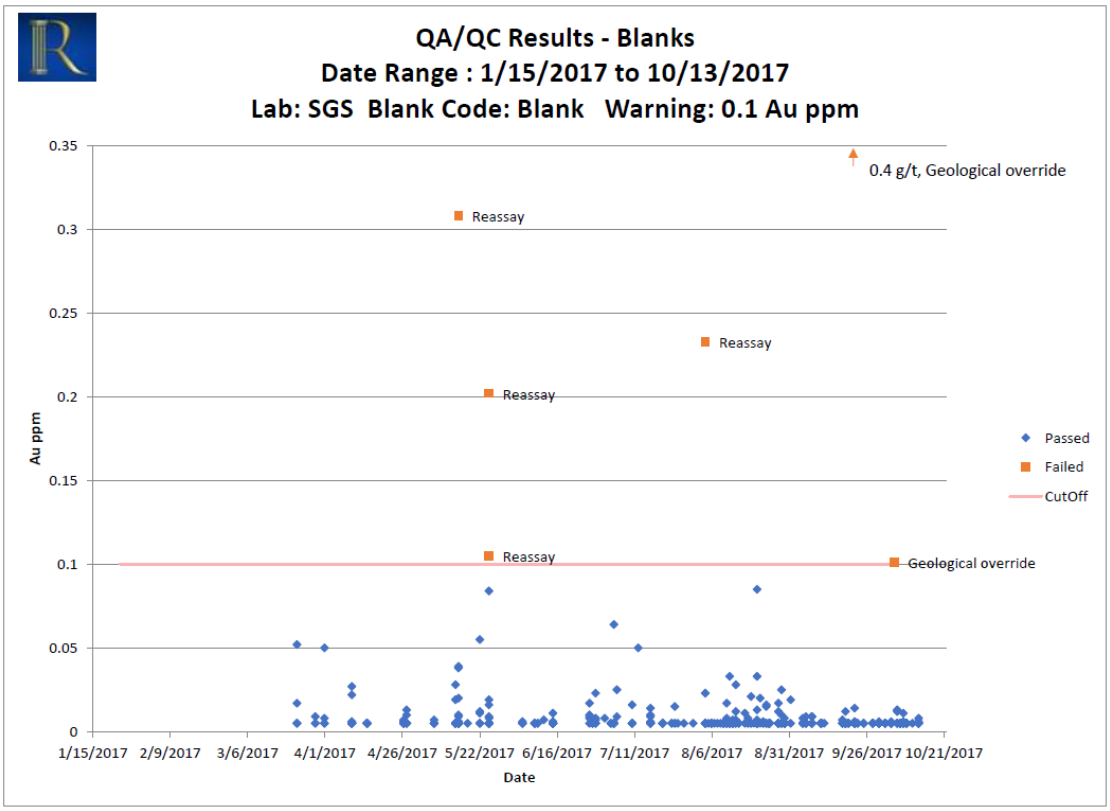


Figure 11-1c: Example Shewhart Control Charts for Monitoring Results for Blank Samples

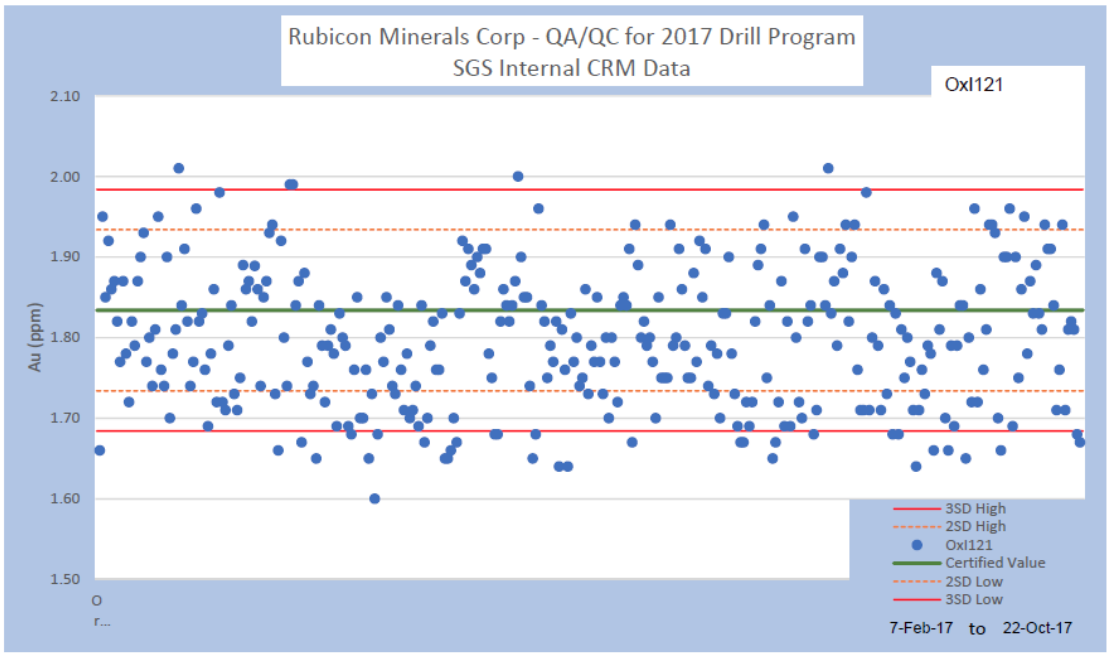


Figure 11-1d: SGS Internal CRM Oxl121 Processed with RMX 2017 Drill Program Samples

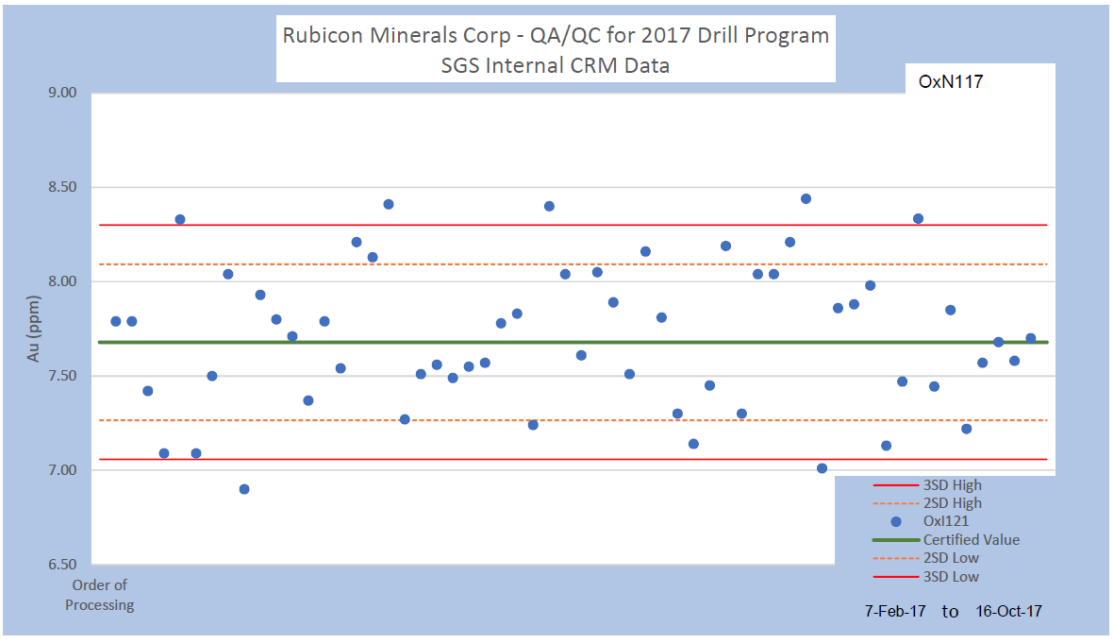


Figure 11-1e: SGS Internal CRM OxN117 Processed with RMX 2017 Drill Program Samples

Analytical QC failures were identified as:

1) Any blank sample that reported greater than 0.1 g/t Au.

2) Any CRM result that reported with a difference greater than 3 standard deviations from the certified mean or recommended value for the standard.

3) More than 2 sequential CRM results that reported with differences greater than 2 standard deviations from the certified mean or recommended value, having the same positive or negative bias.

Results were tracked in an action log as part of the standard QA/QC procedures. Failures were investigated and samples were re-assayed as required.

SGS' performance on the CRMs used in the 2017 program is summarized in Table 11-5 and Table 11-6.

Table 11-5: Internal Lab CRMs

Constituent	Certified Value	Absolute Standard Deviations					RSD (%)	# used	Lab mean	bias (ppm)	Percent bias
		1SD	2SD Low	2SD High	3SD Low	3SD High					
Fire Assay											
OREAS 209	1.58	0.044	1.49	1.66	1.44	1.71	2.80	32	1.54	-0.03	-0.02
OREAS 215	3.54	0.097	3.35	3.74	3.25	3.83	2.72	41	3.51	-0.03	-0.01
OxF125	0.806	0.020	0.766	0.846	0.746	0.866	2.48	5	0.78	-0.03	-0.03
OxI121	1.834	0.050	1.734	1.934	1.684	1.984	2.73	336	1.80	-0.04	-0.02
OxL118	5.828	0.149	5.530	6.126	5.381	6.275	2.56	3	5.63	-0.19	-0.03
OxN117	7.679	0.207	7.265	8.093	7.058	8.300	2.70	58	7.71	0.03	0.00
OxP116	14.92	0.360	14.200	15.640	13.840	16.000	2.41	5	14.72	-0.20	-0.01
OxQ90	24.88	0.560	23.760	26.000	23.200	26.560	2.25	20	25.04	0.16	0.01
CDN-GS-5Q	5.59	0.175	5.240	5.940	5.065	6.115	3.13	5	5.43	-0.16	-0.03

Table 11-6: Blind CRMs

Constituent	Certified Value	Absolute Standard Deviations					RSD (%)	# used	Lab mean	bias (ppm)	Percent bias
		1SD	2SD Low	2SD High	3SD Low	3SD High					
Fire Assay											
GS-1P5L	1.53	0.070	1.25	1.81	1.11	1.95	4.58	218	1.49	-0.04	-0.02
GS-4E	4.19	0.113	3.81	4.57	3.62	4.76	2.69	72	4.08	-0.11	-0.03
GS-6A	5.69	0.240	5.21	6.17	4.97	6.41	4.22	34	5.76	0.07	0.01
GS-7F	6.90	0.205	6.08	7.72	5.67	8.13	2.97	15	6.82	-0.08	-0.01
GS-11A	11.21	0.435	10.34	12.08	9.91	12.52	3.88	1	11.59	0.38	0.03
GS-30B	29.21	0.615	27.98	30.44	27.37	31.06	2.11	9	28.58	-0.63	-0.02

Scatter plots and Q-Q plots for pulp duplicates indicate good correlation between original and duplicate assays. The relative difference plot indicates that less than 5% are greater than 10% different. The Thompson-Howarth precision for the pulp duplicates is 11.6%, which is typical for Archean lode gold deposits.

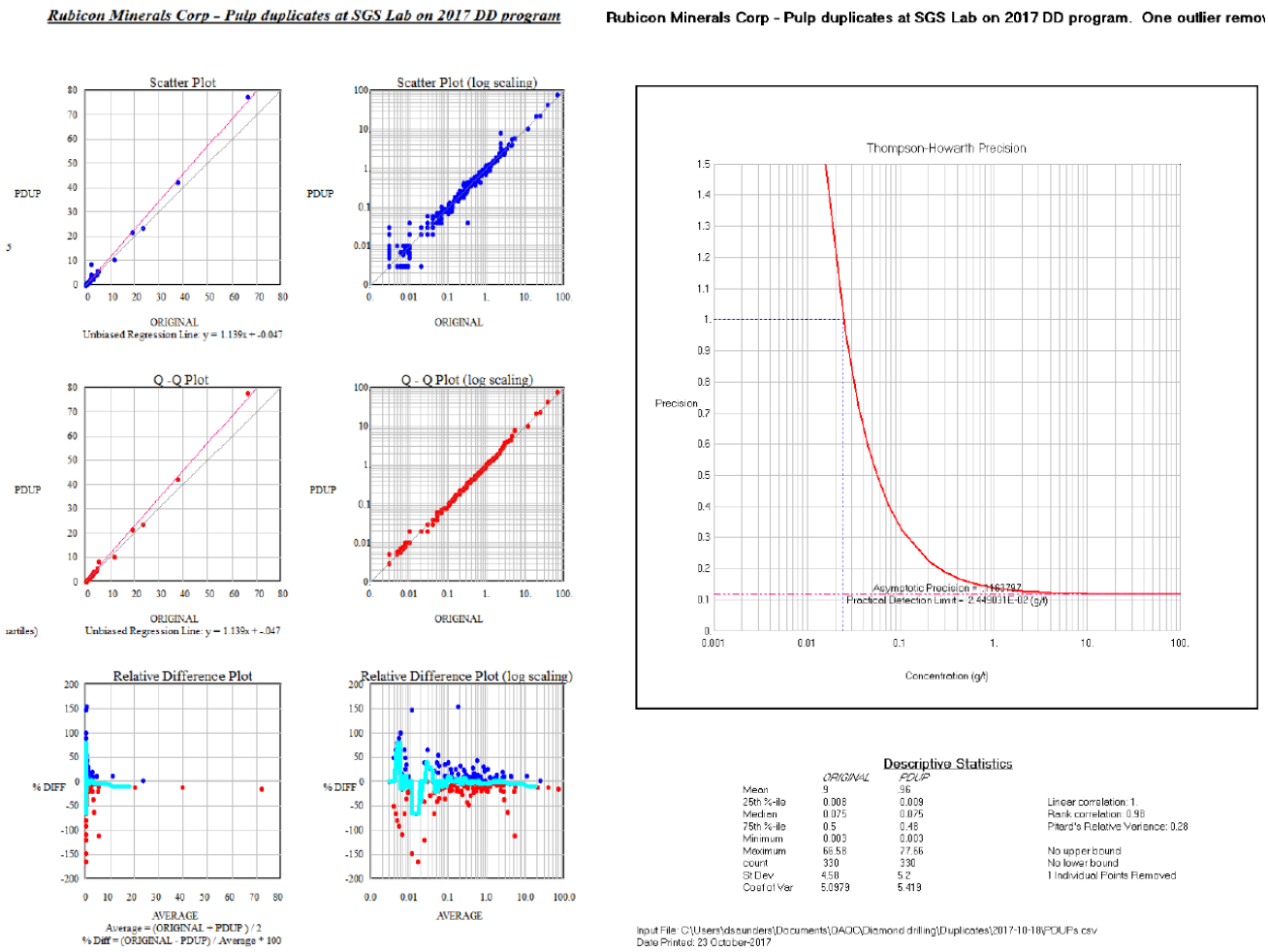


Figure 11-2: Example Scatter Plots, Quantile-Quantile Plots, Relative Difference Plots and Thompson-Howarth Plots Used To Monitor Precision On Duplicate Assay Pairs; Example charts are for Pulp Duplicate Data.

11.6 Qualified Person Opinion on the Adequacy of Sample Preparation, Security, and Analytical Procedures

It is TMAC's opinion that the sample preparation, security and analytical procedures used by Rubicon are consistent with standard industry practices and that the data is suitable for the 2018 Resource Estimate. TMAC has no material concerns with the geological or analytical procedures used or the quality of the resulting data

12.0 DATA VERIFICATION

12.1 Golder 2017

Golder completed a number of data verification checks throughout the duration of the 2018 Mineral Resource Estimate. The verification process included a 1-week site visit (in 2017) to the Phoenix Gold Project property by the resource QP to review geological procedures, chain of custody of drill core samples, and collection of independent samples for metal verification. Other data verification included a spot check comparison of Au assays from the drill hole database against original assay records (lab certificates) and a review of QA/QC performance for the 2017 drill program. Golder has also completed additional data analysis and validation as outlined in Section 14.

12.1.1 Site Visit

A site visit to the Phoenix Gold Project site was carried out by Brian Thomas, P.Geo., QP for this Mineral Resource Estimate from June 5th to June 9th, 2017. The site visit included the following activities:

- underground tour of accessible development headings and active diamond drill stations
- review of site geology, mineralization and structural controls on mineralization
- review of drilling, logging, sampling, analytical, and QA/QC procedures
- review of bulk density measurement procedures
- review of site security and chain of custody of drill core from the drill to the assay lab
- confirmation of drill logs and independent assay verification on selected drill core samples
- review of infill drill targets and potential development and test stope areas
- inspection of the SGS Laboratory located in Red Lake

No significant issues were identified during the site visit and the geological data collection procedures and the chain of custody were all found to be consistent with industry standards and in accordance with Rubicon internal procedure documentation. On conclusion of the site visit, Golder recommended that a series of bulk density measurements be completed by a certified lab as confirmation of the Rubicon density database and that a series of sample pulps be sent to a secondary lab for comparative analysis. Results of these bulk density checks were found to confirm the quality of the Rubicon density data, further described in Section 14, as well as the assay results from the 2017 drill program.

Golder provided Rubicon with a list of recommendations for minor process improvements that were not deemed to be material to the 2018 Resource Estimate. Full details of the site visit are documented in the Golder technical memo entitled “Phoenix Gold Project – June 2017 Resource Qualified Person Site Visit Report” dated July 10, 2017.

In addition to the site visit performed by the Golder Mineral Resource QP, Golder also performed two site visits during the drilling program from February 13 to February 17, 2017 and again from April 17 to April 21, 2017. The purpose of these two site visits was to monitor the oriented core drilling, core orientation, oriented core measurement, and core logging procedures to monitor the collection of structural data and observations during

the 2017 drilling program. These two site visits included time underground with Rubicon personnel observing the core drilling and initial core orientation by the drilling contractor, as well as significant time in the core shed with the Rubicon team reviewing the descriptive re-logging of historical drill holes, logging of 2017 program drill holes and observing core orientation and structural measurement collection and observations from the oriented drill core.

Minor recommendations for improvements to the process were provided by Golder to Rubicon, but in general, the oriented core drilling, core orientation, oriented measurements and structural data and observations collected were reliable and representative of the structural features being drilled and of those observed in the underground mine development. The collection of structural data and observations was found to be consistent with industry standards and in accordance with Rubicon's internal procedure documentation.

12.1.2 SGS Laboratory Inspection

The Golder QP, accompanied by the TMAC QP conducted an unannounced inspection of the SGS laboratory in Red Lake during the afternoon of June 9, 2017. The Manager of the laboratory led the tour through the sample receiving area, sample preparation area, fire assay area and the wet lab. The Golder QP did not perform a detailed audit of the laboratory or observe the sample preparation or fire assay procedures, but the lab was found to be well organized and clean and all scales were found to have been properly calibrated for the day.

12.1.3 Independent Sampling

The Golder QP selected intervals from 5 holes from the 2017 drill program for validation logging and sampling as listed in Table 12-1. A total of 27 core samples and 3 control samples (2 CRM standards and 1 blank) were taken from quarter sawn core. Golder elected to combine some of the shorter sample intervals, ranging from 0.3 m to 0.5 m, into longer composite samples due to the low sample volume of the quartered core.

Table 12-1: Verification Intervals

Hole ID	From (m)	To (m)
305-17-01	44.6	55.4
	59.9	63.8
	70.9	73.4
305-17-02	36.0	38.0
	58.5	60.2
305-17-03	58.5	64.9
305-17-07	49.0	54.0
	62.5	67.1
305-17-09	43.5	51.9
	74.2	82.0

The core was compared to the logged descriptions and found to be reasonably accurate with some minor inconsistency issues identified. These issues were discussed with Rubicon while on site. Figure 12-1 provides an example of a core interval check logged and sampled, where intervals designated for sampling were turned so that the uncut side is facing up.

Figure 12-1: Example Interval for Verification Sample and Logging

Golder samples were quarter sawn and placed into plastic sample bags and then combined into larger rice bags and secured with a security seal (Figure 12-2). All samples were then shipped to the Actlabs facility in Ancaster, Ontario for fire assay using the same analytical procedures as used by Rubicon.

Figure 12-2: Golder Verification Samples

The Golder assay results were then compared to the Rubicon database and summarized in the following scatter plot (Figure 12-3). Despite some obvious sample variance, most assays compared within reasonable tolerances for the deposit type and no material bias was evident. One Rubicon outlier assay (1,182 g/t) from a short sample interval (0.35 m) was not repeatable and the composite grade of the entire 1.35 m interval plotted off the scale of the graph at 85.62 g/t. The Golder composite grade for the same interval was 4.38 g/t.

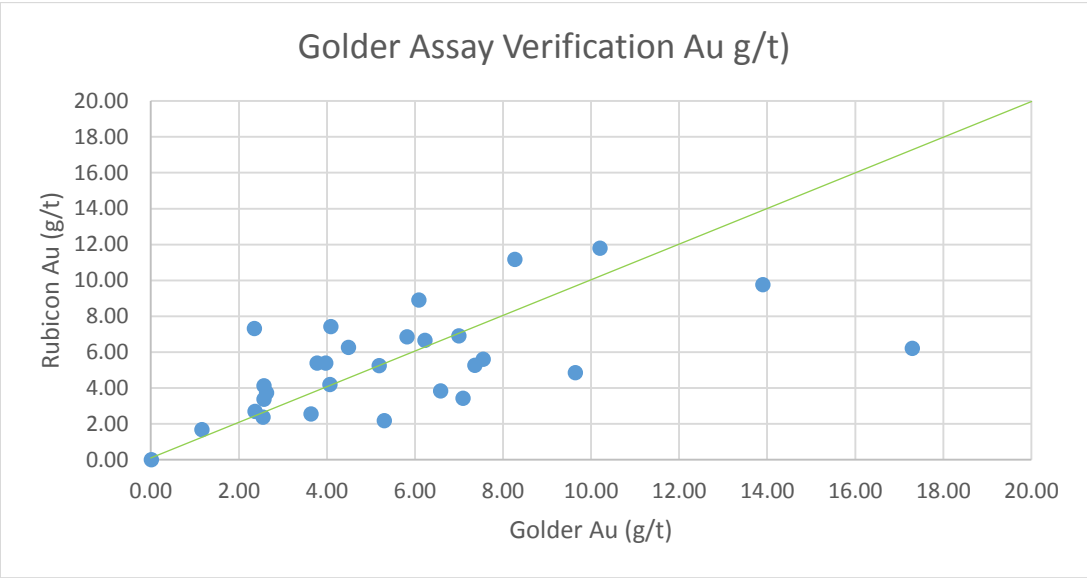


Figure 12-3: Scatterplot Comparison of Verification Samples

12.1.4 Database Verification

The Golder QP completed spot check verification of 281 Au assays from representative areas within the modelled mineral zones, focusing on samples having a grade greater than 2.0 g/t. Sample intervals were selected from holes spanning date ranges from 2008 to 2017. Golder did not identify any material issues and the data was found to match the original lab certificates. A summary of the data validation is listed in Table 12-2.

Table 12-2: Drill Hole Sample Data Validation

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
# of Samples	12	37	112	15	51	0	1	1	0	52
# of Errors	0	0	0	0	0	0	0	0	0	0

12.1.5 Structural Data Verification

Golder performed regular desktop reviews on the core orientation and structural data measurements and observations collected during the 2017 drilling program to ensure the data was being collected in accordance with the Rubicon procedures for oriented core drilling and structural data collection and core logging.

Oriented core data measurements were compiled by Rubicon and provided to Golder in a master MS Excel™ spreadsheet. The data were imported into the Project master drill hole database in MS Access™ and basic data integrity checks were run to ensure the data were free of errors or omissions. The oriented core measurement records were also cross referenced against lithology and assay data in the database to capture details on rock type, alteration and mineralization types and assay grades associated with the structural point data. This data was compiled into a single table and exported to a MS Excel™ spreadsheet for use in generating stereonets and rose plots in Dips™.

The validated structural measurement data set included 4,629 structural measurements taken from 34 drill holes. Figure 12-4 shows the distribution of oriented core structural measurement data according to drill hole collar azimuth orientation, mine level, host rock type, and structural feature type.

The oriented core drill holes were fairly evenly divided between NE and E drilling directions (based on drill collar azimuth), allowing for evaluation of both N-S and E-W oriented structural features. The majority of oriented core drill holes (23 of 34 drill holes) were drilled from the 305 level and focused primarily on the F2 Basalt Zone of the deposit; future drilling should include additional oriented core drilling from other levels and targeting other zones in the deposit to help establish a more robust and spatially representative database of structural measurement data.

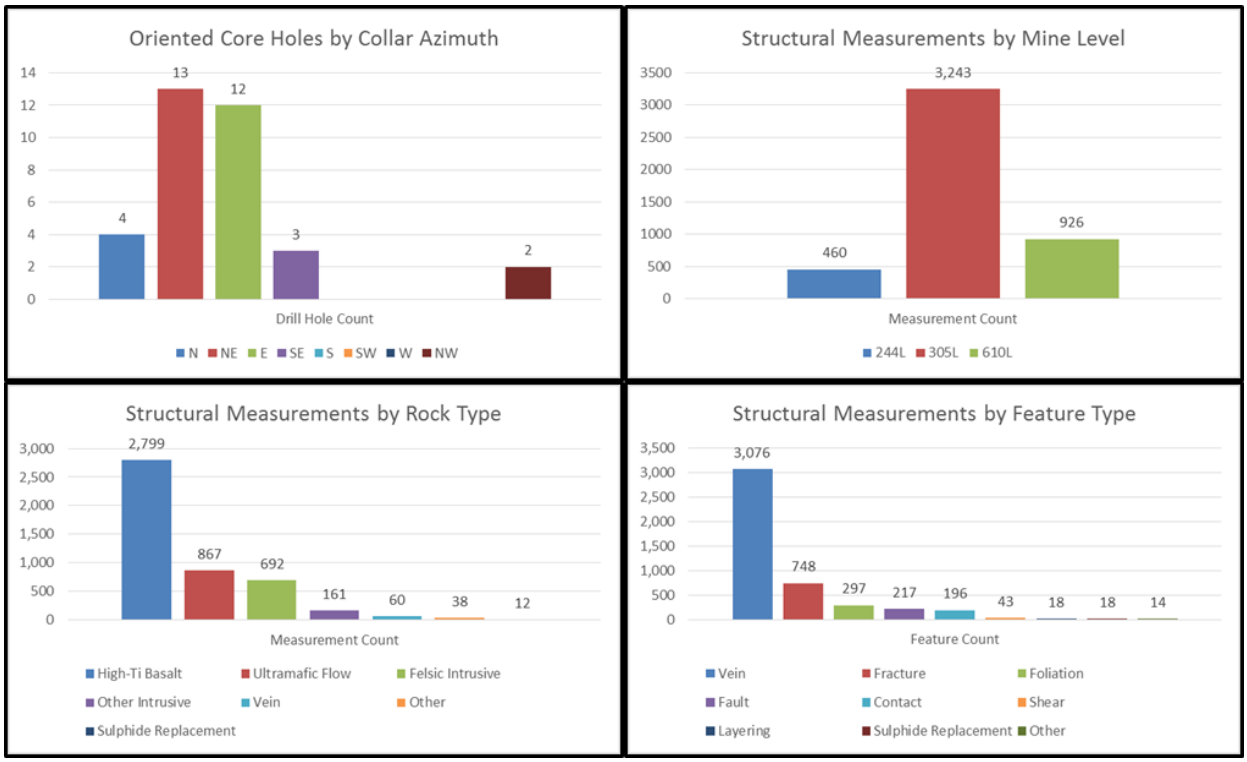


Figure 12-4: Structural Measurement Data by Various Categories

Given the primary focus on evaluating structural controls on gold mineralization, a significant proportion of the structural measurements were collected from the High-Ti Basalt and the Felsic Intrusive units; these measurements were primarily quartz vein orientations. A significant number of measurements were also collected in the Ultramafic unit, where fractures/joints and the S1 foliation were the predominant features measured.

Golder performed detailed statistical and graphical orientation analysis of the structural measurement data, calculating univariate statistics and generating stereonets and rose plots for the various structural features with a variety of filters applied including orientation confidence level, host rock type, gold grade range bins and mine level associations. To ensure reliable orientation measurements, only measurements with an orientation line confidence category of 5 or greater (lock angle between 0° and 10°) were used in the orientation analysis.

Example stereonets are presented in Figure 12-5 (all foliation, orientation line confidence greater than 5) and Figure 12-6 (all veins, gold grade greater than 3 g/t, orientation line confidence greater than 5).

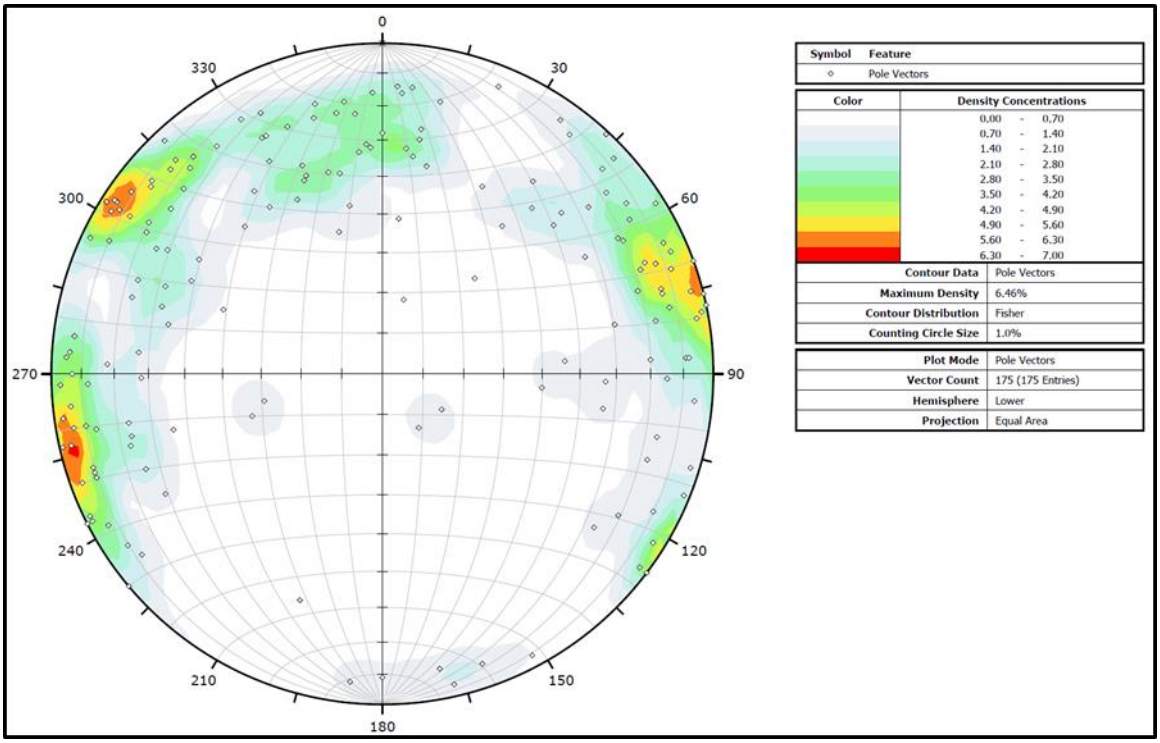


Figure 12-5: Example Stereonet, All Foliation, Orientation Confidence > 5

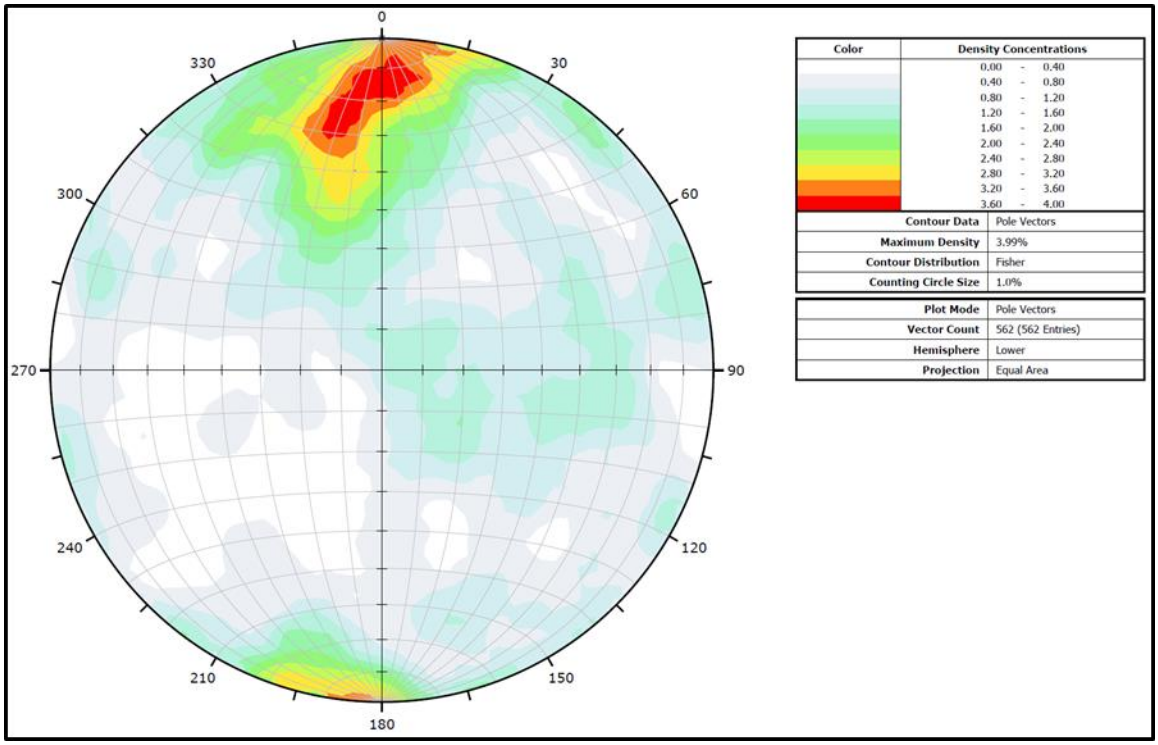


Figure 12-6: Example Stereonet, All Veins, Gold Grade >3g/t, Orientation Confidence > 5

In addition to the statistical and graphical orientation analysis, Golder also performed a 3D visual orientation and spatial analysis of the orientation data in the Datamine Studio RM™ software package. The various structural features were imported into the Datamine geological model as down hole point data features and -3D dip and dip direction vectors were plotted. These features were then used along with other drilling and underground mapping data and observations when developing interpretive lithological, structural and gold mineralization domain wireframes and trend control surfaces and strings.

Consistent with the observations from the statistical and graphical orientation analysis, the Datamine geological model structural feature visual analysis supported the relationship between E-W oriented, steeply-dipping quartz-actinolite veins and elevated gold grades.

Based on the review of the structural data and observations, Golder is satisfied that they were collected in an appropriate manner and are free from any significant errors or omissions and are considered reliable and representative for use in geological modelling.

12.1.6 Review of Rubicon QA/QC

Rubicon has a robust QA/QC process in place as previously described in Section 11. Rubicon actively monitored the assay results throughout the 2017 drill program and summarized QA/QC results in reports provided to Golder for review. A number of failures for standard and blank reference materials were documented resulting in re-assay of entire sample batches. The majority of certified reference materials performed as expected within tolerances of 2 to 3 standard deviations of the mean grade. Golder is satisfied that the QA/QC process is performing as designed to ensure the quality of the assay data.

12.2 Conclusions

On completion of the data verification process, it is the Golder QP's opinion that the geological data collection and QA/QC procedures used by Rubicon are consistent with standard industry practices and that the geological database is of suitable quality to support the 2018 Mineral Resource Estimate, as reported in Section 14.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

This section summarizes the metallurgical test work completed on samples from the F2 gold deposit between 2008 and 2012 to support the conceptual design of a processing plant for the 2013 Technical Report (SRK 2013). The information from this section was extracted from the 2013 Technical Report. No additional specific process development testing was conducted after 2012. Mill operation in 2015 confirmed that the basic design criteria with respect to recovery and throughput at 1,250 t/d could be achieved.

The process plant construction was initiated in 2013 and completed during 2015. The crushing and material handling systems, grinding, gold recovery and refinery areas of the process plant were commissioned and operated in 2015, processing a total of 57,793 dry tonnes of low grade development material and mineralized material extracted from test stopes in the F2 gold deposit. The mill ceased operating on November 21, 2015 and was placed into care and maintenance. A total of 5,153 ounces were produced, including 740.7 ounces recovered from cleanup activity after operations ceased. These cleanup ounces were not reflected in the

previous technical report (SRK, 2016) and had a slightly positive impact on both average head grade and recovery for the processing period. The cleanup effort, while significant, was not to the extent of a permanent mine closure. Rubicon pursued alternatives to continue the Phoenix Gold Project and ultimately completed a corporate restructuring. The Project restarted advanced exploration with activities focused on re-logging core and diamond drilling to add data to the resource base. No specific metallurgical testing was performed on the new core. A number of samples were taken from the new drill core for specific gravity determination. The results obtained fit within the historical specific gravity data, indicating that the mineralized material tested in 2017 is similar to previously tested material.

13.1 Summary of Historical Testwork

In September 2008, Vancouver Petrographics Ltd. (Vancouver Petrographics, 2008) performed a petrographic analysis on 10 thin sections derived from representative mineralized core samples from the F2 gold deposit.

In October 2010, Rubicon completed a metallurgical testwork program (the “2010 study”) performed by Soutex. The study was done on small samples from different underground zones. The testwork program was conducted at G&T under the supervision of Soutex (G&T, 2010). This study included running a metallurgical testwork program, developing a preliminary milling process, and designing a preliminary concentrator. The design addressed the gold recovery process from mineralized material delivered by the mine to the process plant for gold extraction and ultimately discharging a cyanide-free tailings to the tailings management facilities and the production of gold doré. Paste plant considerations and the tailings management facility were not included in the study.

In September 2011, Rubicon completed a further metallurgical testwork program performed by Soutex. The study was done on representative subsamples (composites) extracted from two approximately 1,000-tonne bulk samples representing two underground areas on the 305 m level. The metallurgical testwork program was conducted at G&T under the supervision of Soutex (G&T, 2011).

Characterization of mineralized material competency for semi-autogenous grinding (SAG) milling was performed by G&T under the supervision of JKTech Pty Ltd. (JKTech, 2011). The grinding circuit design was validated by simulation with SGS Minerals Services (SGS, 2011). In July 2012, the processing of the two approximately 1,000-tonne bulk samples was completed at SMC under the supervision of Soutex in order to reconcile the bulk sample grades against the resource estimate (Soutex, 2013).

A processing plant was constructed at the Phoenix Gold Project site and commenced treating mineralized material in 2015. The process flowsheet consisted of a SAG and a ball mill in closed circuit with cyclones, gravity concentration, and carbon in leach (CIL) followed by electrowinning. Doré was produced from gravity concentrate and electrowinning sludge. Cyanide was destroyed and the tailings were deposited in the tailing management facility. Gold produced during this period was 5,153 ounces from processing 57,793 dry tonnes of mineralized material grading 3.02 g/t between May and December 2015. The mill feed was primarily sourced from test stopes mined in the F2 gold deposit and mineralized development material. A partial clean-up of the milling circuit was conducted to recover some of the gold locked up in the circuit. Grade and recovery values reported in the 2016 SRK Technical Report have been adjusted to include these ounces. Gold recovery achieved was 91.9%. This result is consistent with the results obtained in the metallurgical testwork used by Soutex for process flowsheet development in the preliminary economic assessment (Figure 13-1).

The cyanide destruction circuit achieved the target cyanide (CN) levels required at the Tailings Management Facility (TMF).

13.2 Gold Recovery Estimates

13.2.1 Projected Gold Recovery

The gold recovery results obtained from only two core samples (RL-01-01 and RL-01-02) were used to evaluate the average gold recovery, using gravity and cyanide leaching, for the preliminary economic assessment (SRK, 2013b). These results are presented in Figure 13-1. It should be noted that the core sample grades used at the time were greater than 5 g/t while the mineralized material treated in 2015 was approximately 3 g/t.

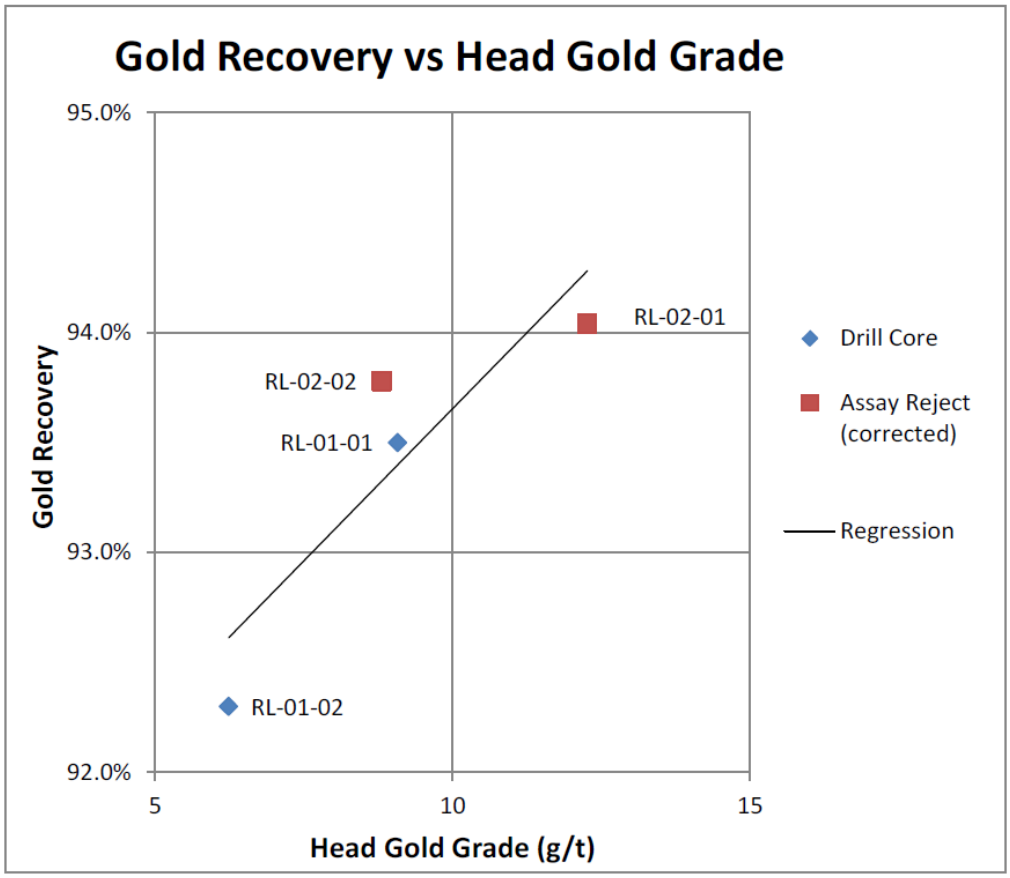


Figure 13-1: Effect of Head Gold Grade on Gold Recovery

13.2.2 Actual Gold Recovery Achieved During Operation in 2015

The mill commenced operation in May 2015 using gravity and carbon-in-leach to recover gold. Operation of the mill was intermittent as the mine could not sustain the permitted daily feed rate of 1,250 t/d. Mill operation ceased on November 21, 2015 and the majority of the gold locked inventory contained in the gravity and leach circuit was recovered during cleanup.

During commissioning and start-up of the process plant, the mill treated low-grade mineralized material mined during underground mine development. The actual gold recovery achieved from the processing of 57,793 dry tonnes of mineralized material grading an average of 3.02 g/t from trial stopes between May and December 2015 was 91.9%. This is consistent with the results obtained in the metallurgical testwork and used for the estimates in the preliminary economic assessment (Figure 13-1). In the preliminary economic assessment, the grade recovery relationship was developed from a small number of samples with head grades in a higher range than were delivered from the stopes mined. By extrapolating this curve into the lower head grade range of the mineralized material milled in 2015, the expected recoveries fall into the 88-90% range. The recoveries achieved by the mill are relatively high at 91.9% for the lower-grade material when compared to the extrapolated grade recovery curve.

The final reconciled metallurgical data by month for the processing of test stopes is shown in Table 13-1. The total amount of gold recovered was 5,153 ounces including 741 ounces recovered from the ball mill cleanup after operations ceased. Figure 13-2 displays the relationship between head grade and recovery derived from actual plant data combined with metallurgical test data.

Table 13-1: Monthly Metallurgical Reconciliation for 2015 During Trial Stoping (including Cleanup Ounces)

Parameter	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Mill Feed (tonnes dry)	13,226	11,747	5,940	8,460	6,318	275	11,826	-	57,793
Gold Poured (oz.)	0	742	448	570	738	0	1,915	-	4,412
Inventory Change (oz.)	795	-227	116	319	-172	34	-370	-	740*
Change in Cathodes (oz.)	0	178	94	49	100	0	-421	-	0
Gold in Tails (oz.)	73	76	36	102	75	2	93	-	457
Gold in Mill Feed (oz.)	868	769	693	1,041	740	35	1,217	-	5,610
Grade (g/t)	2.04	2.04	3.63	3.83	3.64	4.00	3.20	-	3.02
Recovery	91.5%	90.1%	94.8%	90.2%	89.9%	94.7%	92.4%	-	91.9%
Gold Recovered (oz.)	795	693	657	938	665	34	1,124	-	5,153

*740 ounces recovered in 2016 from partial mill cleanup included in gold accounting Source: RMX internal document

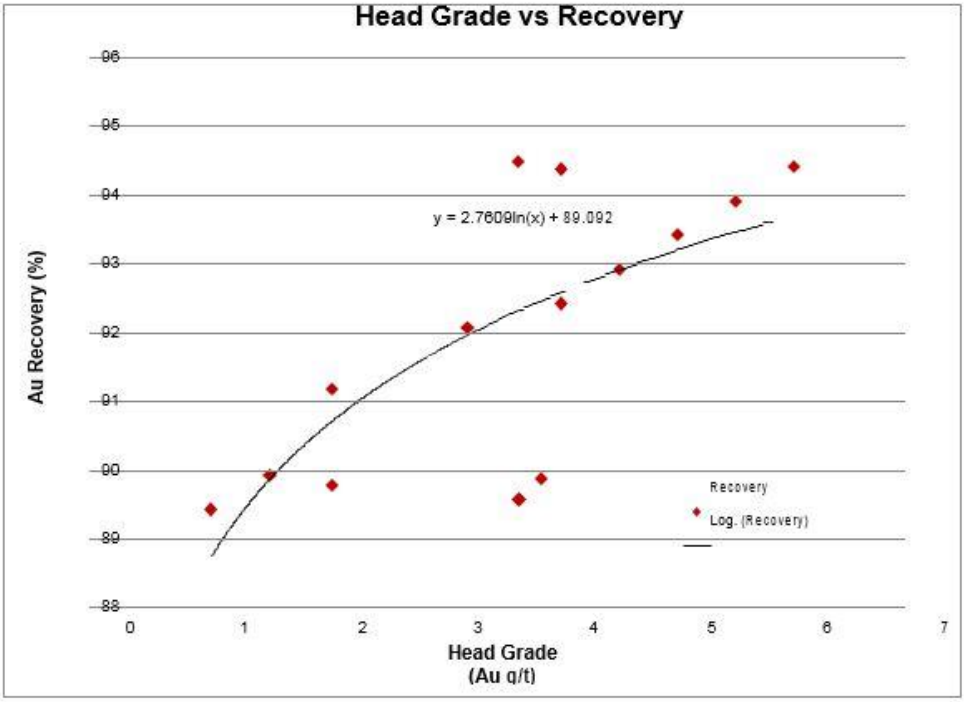


Figure 13-2: Head Grade and Recovery Derived from Actual Plant Data and Metallurgical Test Data

13.2.3 Improvements in Gold Recovery

It is anticipated that with better knowledge of the gold deportment in the various zones of gold mineralization, and having all CIL installed capacity available for leaching, combined with steady state operation, higher head grades, with continuous operational improvement efforts, gold recoveries greater than 91.9% may be realized in future years of operation.

13.3 Mill Feed Sources

During commissioning and start-up of the process plant, the mill treated low-grade mineralized material mined during underground mine development. This is standard practice in commissioning a new facility. The main source of feed was from the HW and West Limb basalts of the F2 gold deposit. Four stopes (030, 489, 159, and 161) plus development muck accounted for 61% of the mineralized material milled. The balance of mill feed was mined from four trial stopes (977, 994, 065, 164) plus development muck in the F2 gold deposit and accounted for 17% of the mineralized material milled. The remaining 22% of tonnes milled was waste rock that entered the system while mining low-grade mineralized material. The primary mineralized material sources are shown in Figure 13-3 below.

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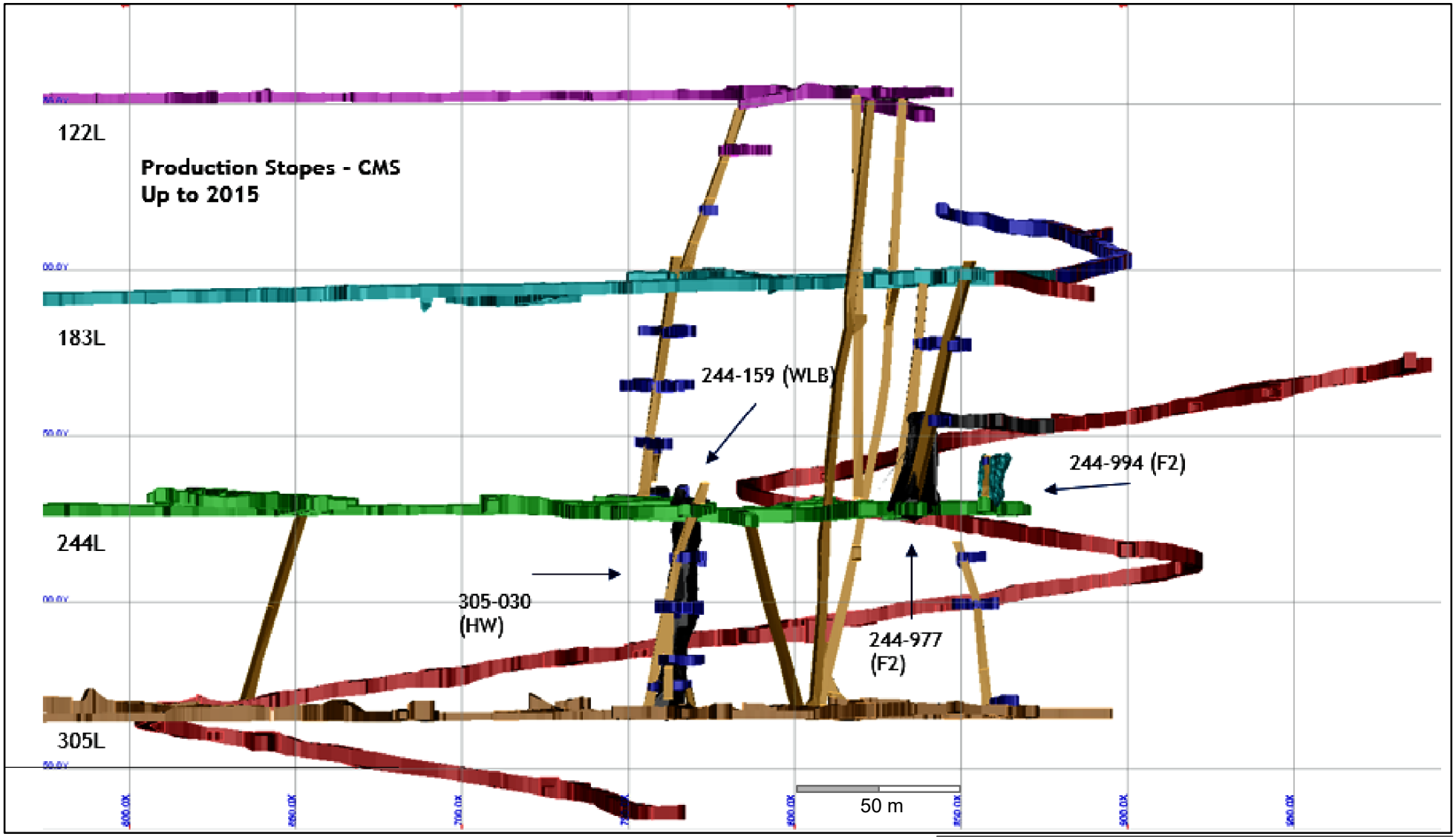

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CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-05-28
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
MINERALIZED MATERIAL SOURCES 2015

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	13-3

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Rubicon intends to process, in batches, up to 30,000 tonnes of test mined material from three stopes in the F2 Basalt Zone in 2018 as shown in Figure 13-4. This information will be used to validate the 2018 Mineral Resource Estimate and block modelling procedures. The mill campaign will enable the operation to optimize grind, reagent additions and create a more robust grade recovery relationship.

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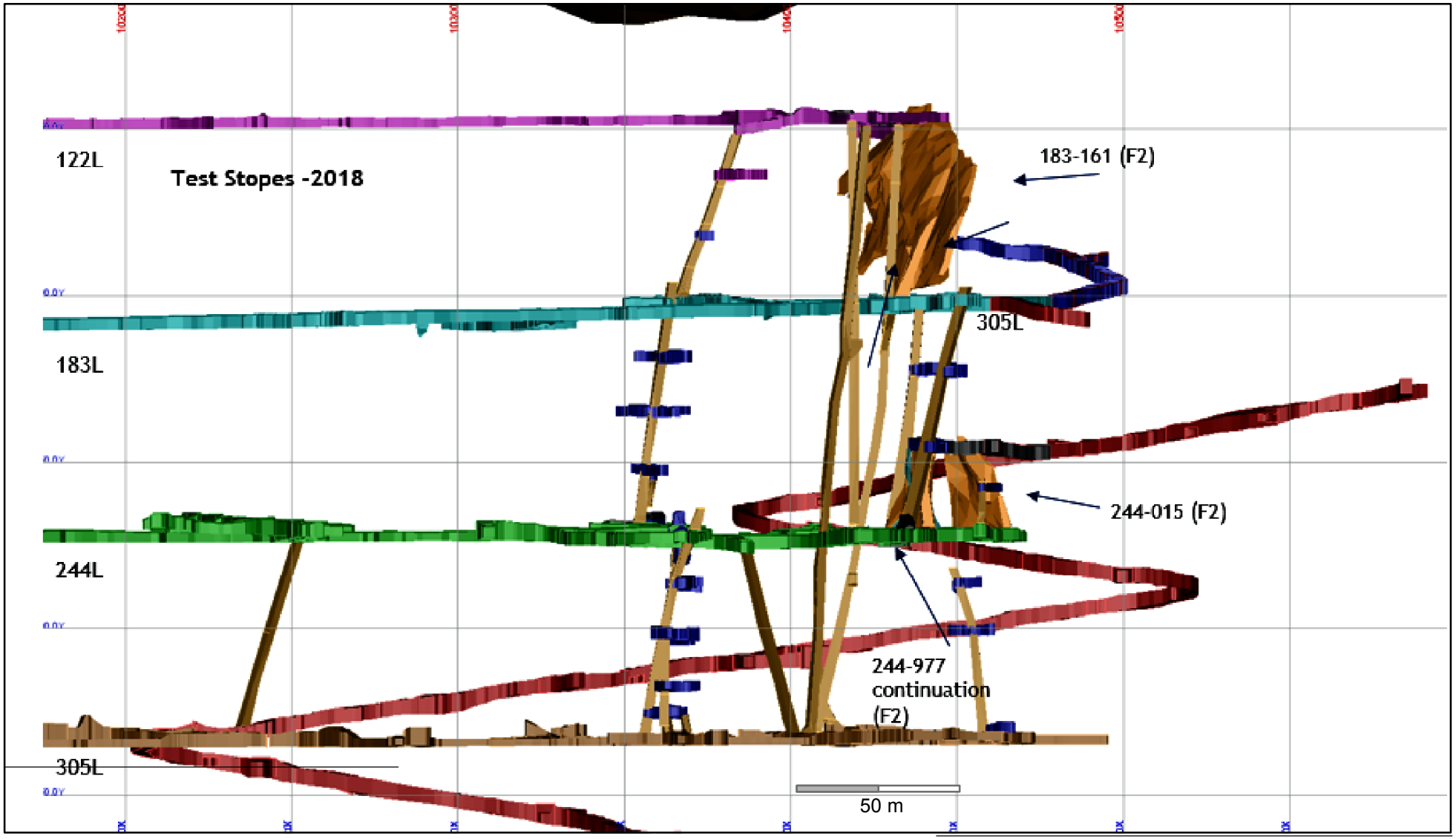

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CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-12
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
PLANNED MINERALIZED MATERIAL SOURCES FOR 2018 BULK TEST

PROJECT NO.	CONTROL	REV.	FIGURE
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13.4 Factors with Possible Effect on Potential Economic Extraction

13.4.1 Main Process Equipment

For operation of the grinding circuit at 1,250 t/d, it was expected that the SAG mill would be operated at a lower speed with a reduced ball charge. This was experienced in the early stages of the 2015 trial operation. Although the mill is currently permitted to process only up to 1,250 t/d, the grinding mills are capable of processing approximately 1,800 t/d with minimal change in the downstream processes. The mill layout allows for the addition of a second ball mill, a second hydrocyclone cluster, a pre-crushing unit and a second stripping column if required in the future.

At the paste plant, for normal operation, 1-disc filter would meet the operating requirement at 1,250 t/d with the second unit on standby. The second filter could be used to increase paste production to 1,800 t/d if needed. There is provision to install a third disc filter. The decision to add a third disc filter could be deferred until there is a definite need for additional capacity. This capacity could be used to meet either paste backfill requirements or to produce dewatered tailings.

13.4.2 Plant Tailings Toxicity

CIL plant tailings are treated using the SO_2/O_2 cyanide destruction process and in the 2015 campaign, cyanide levels less than 5 parts per million (ppm) were consistently achieved.

13.4.3 Tailings Management Facility (TMF) Effluent

The cyanide in the CIL tailings is destroyed using the SO_2/O_2 cyanide destruction process. Cyanate ions are produced as a product of the destruction process. The cyanate breaks down, producing ammonia. Ammonia is a regulated discharge parameter that must be kept within the allowable limits.

During initial operation in 2015 ammonia concentrations in the tailings supernatant pond exceeded the allowable discharge limits. The sources of ammonia were identified to be 1) the cyanide destruction circuit and 2) the mine water which was pumped from underground to the tailings management facility. In order to comply with discharge limits, Rubicon implemented several mitigation measures. These included: 1) eliminating the use of ANFO explosives underground; 2) locally treating mine water with zeolite in the mine and 3) utilizing two tanks in the mill CIL circuit as reactors to create a temporary ammonia removal system using zeolite to lower ammonia to meet discharge limits. As a result, 91,237 cubic m (m^3) was successfully treated and discharged to the environment between September and November 2015.

In 2016, 66,281 m^3 was discharged from a variety of runoff collection ponds on the property, with the permission of the provincial environmental authority. This allowed for some dewatering to occur despite ammonia levels in the TMF remaining above approved discharge limits. Sewage sludge was added to the pond in order to increase bacterial degradation of ammonia and this increased the rate of destruction. In 2017, ammonia levels fell below discharge limits and 221,158 m^3 of water was discharged from the TMF, returning the water elevation to levels not seen since mid-2015. Ammonia levels in the TMF are currently near zero or 1 ppm, well below the discharge objective of 5 ppm. The existing Tailings Management Facility is adequate for the short and near future. An Actiflo® system has been installed to ensure compliance with effluent discharge limits, and a metals removal circuit was added in 2017 and will be commissioned in 2018. The sourcing of an acceptable ammonia treatment

system remains underway. In the future, for long term operation, tailings deposition options should be investigated to determine the optimum method for the life of the mine plan.

13.5 Statement of Representativeness of Samples

The mineralized material processed in 2015 was test mined from the F2 gold deposit. Metallurgical testing and process flowsheet development was based on a small number of samples and two 1,000 tonne bulk samples that were custom processed. Metallurgical testing was conducted on samples with Au grades higher than those delivered to the mill during the 2015 milling campaign. The grade to the mill averaged 3.02 g/t which was much lower than the development testwork which ranged from 5 to 15 g/t. Grade recovery data generated during mill operation in 2015 was incorporated in to the grade recovery curve developed for the Project. The head grade and recovery results obtained from 2015 mill operation have been adjusted to include actual ounces recovered from the partial mill cleanup. The mineralized material milled was lower-grade than the head grades used in the development testwork but the relationship held and could be considered robust considering that 57,793 dry tonnes were milled.

In 2015, mill operations were intermittent and leach capacity was sacrificed as two leach tanks were temporarily repurposed to reduce ammonia concentrations to acceptable discharge levels. At start up, the TMF ponds contained water with extremely high ammonia concentrations that could not be discharged to the environment.

The Phoenix mill never truly achieved steady state operation under optimum controlled conditions. The expectation is that under optimum operating conditions, at steady state, gold recoveries should be higher than those achieved in 2015.

The metallurgical QP interviewed the senior mine geologist and relied on information supplied by Rubicon personnel that the source of the material milled in 2015 was from the F2 deposit.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Introduction

Caution to readers: In this report, the Mineral Resource Estimates for the Rubicon Gold Project contain forward-looking information. Inferred Mineral Resources are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. Material factors that could cause actual results to differ materially from the conclusions and estimates set out in this report include: 1) naturally occurring geological variability 2) geological interpretations 3) differences from the assumed criteria applied by the Qualified Persons to determine the reasonable prospects of economic extraction. The material factors, or assumptions, that were applied in drawing the conclusions, forecasts, and projections set forth in this Item are summarized in this, and other Items of this Technical Report. For this reason, readers should read this Item solely in the context of the full report, and after reading all other Items of this report.

The 2018 Mineral Resource Estimate for the Rubicon Phoenix Gold Project was completed by Mr. Brian Thomas, P.Geo., Senior Resource Geologist with senior peer review by Mr. Jerry DeWolfe, P.Geo., Senior Geological

Consultant, both of Golder, with external 3rd party review completed by Tim Maunula, P.Geo. The effective date of this resource estimate is April 30, 2018.

The Mineral Resource Estimate is based on data provided by Rubicon from surface and underground diamond drill programs, as well as chip samples and mapping from underground development completed between 2002 and 2017. All data received was in the Phoenix Gold Project co-ordinate system which is rotated 45 degrees to the east of magnetic North. No other data translations were completed for the purpose of this Mineral Resource Estimate.

The Phoenix Gold Project mineralization was modelled in four zones defined as Zones 1 to 4 (as described further in Section 14.3). A 3D block model was constructed for the purpose of estimating stratigraphy (i.e. rock type groupings) and Au grades, where stratigraphy was used as a zonal control on Au estimates. The Mineral Resource Estimates were reported at a 3.0 g/t break even cut-off grade and classified according to Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014). Density values were assigned to the model based on the average value of each stratigraphic unit.

The software used for the 2018 Mineral Resource Estimate was Datamine Studio RM and Datamine Studio 3, collectively referred to as Datamine Studio.

14.2 Source Data

The Phoenix Gold Project block model and Mineral Resource Estimate is based predominantly on diamond drill hole data consisting of geological descriptions, gold assays and density measurements, along with lesser amounts of underground development mapping and chip samples (taken by Rubicon Geologists on development faces and walls). The cut-off date for data used in the 2018 Mineral Resource Estimate was November 30, 2017.

Data was provided in electronic format from CSV, and DXF files and imported into Datamine Studio software for modelling as summarized in this Section.

14.2.1 Diamond Drill Holes

A drill hole database consisting of 2,855 holes totaling 695,855 m of core and 207,599 gold assays was made available for modelling. This database covers a volume that includes the historic McFinley deposit as well as the F2 gold deposit. The historic McFinley deposit is not included in this Mineral Resource Estimate.

The database was analyzed for interval errors and out of range values and was reviewed in 3D space to validate the hole locations and desurveyed hole traces. A minor number of interval issues were identified and corrected prior to block modelling and grade estimation.

In an effort to prevent grade bias in the model, a number of surface holes oriented down-dip / down-plunge of mineralization were removed from the database for grade estimation purposes, in areas where underground drilling provided adequate coverage and more representative samples. A minor number of underground holes were also removed from the database where it was obvious that there were geological discrepancies that would have caused bias issues in the model. A summary list of all holes removed from the drill hole database is provided in Table 14-1.

Table 14-1: List of holes not used in the Mineral Resource Estimate

Borehole ID's Removed			
F2-01	F2-10	F2-57	305-29
F2-02	F2-11	F2-60B	
F2-03	F2-12	F2-61B	
F2-04	F2-13	F2-2012-06A-W1	
F2-06	F2-21	244-09-03	
F2-07	F2-22	244-09-04	
F2-08	F2-41	305-05-HQ1	
F2-09	F2-42	305-18	

The quality of the drill hole data is supported by Rubicon's QA/QC process as described previously in Section 11. Golder has also completed independent sample verification and check logging as summarized in Section 12 and has not identified any material flaws in the drill hole data or data collection procedures. Data collection procedures were found to be consistent with current industry practices. The drill hole database has been determined by Golder to be of suitable quality to support the 2018 Mineral Resource Estimate.

14.2.2 Chip Samples

A chip sample database consisting of 4,407 samples, with a total sample length of 4,071 m (giving an average sample length of 0.92 m) was provided by Rubicon. Chip samples were taken by geologists during underground drift and sub-level development using the procedures previously discussed in Item 11. A limited QA/QC program was used for the chip sampling programs in 2015 and 2017 to supplement internal laboratory QA/QC procedures to monitor the quality of the chip sample assay data. It is relatively common practice in the mining industry for chip samples to be assayed by on-site laboratories due to the short turnaround time required for production assays and it is not unusual that QA/QC standards are not as robust as with drill core. The chip sample data consists of Au grade data only without any other geological descriptions.

Chip sample populations have the potential to be biased as they are generally taken where there is greater likelihood of potentially economic mineralization. In order to qualify the chip sample data for use in the grade estimation, Golder compared the chip sample grade population to the diamond drill hole grade population using Quantile – Quantile plots (Q-Q) to assess the likelihood for grade bias. Comparisons were done based on a closest sample pair basis using 3 distance scenarios of 1 m, 5 m and 10 m. Comparisons of the grade populations completed over shorter distances indicated more potential for grade bias but were based on a low number of sample pairs. Comparisons completed over larger distances showed less potential for bias and were based on a larger, and more statistically significant number of sample pairs ranging from 181 (<1 m), 2,593 (<5 m), and 4,058 (< 10 m). The correlations between populations is reasonable up to a point but it is not perfect as the distributions

differ at higher grades. Based on this analysis, Golder elected to accept the chip sample data for use in grade estimation on a limited basis, restricting the distance of influence on the grade estimates to a maximum of 10 m. The volumes impacted by chip samples are relatively low overall but they do influence grades, and therefore quantity of metal of Measured and Indicated Mineral Resources in areas supported by drift and sub-level development. Figure 14-1 shows a Q-Q plot summary of the grade comparisons for each test distance.

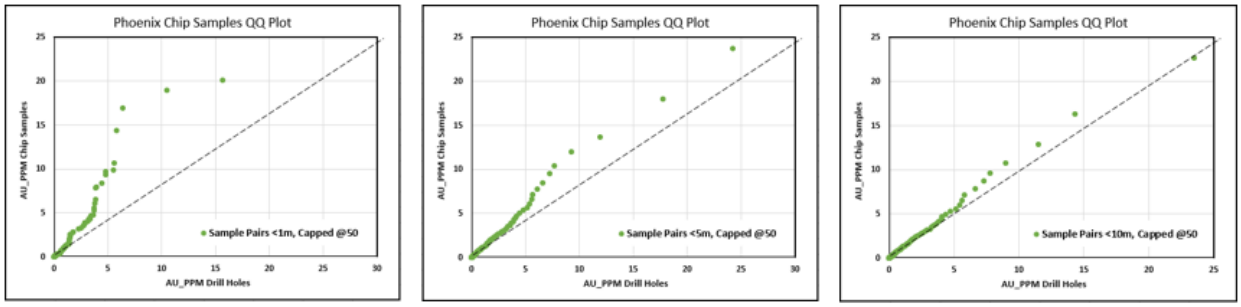


Figure 14-1: Drill Hole-Chip Sample Q-Q Plots at Different Spatial Separations

14.2.3 Development Mapping

Rubicon provided drift and sub-level development mapping for the upper levels of the Project from the 305 m level and up. Golder incorporated the mapping into the block model by creating a representative drill hole file coded with the mapped stratigraphy as shown in the Figure 14-2 example from 244 m level Sub 2 (ultramafic rocks – purple, basalts – green, and felsic intrusive – orange). These drill holes were then combined with the diamond drill hole data in order to estimate stratigraphy into the block model and assign stratigraphic units to the chip sample data. The stratigraphic units were used to constrain the grade estimation as described further in Section 14.6.6.

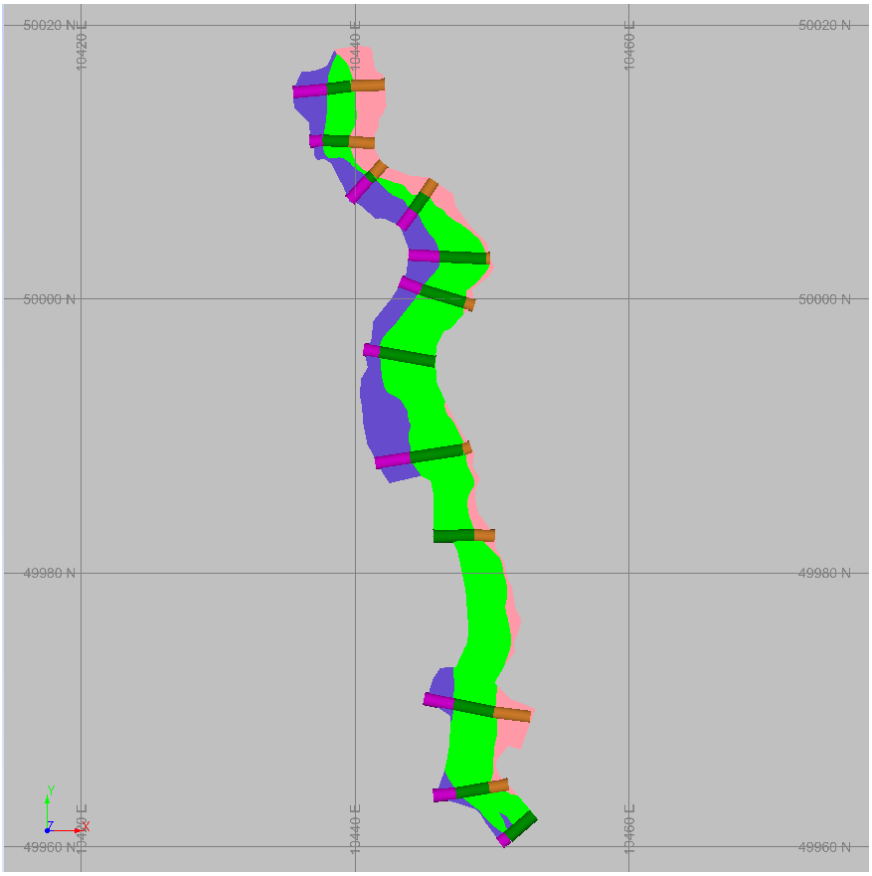


Figure 14-2: Example of Holes Created to Represent Mapped Stratigraphy from 244 m Level Sub 2

14.2.1 Specific Gravity and Bulk Density

A total of 6,710 SG measurements were provided from onsite drill core measurements, taken mainly during 2010 and 2011. Measurements were taken from 10-20 cm samples of NQ sized core using the weight in air versus the weight in water method (Archimedes) based on the following formula:

SG = weight in air / (weight in air – weight in water)

A full description of the SG measurement process is provided in Item 11.

Mean SG values were used to assign bulk density to all zones in the model based on the stratigraphic unit as defined in Table 14-2. Only the SG values for the actual lithological units were used to calculate and assign bulk density (i.e., prior to stratigraphic groupings).

Table 14-2: Bulk Density Values Assigned to Stratigraphic Units

Stratigraphic Unit	Mean Density (t/m^3)	# of Samples
Basalt	2.96	1,395
Ultramafic	2.90	1,599
Felsic Intrusive	2.67	847

The mean density values were used to calculate block tonnages which have a direct impact on the total estimated resource tonnage and quantity of gold stated in this report. A total of 50 SG measurements were taken in 2017 by Actlabs in order to confirm the density values assigned in the block model. Measurements were based on sample pulps using gas pycnometer techniques. Check sample results confirmed the mean density values used as summarized in Table 14-3.

Table 14-3: Check Sample Results For SG

Stratigraphic Unit	Mean SG	# of Check Samples
Basalt	2.95	24
Ultramafic	2.92	14
Felsic Intrusive	2.62	1

14.3 Geological Domaining

Gold mineralization is mainly hosted within High-Ti basalt units, with lesser mineralization occurring in ultramafic units, and felsic intrusive rocks (dykes and sills). Four mineralized zones have been modelled and defined as Zones 1 to 4. There are 3 main basalt lenses hosting mineralization including, from West-to-East: Hangingwall Basalt (HW), West Limb Basalt (WLB), and F2 Basalt (F2). These zones make up the majority of the mineralization and define Zone 1 (F2) and Zone 2 (HW, WLB). Zone 3 is a small, narrow zone hosted in felsic intrusive rocks between the F2 and WLB and Zone 4 is located in the F2 Basalt to the north of the main mineralized area of Zone 1. All zones are outlined in Figure 14-3 below with volumes for each summarized in Table 14-2. Zone 2 (green) hosts the majority of mineralization followed by Zone 1 (red). Zones 3 (brown) and 4 (purple), although similar in volume to Zone 1, do not host a significant amount of mineralization.

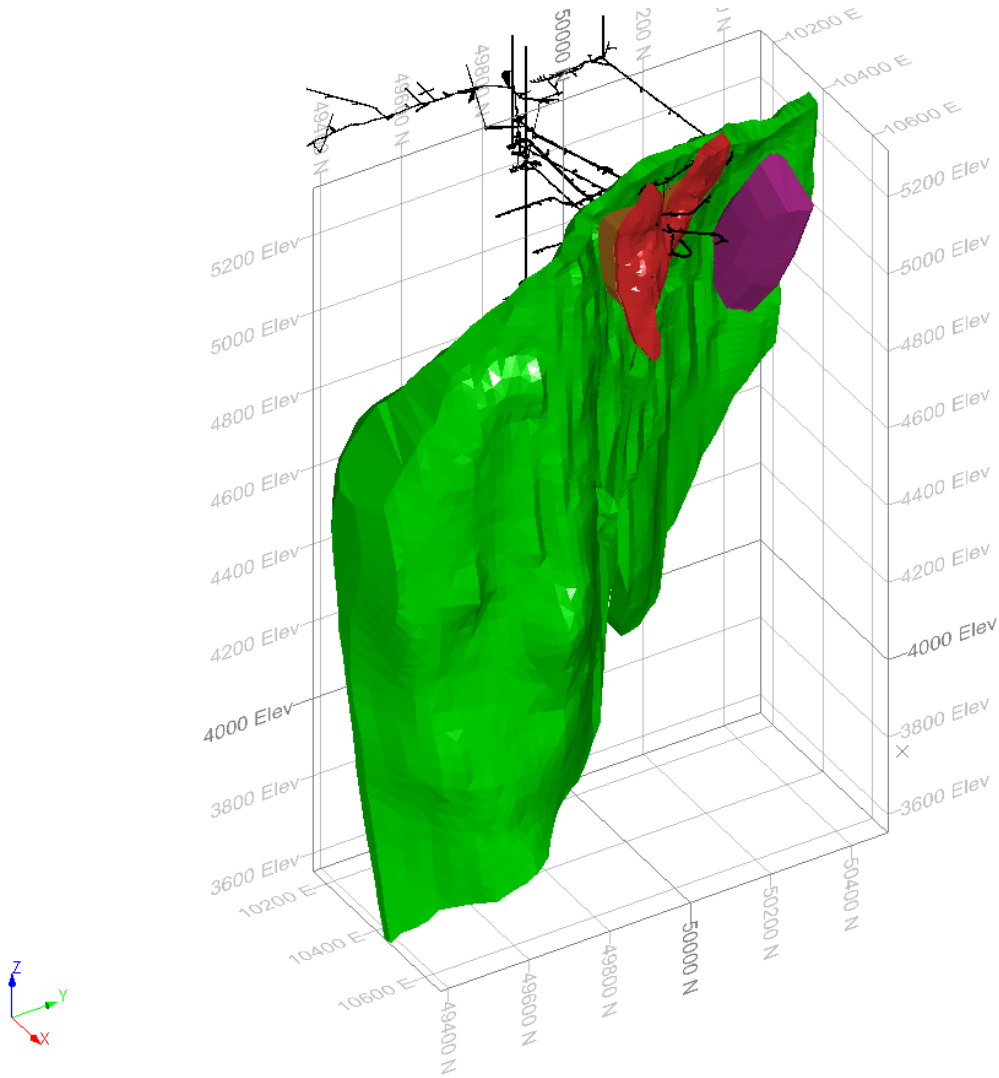


Figure 14-3: F2 Deposit Mineralized Zones (Oblique View Facing North-West)

Table 14-4: Volume Summary of Mineralized Zones

Zone	Colour	Volume (m^3)
1	Red	2,148,427
2	Green	128,179,342
3	Brown	1,755,667
4	Purple	4,124,068

The rock units comprising these mineralized zones have been subjected to deformation and as a result have complex shapes and distributions with variable continuity. Due to contrasts in the physical characteristics (competency contrasts) between rock units, as described previously in Item 7, the soft and locally talcose altered ultramafic unit is interpreted to have deformed in a ductile manner around more competent basalt and felsic units which are believed to have deformed in a brittle-ductile manner and possibly pulled apart (boudinaged) locally. Due to the complexity of the host rock units and associated mineralization, Golder chose to model mineral domains as broad low-grade envelopes that included all of the 3 main stratigraphic units. This approach has the advantage of being able to interpret the mineralization in context with the deposit geology, and in Golder's opinion minimizes the risk of inferring mineral continuity had the mineralization been constrained based on grade envelopes alone.

14.4 Exploratory Data Analysis (EDA)

Analysis was conducted on raw drill hole data selected from within each mineral zone in order to determine the nature of the Au grade distribution, correlation of grades with individual rock units and the identification of high grade outlier samples. Golder used a combination of descriptive statistics, histograms, probability plots and XY scatter plots to analyze the grade population data. The findings of the EDA analysis were used to help define modelling procedures and parameters used in the Mineral Resource Estimate as further described in this section.

Descriptive statistics were used to analyze the grade distribution of each sample population, determine the presence of outliers and identify correlations between grade and rock types for each mineral zone. Table 14-5 and Table 14-6 provide a summary of the descriptive statistics for the raw sample populations captured from within each mineral zone.

Table 14-5: Summary of Data Available by Zone

Zone	# of Holes	# of Samples	Total Sample Length (m)
Zone 1	490	20,514	19,642
Zone 2	1,051	70,283	108,237
Zone 3	549	6,421	24,950
Zone 4	66	2,592	6,019

Note: Holes that were ignored (see Table 14-1) are not included in these statistics.
The total sample length includes un-assayed sample intervals.

Table 14-6: Descriptive Statistics of Raw Sample Data by Zone

Zone	Grade g/t	Samples	Minimum g/t	Maximum g/t	Mean g/t	Standard Deviation	Skewness	Coefficient of Variation
Zone 1	Au	20,514	0.00	2,305.23	1.99	24.00	68.49	12.04
Zone 2	Au	70,283	0.00	3,194.65	1.16	19.50	98.51	16.77
Zone 3	Au	6,421	0.00	185.26	0.55	3.35	29.90	6.08
Zone 4	Au	2,592	0.00	457.43	0.57	7.50	50.80	13.11

Note: Sample statistics weighted by length.

Analysis of the grade ranges and the co-efficient of variation indicated that high-grade outlier data could have a material impact on the grade estimation if not accounted for. Outlier handling techniques are discussed further in Sections 14.5.3 and 14.6.6.

Descriptive statistics were also generated by rock type and grade distributions for each rock type were summarized in cumulative probability plots which were used as the basis for grouping original rock types into stratigraphic units as summarized further in Section 14.5.1.

A series of histograms, cumulative probability plots and X-Y scatter plots were generated in order to analyze the grade distribution and relationship between sample length and grade in order to help determine a sample compositing strategy and to determine approximate ranges for outlier values. The gold distributions were found to be highly skewed in all zones which is common for the deposit type. Figure 14-4 and Figure 14-5 provide an example of the frequency distribution of the sample population of basalts in Zone 1. Many of the high-grade samples were observed in the shorter samples.

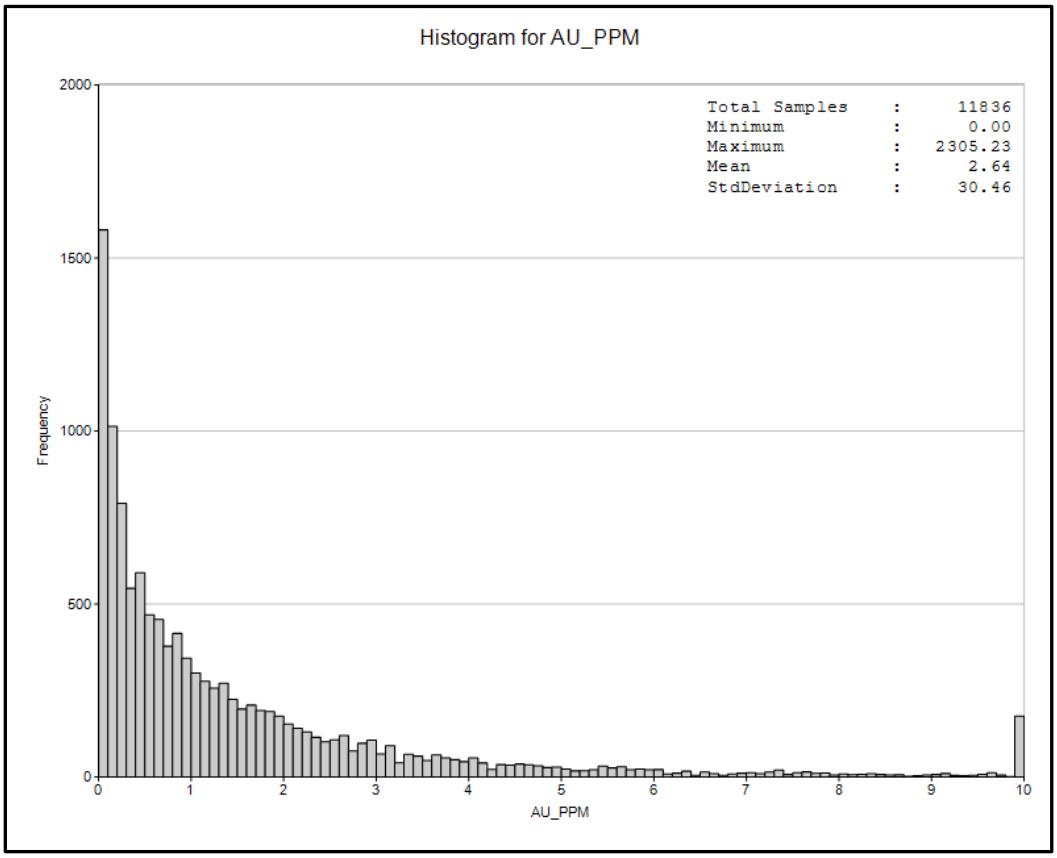


Figure 14-4: Histogram of Zone 1 Basalt

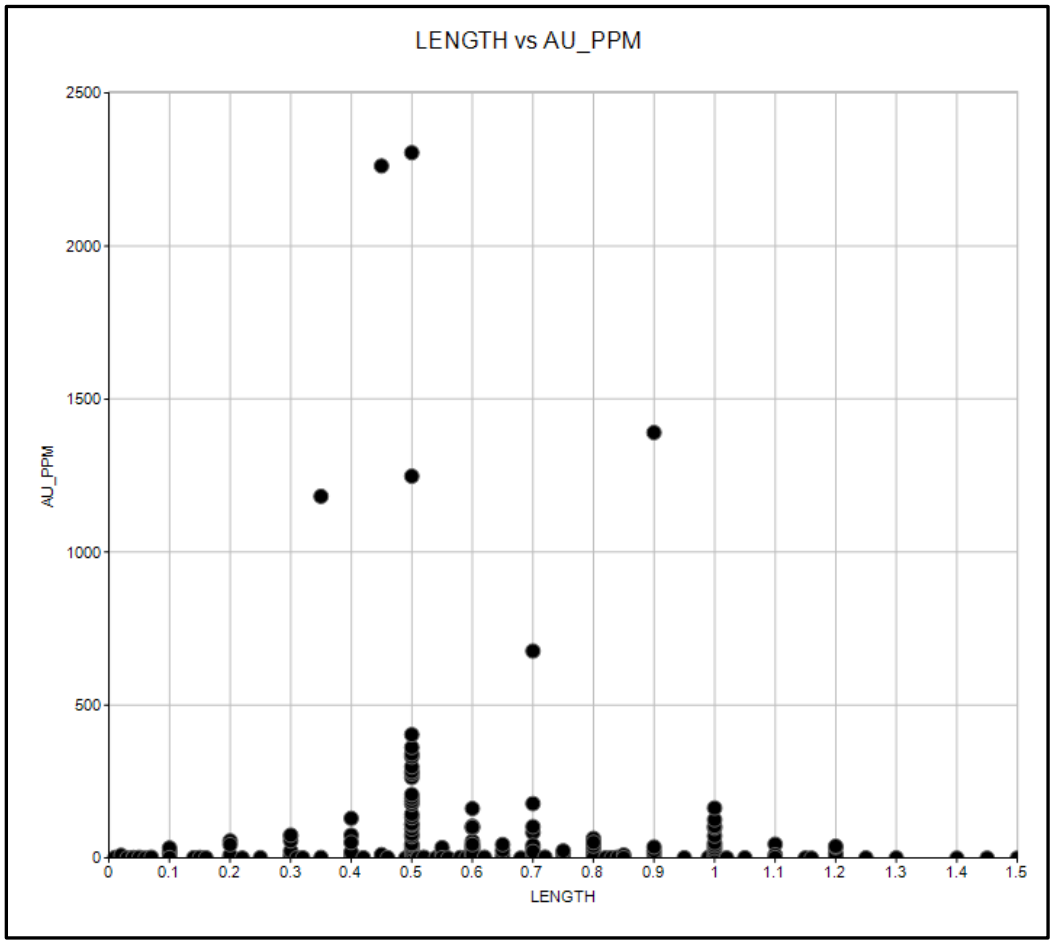


Figure 14-5: Scatterplot of Length versus Grade for Zone 1 Basalt

14.5 Data Preparation

Prior to grade estimation, the data was prepared in the following manner:

1) All drill hole and chip samples were assigned a number representative of the stratigraphic unit (strat no.).

2) Un-assayed intervals were assigned a default Au grade of 0.0025 g/t, representing half the lower detection limit.

3) All samples were composited to an average sample length of 1 m.

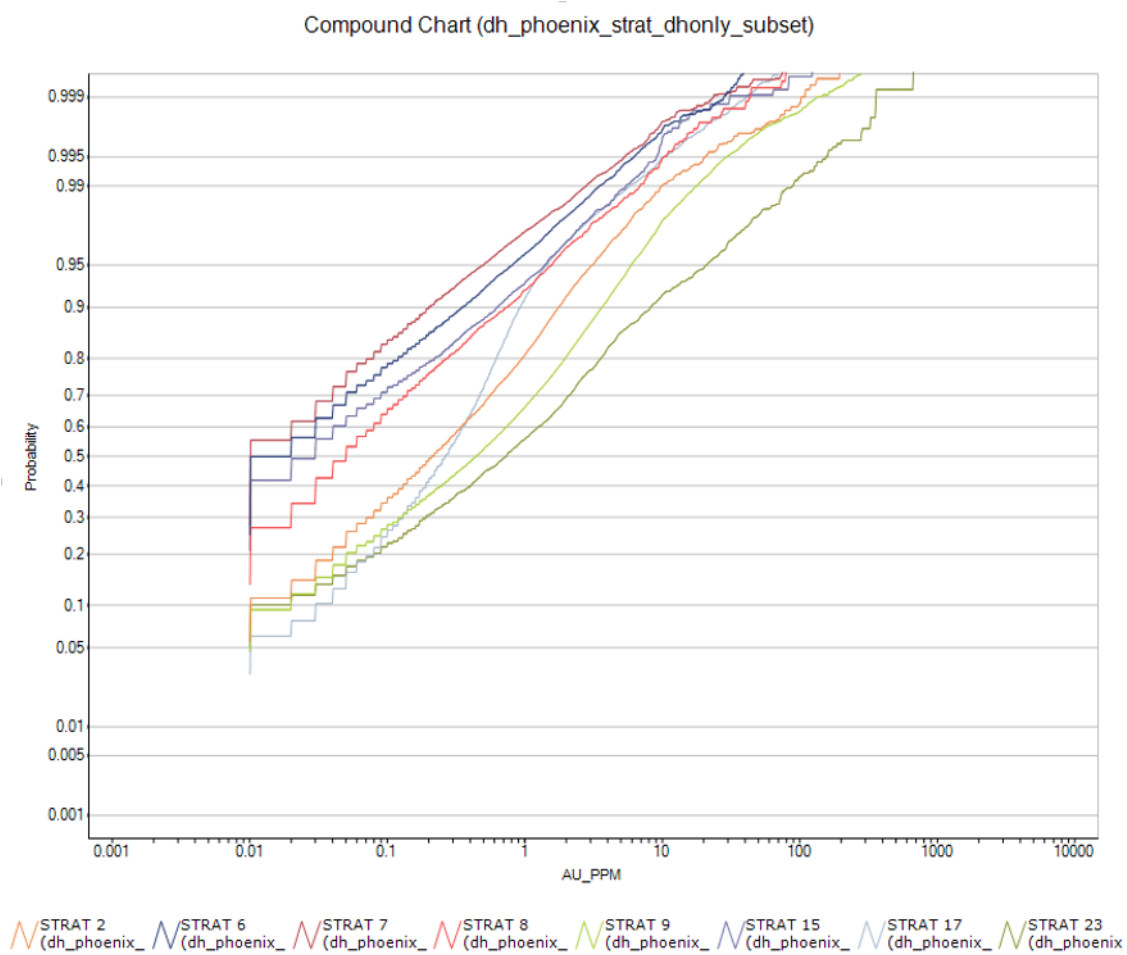
4) High-grade outlier samples were top-cut to a maximum assay value based on the mineral Zone and stratigraphic unit.

14.5.1 Assignment of Stratigraphic Unit

All drill hole samples were assigned a stratigraphic unit (strat), based on the logged lithology, for the purpose of estimating stratigraphy into the block model. Each lithological rock unit in the drill hole database was grouped into 1 of 3 possible stratigraphic units consisting of Ultramafic (strat no. 7), Basalt (9) or Felsic Intrusive (17).

Some of the logged units described other geological characteristics including Veining and Alteration that are not actual rock types. These units were assigned a stratigraphic unit dynamically based on the unit logged in the nearest drill hole sample, representing the host rock unit.

The grouping of lithological units into stratigraphic units was supported by cumulative probability distribution plots of gold grades, for the most predominant units, as outlined in Figure 14-6. Ultramafic rocks (Komatiite, Talc) are shown grouped at the top of the graph in red and blue (having higher proportions of low-grade material), whereas the basaltic rocks, alteration and veining are clustered around the bottom, shown in green and orange. The felsic intrusive grade distribution plots as a mixture of the basalt and ultramafic units, running in between (grey). All other non-mineralized rocks were grouped into the Ultramafic unit.



STRAT codes: 2=Alteration, 6=UM Flow, 7=UM Talc, 8=Basalt, 9=High-Ti Basalt, 15=Mafic Intrusive, 17=Felsic Intrusive and 23=Vein

Figure 14-6: Cumulative Probability Distributions of the Predominant Stratigraphic Units

The three stratigraphic codes assigned to all units are defined in Table 14-7.

Table 14-7: Summary of Stratigraphic Units

Stratigraphic Unit	Stratigraphic Number
Ultramafic	7
Basalt	9
Felsic Intrusive	17

The chip sample database contained grade and interval information only and did not have any associated rock type details. Stratigraphic units were assigned to the chip samples based on the nearest drill hole or mapping data.

Stratigraphic groupings were used in the grade estimation process to constrain the grade estimates, effectively acting as hard boundaries to prevent samples from one unit influencing grade estimates of another.

14.5.2 Compositing

Compositing of samples is a technique used to give each sample a relatively equal length in order to reduce the potential for bias due to uneven sample lengths. The Rubicon raw core sample data was found to have a wide range of sample lengths due to variable widths of the vein sizes and the respecting of lithological contacts. A histogram of raw sample length was generated for each zone in order to determine the most common sample length used (mode), as illustrated in Figure 14-7 for Zone 1 Basalt (Strat 9).

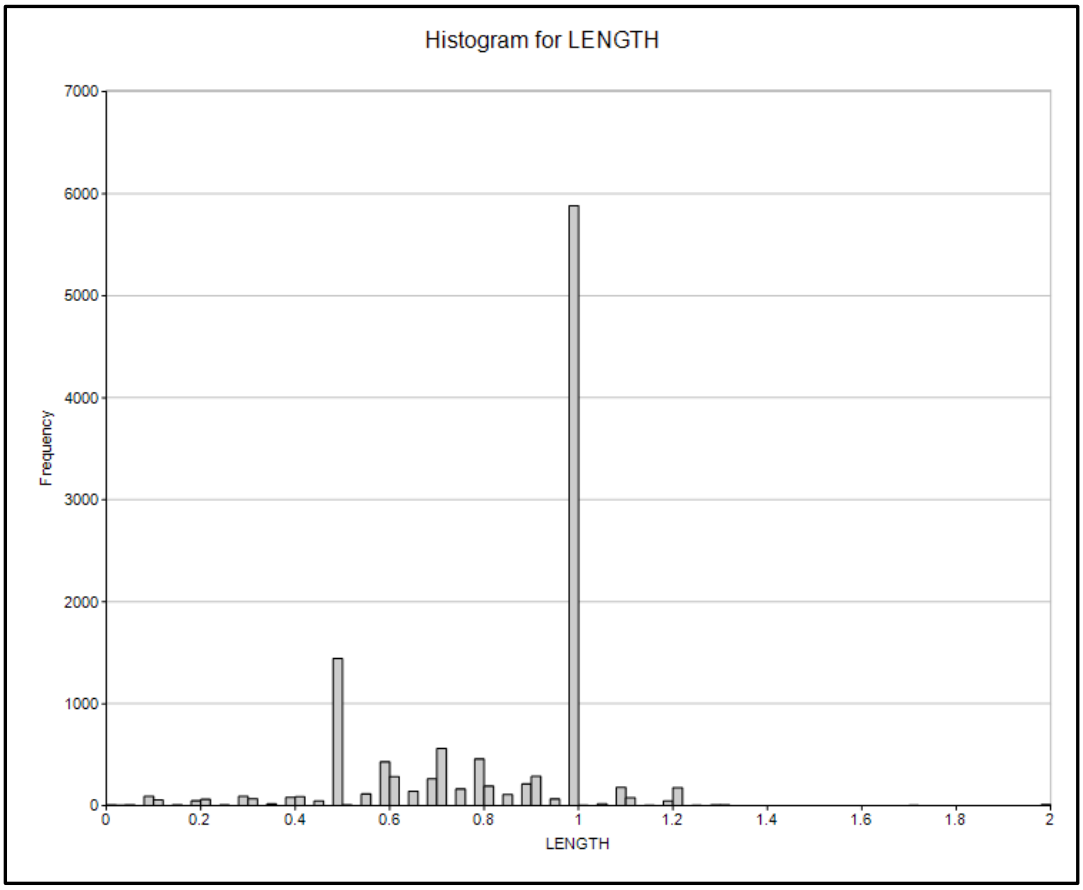


Figure 14-7: Histogram of Raw Sample Length (m) (Zone 1, Basalt)

Samples captured within all zones were composited to an average length of 1.0 m based on the observed modal distribution of sample lengths. The option to use a variable composite length was chosen in order to prevent the potential loss of sample data and reduce the potential for grade bias due to the possible creation of short and potentially high-grade composites that are generally formed along the contacts when using a fixed length. All composite samples were generated within each mineral zone and individual stratigraphic unit with no overlaps along boundaries. A histogram of composite length was used to confirm that the compositing was completed as expected. The histograms displayed a normal distribution around the 1.0 m composite length as shown in the Figure 14-8 example for Zone 1 Basalt.

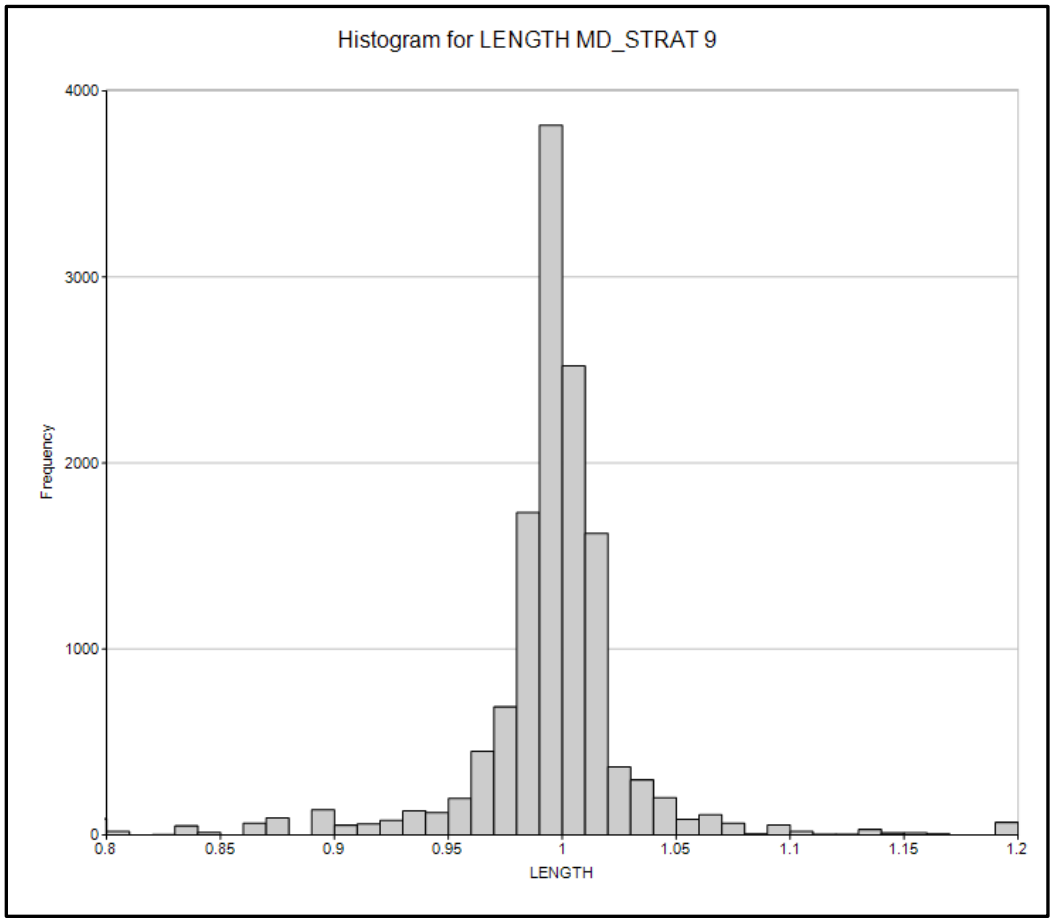


Figure 14-8: Histogram of 1m Composite Samples, Zone 1 Basalt

The composite samples were validated statistically to ensure there was no loss of data or change to the mean grade of each sample population. The total sample lengths of the composites and the mean Au grade of the composites were found to match that of the raw captured samples as summarized for Zones 1 and 2 in Table 14-8.

Table 14-8: Comparison of Captured Samples and Composite Samples for Zones 1 and 2

Zone	Stratigraphic Unit	# Raw	Raw Total Length	Raw Mean Au (g/t)	# Comps	Comp Total Length	Comp Mean Au (g/t)
1	7 (Ultramafic)	6,180	6,049	0.49	6,098	6,049	0.49
1	9 (Basalt)	11971	11,646	2.56	11,701	11,646	2.56
1	17 (Felsic)	1,945	1,930	0.49	1,935	1,930	0.49
2	7 (Ultramafic)	61,513	61,107	0.22	61,232	61,107	0.22
2	9 (Basalt)	19,091	18,871	1.85	18,962	18,871	1.85
2	17 (Felsic)	28,426	28,190	0.84	28,324	28,190	0.84

Note: Drill hole data only

14.5.3 Outlier Capping

Grade outliers are high-grade assay values that are much higher than the general population of samples and have the potential to bias (inflate) the quantity of metal estimated in a block model. X-Y scatter plots, cumulative probability plots and decile analysis were used to analyze the 1.0 m composite data in each Zone and stratigraphic unit in order to determine threshold limits for outlier values. Golder elected to use the composite data as the basis for outlier analysis, over the raw sample data, in order to evaluate the samples on an equal length basis.

Reasonable ranges were first established using the scatter plots of Au grade vs composite sample length and then actual limits were chosen based on the inflections identified in the cumulative probability plots of the 1.0 m composite samples. The chosen top-cutting thresholds were then evaluated for metal loss using decile analysis. Table 14-9 summarizes global (no grade cut-off applied) theoretical “metal loss”, based on the composite samples alone, and the number of samples cut for each zone and stratigraphic unit. The reader should note that the term metal loss is a theoretical calculation used to gauge the sensitivity of the chosen top-cut value and does not represent actual in situ gold.

Table 14-9: Theoretical Metal Loss from Capping By Zone and Stratigraphic Unit

Zone	Stratigraphic Unit	Number of Composites	Cap (g/t)	Number Capped	Metal Loss (%)
1	7 (Ultramafic)	6,332	35	11	23
1	9 (Basalt)	13,322	70	42	16
1	17 (Felsic)	2,076	10	8	11
2	7 (Ultramafic)	61,551	35	43	46
2	9 (Basalt)	20,486	70	43	16
2	17 (Felsic)	28,572	35	32	16
3	7 (Ultramafic)	20,619	35	5	18
3	9 (Basalt)	148	70	0	0
3	17 (Felsic)	4,253	10	11	4
4	7 (Ultramafic)	4,363	35	1	19
4	9 (Basalt)	1,129	70	0	0
4	17 (Felsic)	528	10	1	62

Note: Drill hole and chip data combined

The coefficient of variation (CV) was calculated for the capped composite samples and compared to raw values as outlined in Table 14-10. The capped CV values were found to have been reduced to within more desirable ranges, with the basalt units being the most relevant to the resource estimate.

Table 14-10: Impact of Capping on CV by Zone and Stratigraphic Unit

Zone	Stratigraphic Unit	Composite Mean Au (g/t)	Composite CV	Capped Composite Mean Au (g/t)	Capped Composite CV
1	7 (Ultramafic)	0.60	11.2	0.46	5.1
1	9 (Basalt)	2.58	7.1	2.17	2.5
1	17 (Felsic)	0.59	3.6	0.53	2.3
2	7 (Ultramafic)	0.23	32.2	0.12	9.3
2	9 (Basalt)	2.01	7.7	1.68	2.9
2	17 (Felsic)	0.86	12.8	0.72	2.7
3	7 (Ultramafic	0.05	25.7	0.04	18.7
3	9 (Basalt)	0.75	3.0	0.75	3.0
3	17 (Felsic)	0.50	2.3	0.48	1.6
4	7 (Ultramafic)	0.05	24.2	0.04	15.1
4	9 (Basalt)	0.69	4.4	0.69	4.4
4	17 (Felsic)	0.67	14.5	0.26	3.3

Note: Drill hole and chip data combined

14.6 Block Model and Resource Estimation

14.6.1 Testing and Analysis

A series of upfront test modelling was completed in order to define an estimation methodology that could meet the following criteria:

1) Be representative of the deposit geology and structural model

2) Account for variability of grade and orientations / continuity of mineralization

3) Control the smoothing (grade spreading) of grades and influence of outliers

4) Account for the majority of mineralization on the property

5) Be robust and repeatable without extensive modelling of local discrete mineral domains

The following test scenarios were evaluated in order to determine the optimum processes and parameters to use to achieve these goals. Each scenario, with the exception of #7 (Multiple Indicator Kriging), was based on Nearest Neighbour (NN), Inverse Distance Squared (ID^2), Inverse Distance Cubed (ID^3) and Ordinary Kriging (OK) interpolation methods. Zone 1 (F2 Zone) was defined as the representative test area.

1) Base case using Dynamic Anisotropy (a Datamine process used to dynamically adjust the orientation of the search ellipse to account for variable orientations of mineralization)

2) Stratigraphic controlled zonation

3) Simplified stratigraphic controlled zonation

4) Restriction of outliers by set maximum distance

5) Reduced minimum and maximum number of samples from the base case

6) Constrained mineralization by wireframe (2 g/t hard boundary)

7) Multiple Indicator Kriging (MIK)

All test scenarios were evaluated based on global statistical comparisons, visual comparisons of composite samples versus block grades and the assessment of smoothing based on a smoothing ratio calculation (ratio between the theoretical model variance and actual model variance, where the theoretical variance is calculated based on the sum of the variance inside the block and variance between blocks using such parameters as the variogram model, block size and F Function). Based on results of the testing, it was agreed by Rubicon and their consultants that the final resource estimation methodology would be based on ID^3 interpolation along with multiple elements of the test scenarios including: Dynamic Anisotropy, stratigraphic controls, distance restriction of outliers and a reduced number of samples used for the grade estimates as further described in this section. These parameters were chosen in order to best meet the criteria outlined above.

14.6.2 Stratigraphic Model

Stratigraphic units were estimated into the block model based on diamond drill hole and underground mapping using Nearest Neighbour interpolation. Search ellipse dimensions were based on general dimensional proportions observed and tested by trial and error until a point where the stratigraphic estimates were determined to be representative of the data. A dynamic search strategy was used, based on the general shape of the Zone models, to account for variability of orientations. Local dynamic controls were used where the orientation of stratigraphy was found to differ from these orientations. Figure 14-9 provides plan view (5,130 m elevation) and North-facing E-W cross-section (49,990 N) examples of the stratigraphic model for Zone 1, where Ultramafic is purple, Basalt is green and Felsic Intrusive is orange. The stratigraphic model was used for zonal controls and hard boundary domaining of mineralization during grade estimation as described further in Section 14.6.6.

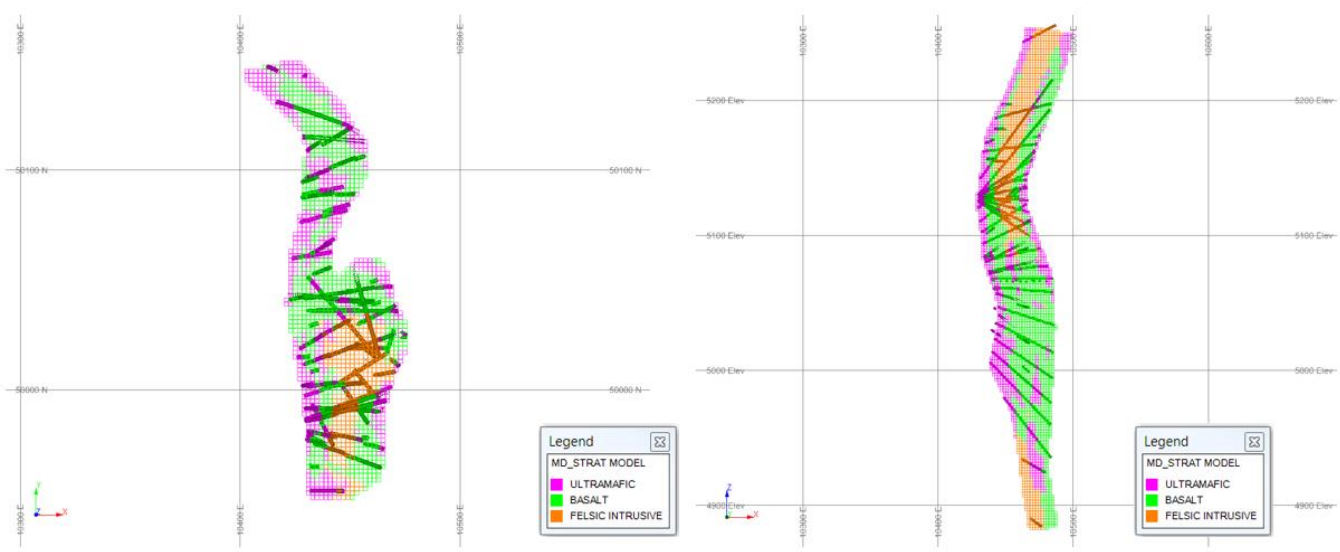


Figure 14-9: Example Plan (Left) and Section (Right) of Stratigraphic Model

14.6.3 Assessment of Spatial Grade Continuity

Experimental grade variograms were generated from the composite sample data in order to determine approximate search ellipse dimensions and orientations. Since ID^3 was chosen for the final grade interpolation, the variogram models only influenced the search ellipse volume (sample neighbourhood) and anisotropy (differences in search distances along each axis) and were not used for calculating weights for grade estimation.

Pairwise relative experimental Au grade variograms were generated for Zones 1 and 2, for each stratigraphic unit, based on the parameters outlined in Table 14-11. Pairwise relative variograms were chosen due to the high variability of the grade data. Variograms were not generated for Zones 3 and 4 due to the limited amount of data in those areas of the deposit and Zone 1 models were assumed for those zones.

Table 14-11: Grade Variogram Parameters

Elements	Zones 1 and 2
Rotations	0
Lag Distance	20 m
Number of Lags	15
Sub-lag Distance	5 m
Regularization angle	22°
Cylindrical search radius	30

A set of two structure spherical variogram models were fitted to the experimental variogram data. An example of the variogram model for Zones 1 and 2 Basalt units are provided in Figure 14-10 and Figure 14-11.

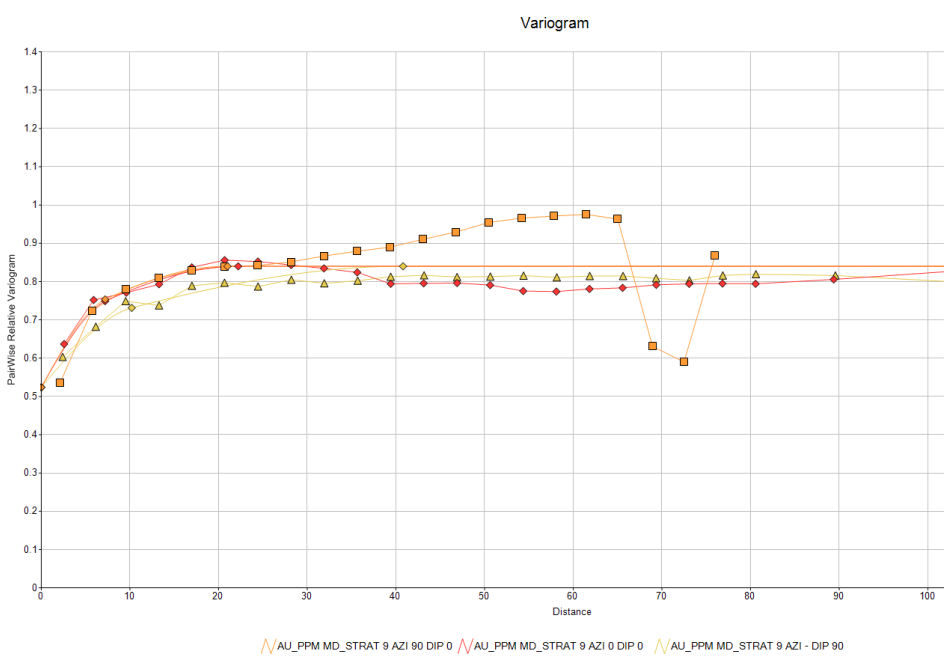


Figure 14-10: Variogram Model for Zone 1 Basalt Unit

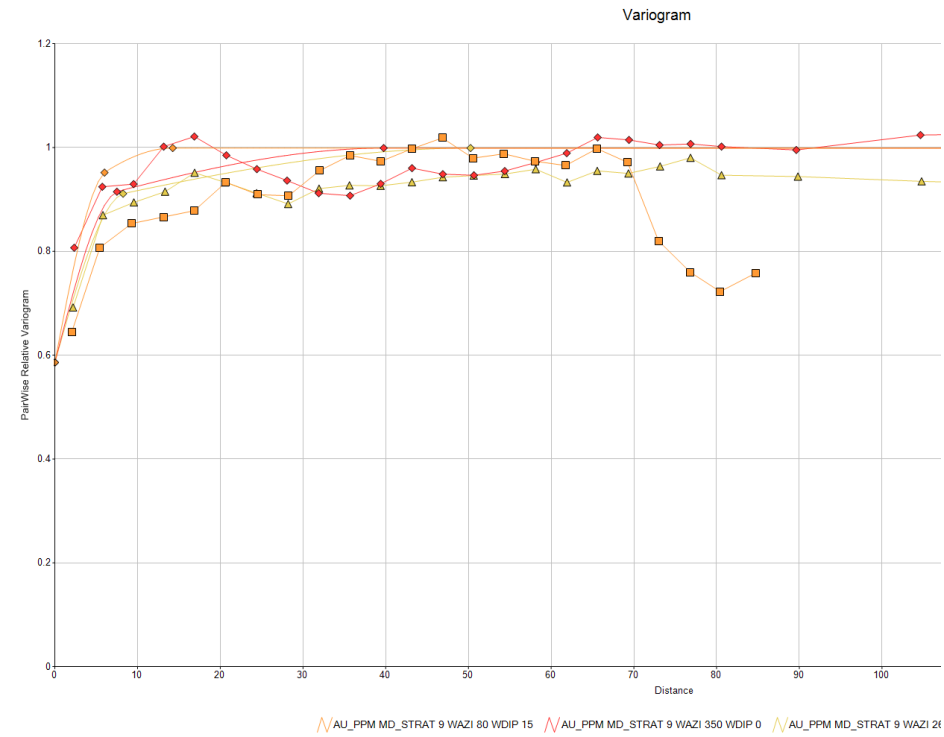


Figure 14-11: Variogram Model for Zone 2 Basalt Unit

The down-dip and along-strike directions of the mineralization were interpreted to be the directions of greatest grade continuity. The modelled second structure range of each axis was used as the basis to define the search ellipse dimensions used for interpolating grades into the Mineral Resource block model.

Zone 2 encompasses a large volume with significant differences in drill hole density so variogram modelling was also conducted on a subset of Zone 2 with drill hole density similar to that of Zone 1. The results were very similar to that of Zone 1 so the same search volumes were adopted for all zones. Search ellipse distances are listed in Table 14-12.

Table 14-12: Search Ellipse Dimensions by Stratigraphic Unit

	Pass 1			Pass 2			Pass 3			Pass 4		
Stratigraphic Unit	Dist1	Dist2	Dist3	Dist1	Dist2	Dist3	Dist1	Dist2	Dist3	Dist1	Dist2	Dist3
7 (Ultramafic)	18	25	3	36	50	6	54	75	9	90	125	15
9 (Basalt)	9	13	3	18	26	6	27	39	9	45	65	15
17 (Felsic)	6	15	3	12	30	6	18	45	9	30	75	15

Note: The use of dynamic anisotropy means that Dist1, Dist2 and Dist3 effectively represent along strike, down dip and across strike distances.

In order to reduce grade spreading and improve local estimates, Golder chose to use half the distance of the second structure range as a general search distance for the first estimation pass and then applied factors to the search distances for the remaining passes.

14.6.4 Block Model Definition

The Phoenix Mineral Resource block model proto-type covers an area of Phoenix Gold Project grid co-ordinates from 49,250 m to 50,500 m north, 10,190 m to 10,730 m east, and from 3,330 m to 5,390 m Elevation. Block shape and size is typically a function of the geometry of the deposit, density of sample data, and expected smallest mining unit (SMU). On this basis, a parent block size of 2 m (N-S) by 2 m (E-W) by 2 m (Elevation) was chosen for all zones. The block model definition parameters are summarized in Table 14-13.

Table 14-13: Block Model Definition Parameters

Direction	Minimum	Maximum	# Blocks
Northing	49,250	50,500	625
Easting	10,190	10,730	270
Elevation	3,330	5,390	1030

All mineral zone volumes were filled with blocks using the parameters described in Table 14-13. Block volumes were then compared to the mineral zone volumes to confirm there were no errors during the process. Block volumes for all zones were found to be within reasonable tolerance limits for all mineral zone volumes.

14.6.5 Interpolation Methods

ID^3 was the grade interpolation method chosen as the basis of the 2018 Mineral Resource Estimate. This method assigns estimation weights to the samples within the search volume relative to the distance of the sample data from the centre of the block. The closer the sample, the higher the weights as described in the following formula where p is defined to the power of 3.

$$\hat{v_1} = \frac{\sum_{i=1}^{n} \frac{1}{d_i^p} v_i}{\sum_{i=1}^{n} \frac{1}{d_i^p}}$$

ID^3 was chosen over ID^2 and OK in order to better control the smoothing of grades, attributing more weight to the samples spatially located closer to the center of the block, due to the variable and nuggety nature of the mineralization. NN, ID^2 and OK were all estimated for global comparison and validation purposes, but not chosen for final Mineral Resource reporting.

14.6.6 Search Strategy

Zonal controls were used to constrain the grade estimates to within each stratigraphic unit. These controls prevented samples from different stratigraphic units from influencing the block grades of one another, acting as a "Hard Boundary" between units. For example, only samples identified as Basalt could be used to estimate the grade of block cells identified as Basalt, and all samples from other units were ignored.

A total of 4 nested, anisotropic searches were performed for all zones. The search distances were based on factors of the second structure variogram ranges for each of the 3 axes. The search radius of the first search was restricted to approximately one half the variogram range with the second search being the full variogram range, the third search being 1.5 times the variogram range and a fourth search set to 2.5 times the variogram range, as summarized previously in Table 14-12. Search strategies for each domain used an elliptical search with a minimum of 5 samples and a maximum of 8 samples from a minimum of 2 holes in the first and second search passes and a minimum of 4 and maximum of 8 samples from a minimum of 1 hole in the 3rd and 4th passes. Un-estimated blocks were left as absent and not reported in the Resource Estimate. Sample controls are summarized in Table 14-14.

Table 14-14: Summary of Sample Controls for All Zones

	Pass 1		Pass 2		Pass 3		Pass 4		All
	Min. Samples	Max. Samples	Min. Samples	Max. Samples	Min. Samples	Max. Samples	Min. Samples	Max. Samples	Max. per hole
All zones	5	8	5	8	4	8	4	8	4

A dynamic search orientation was used in the grade estimation process in order to account for variable orientations of stratigraphy and mineralization. General search orientations, defined by dip and dip direction, were estimated into the block model based on the shape of the modelled mineral domains which represents the orientation of the host rock stratigraphy. Additional orientations were modelled and estimated locally to account for structural controls of mineralization trending in other orientations representative of a Riedel Shear System.

14.6.7 Outlier Controls

Outlier samples were controlled during the grade estimation process in order to reduce the potential for grade bias in the model, where grade bias could potentially result in the quantity of gold being over-estimated. Outlier samples were left unrestricted within the actual single block (8 m^3) that they occur in, in order to represent the local nature of the high-grade samples in the model. Outside of that single block location, the outlier samples were capped to the threshold values outlined previously in Table 14-9, based on the stratigraphic unit of the sample and the mineral zone. The outliers were restricted to a maximum distance of influence of 10 m within the search ellipse and then excluded from all estimates beyond that range as the outlier grade mineralization is not believed to be continuous beyond those distances.

14.6.8 Model Validation

The block model validation process included visual comparisons between block estimates and composite grades in plan and section, along with global comparisons of mean grades, swath plots and smoothing ratio calculations. Block estimates were visually compared to the drill hole composite data in all domains to ensure agreement. No material grade bias issues were identified and the block grades compared well to the composite data as demonstrated in Figure 14-12.

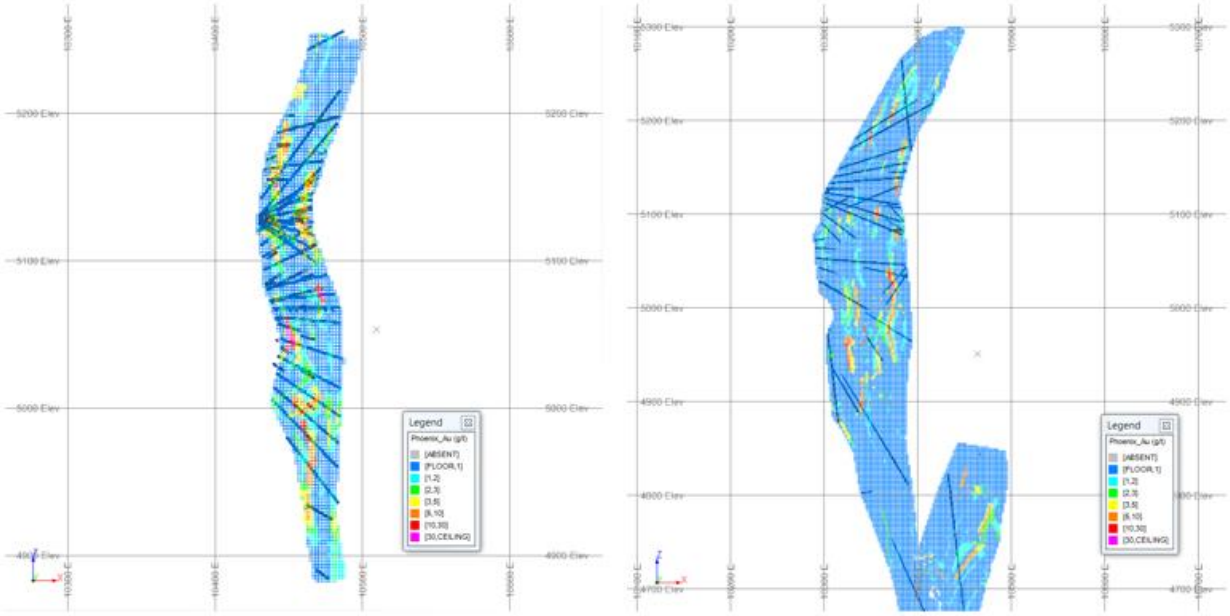


Figure 14-12: Zone 1 and 2 (partial), East-West Section Facing N (49,990 N)

Global statistical comparisons between the composite samples, NN estimates and the final estimates (ID^3) for each Zone and stratigraphic unit were compared to assess global bias, where the NN model estimates represent de-clustered composite data. Clustering of the drill hole data can result in differences between the global means of the composites and NN estimates. Similar global means of the NN and ID^3 estimates indicate that there is no apparent global grade bias in the model. The results summarized in Table 14-15 indicate that no material grade bias was found in the block model. The Basalt in Zone 3 does show a higher difference but this involves a small tonnage and the results are impacted by a single high value sample. Zone 3 consists of mainly Felsic Intrusive with some very narrow lenses or fragments of basalt.

Table 14-15: Statistical Comparison of Global Mean Grades

Zone	Stratigraphic Unit	NN Mean	ID^3 Mean	Relative Difference %
1	7 (Ultramafic)	0.31	0.32	+3.8
	9 (Basalt)	1.96	2.01	+2.4
	17 (Felsic)	0.45	0.44	-0.4
2	7 (Ultramafic)	0.12	0.11	-10.6
	9 (Basalt)	1.06	1.05	-1.0
	17 (Felsic)	0.72	0.71	-0.9
3	7 (Ultramafic)	0.04	0.04	-7.7
	9 (Basalt)	0.96	0.71	-24.1
	17 (Felsic)	0.55	0.56	0.3
4	7 (Ultramafic)	0.03	0.03	-7.0
	9 (Basalt)	0.69	0.69	+0.2
	17 (Felsic)	0.25	0.22	-11.4

Note: Based on a global evaluation for each zone and therefore include all blocks in the models irrespective of classification or crown pillar.

A series of swath plots of Au grades were generated from slices throughout each zone to evaluate for local grade bias issues. Figure 14-13 and Figure 14-14 provide cross-sectional (E-W) examples of the swath plots for Zones 1 and 2. The swath plots compare the model grades to the declustered composite grades in order to identify potential local grade bias in the model. Review of all the swath plots did not identify any bias in the model that is material to the Mineral Resource Estimate as there was general agreement between the declustered composites (NN model) and the final model grades.

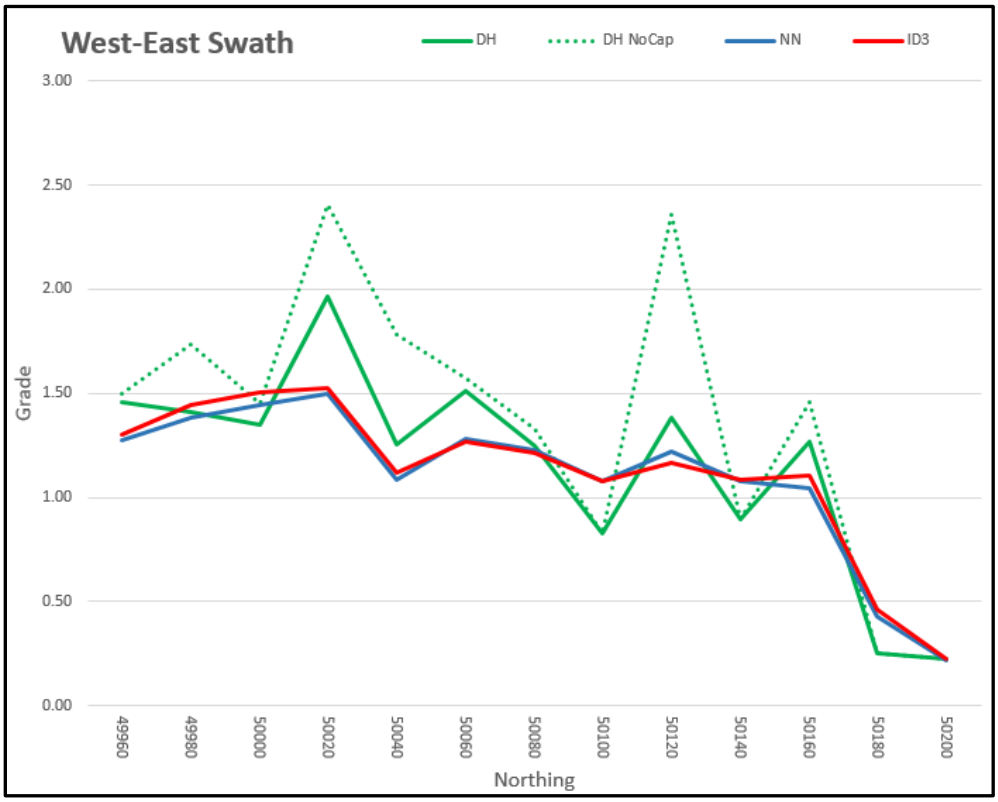


Figure 14-13: West-East Swath Plot of Zone 1

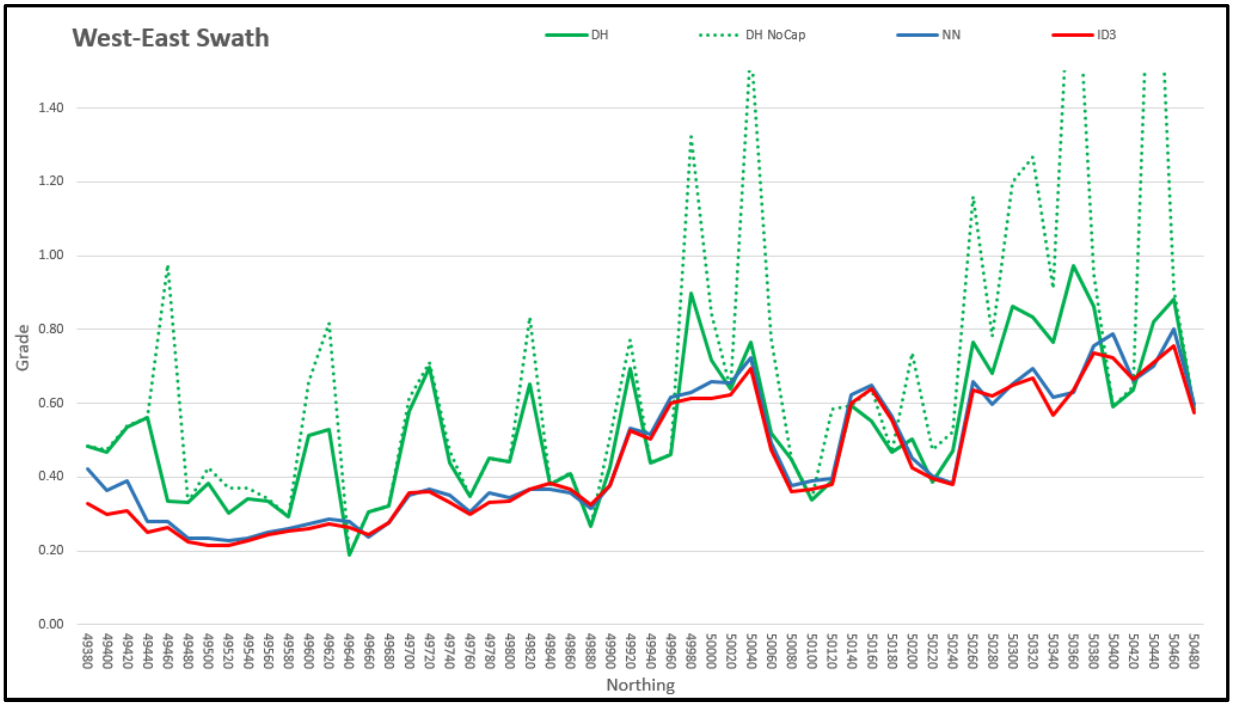


Figure 14-14: West-East Swath Plot of Zone 2

14.6.8.1 Reconciliation

A reconciliation exercise was attempted to compare some of the production results from the original 2015 bulk sample to the 2018 resource block model. The 030 stope located in Zone 2, was by far the largest volume mined and was used as the basis of this reconciliation. There is some uncertainty around the quality of the Phoenix Gold Project test mining data from the bulk sample as development and stope material were not batched to the mill separately and there were some operational issues related to material handling and milling during that time. A partial mill clean-up was completed after operations ceased in 2016 which resulted in the recovery of an additional 741 ounces of gold. Golder pro-rated the additional ounces back to all development and stopes based on the relative metal content of each resulting in 030 stope production of 15,584 tonnes at a grade of 5.73 g/t for a total of 2,869 ounces. Reporting from the 2018 Mineral Resource block resource model for the 030 stope volume resulted in estimates of 15,799 tonnes at a grade of 6.28 g/t for a total of 3,190 ounces. While the reconciliation is not perfect, the numbers are reasonably close and it's uncertain at this point in time if the differences are due to operational, data or estimation issues. Going forward, the 2018 bulk samples will be batched to the mill to allow for improved reconciliation and model validation.

14.6.9 Mineral Resource Classification

The Mineral Resource Estimate was classified in accordance with CIM Definition Standards for Mineral Resources and Mineral Reserves (May 2014). Mineral Resource classifications were assigned to broad regions of the block model based on QP confidence and judgement related to geological understanding, continuity of mineralization in conjunction with data quality, data density and block model representativeness. Drill hole spacing for Mineral Resources in the Measured, Indicated, and Inferred categories were approximately up to 20 m, 20-to-40 m, and 40-to-80 m centers, respectively, where geology and grade continuity were reasonably understood and represented in the model. Measured Resources required a minimum of a 20 m by 20 m drill spacing with sub-level development, mapping, chip samples and supported by reconciliation where available. Measured and Indicated Resources are all located near existing underground infrastructure and development. Figure 14-15 to Figure 14-17 outline approximate areas of Measured, Indicated and Inferred Mineral Resources for Zones 1 and 2.

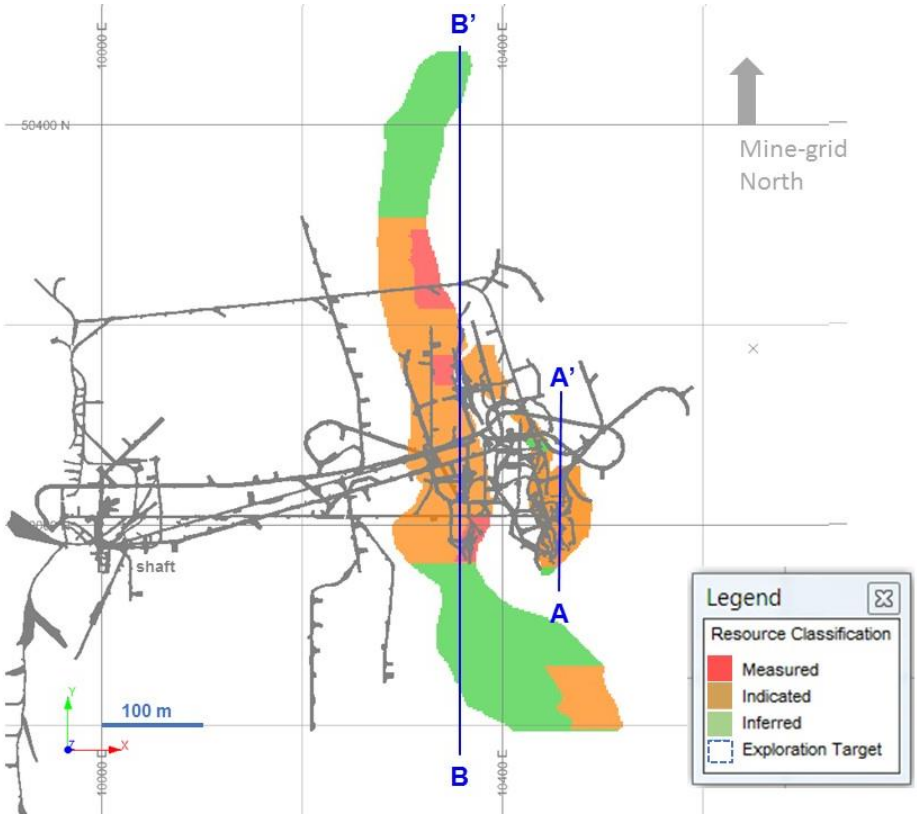


Figure 14-15: Zone 1 and Zone 2 Resource Classification (Plan View)

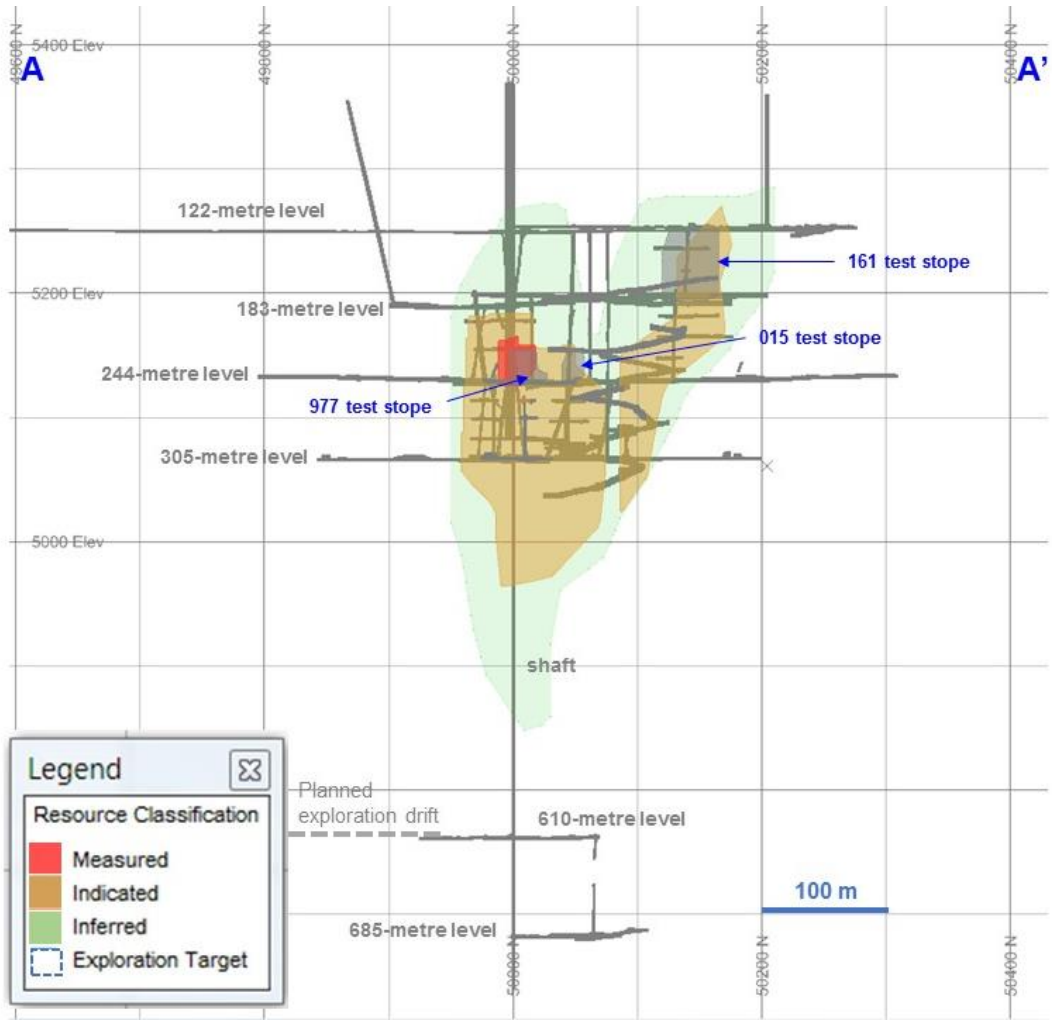


Figure 14-16: Zone 1 Resource Classification (North – South Long Section View Facing West)

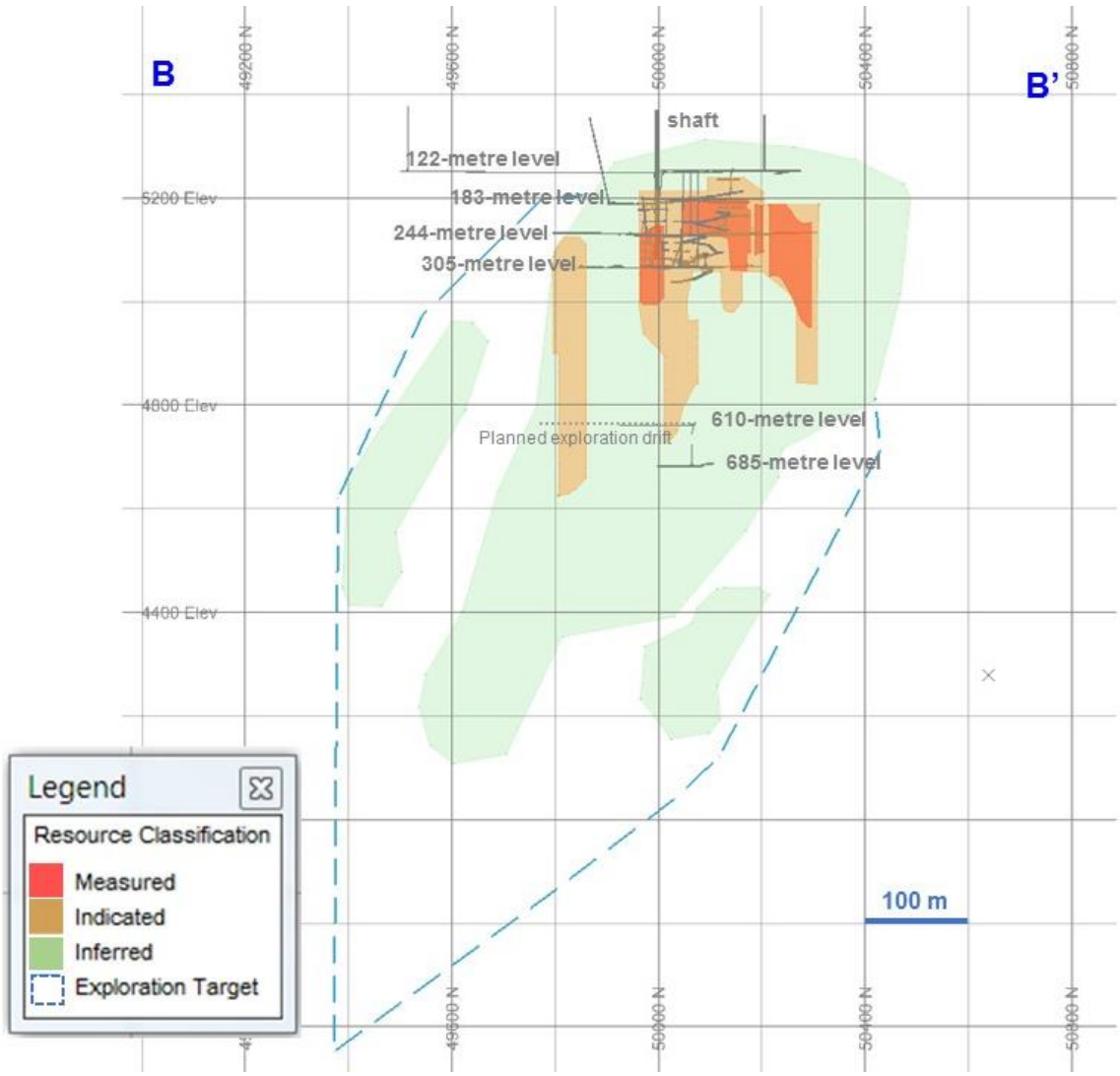


Figure 14-17: Zone 2 Resource Classification (North – South Long Section View Facing West)

Note: With respect to "Exploration Targets", the potential quantity and grade is conceptual in nature. Further, there has been insufficient exploration to define a Mineral Resource and it is uncertain if further exploration will result in the target being delineated as a Mineral Resource. The disclosed potential quantity and grade has been determined based on internal analysis conducted by the QP's.

Table 14-16 summarizes the data density statistics by classification and domain. These statistics are reported on a global basis (no cut-off applied) and based on drill hole data alone, i.e., excludes chip samples and mapping.

Table 14-16: Data Density Statistics

Domain	Mineral Resource Classification	# of Holes	# of Composite Samples	Tonnes Per Hole	Tonnes Per Composite Samples
Zone 1	Measured+Indicated	411	16,628	7,235	179
	Inferred	138	3,106	22,249	989
Zone 2	Measured+Indicated	743	39,577	26,495	497
	Inferred	462	53,365	416,950	3,610
Zone 3	Indicated	549	25,008	9,052	199
Zone 4	Inferred	66	6,020	180,374	1,978

Note: Drill hole data only
Some holes have intervals within both the Measured+Indicated and Inferred classification categories.
Based on a global evaluation for each zone including all material within the classification category (i.e. no cut-off is applied).

The number of blocks estimated in each of the search volumes was reviewed to ensure that the proportion of cells estimated for each was relatively consistent with the spacing of the drill hole data and the classification assigned to the model. The proportion of blocks estimated in the 1st and 2nd passes are considered to be reasonable relative to the assigned Mineral Resource classifications as summarized in Table 14-17.

Table 14-17: Summary of Tonnes per Search Volume

Zone	Mineral Resource Classification	% 1st Search Pass	% 2nd Search Pass	% 3rd Search Pass	% 4th Search Pass
Zone 1	Measured+Indicated	85	15	0	0
	Inferred	31	41	26	3
Zone 2	Measured+Indicated	54	35	11	1
	Inferred	6	18	43	33
Zone 3	Indicated	78	18	4	0
Zone 4	Inferred	19	40	35	6

Note: All numbers are rounded to the nearest integer so they may not total to 100%.
Based on a global evaluation for each zone including all material within the classification category (i.e. no cut-off is applied).

A smoothing assessment was conducted based on the calculation of smoothing ratios (ratio between the theoretical model variance and actual model variance, where the theoretical variance is calculated based on the sum of the variance inside the block and variance between blocks using such parameters as the variogram model, block size and F Function). The results of the assessment, categorized by stratigraphic unit and Mineral Resource classification, are shown in Table 14-18. Golder considers smoothing ratios between 0.8 and 1.2 to be generally acceptable in order to provide a representative tonnage to grade ratio for the deposit. Smoothing ratios greater than 1.2 are an indication of estimates that may over-estimate tonnage and under-estimate grade, whereas smoothing ratios lower than 0.8 could indicate estimates that under-estimate tonnage and over-estimate

grade. The smoothing ratio result for each zone are generally reasonable for the material portions of the Mineral Resource Estimate, being Zone 1 and 2 Basalt units in the Measured and Indicated Mineral Resource categories. There are some elevated values in Zones 3 and 4, but they have little impact on the total Mineral Resource Estimate and should not be considered material.

Table 14-18: Smoothing Assessment

Zone	Stratigraphic Unit	Mineral Resource Classification	Smoothing ratio
Zone 1	7 (Ultramafic)	Measured+Indicated	1.23
		Inferred	1.19
	9 (Basalt)	Measured+Indicated	1.23
		Inferred	0.91
	17 (Felsic)	Measured+Indicated	1.40
		Inferred	1.33
Zone 2	7 (Ultramafic)	Measured+Indicated	1.13
		Inferred	1.44
	9 (Basalt)	Measured+Indicated	0.86
		Inferred	0.80
	17 (Felsic)	Measured+Indicated	0.88
		Inferred	1.46
Zone 3	7 (Ultramafic)	Measured+Indicated	1.97
	9 (Basalt)	Measured+Indicated	1.10
		Inferred	NA
	17 (Felsic)	Measured+Indicated	1.36
		Inferred	NA
Zone 4	7 (Ultramafic)	Measured+Indicated	NA
		Inferred	2.16
	9 (Basalt)	Measured+Indicated	NA
		Inferred	0.86
	17 (Felsic)	Measured+Indicated	NA
		Inferred	2.31

Note: Based on a global evaluation for each zone including all material within the classification category (i.e., no cut-off is applied).

14.6.10 Cut-Off Grade

The cut-off grade used for this Mineral Resource Estimate is 3.0 g/t Au based on Rubicon's estimated break-even OPEX mining cost of $CAD $132 per tonne as outlined in Table 14-19. The OPEX cost is based on assumptions of $US1,300/ounce, a $US/$CAD exchange rate of 0.77 and a gold recovery of 92%. Mineral Resources can be sensitive to the reporting cut-offs used. Resource sensitivities for the 2018 Mineral Resource Estimate are summarized in Table 14-21.

Table 14-19: Summary of OPEX Assumptions

OPEX	$CAD/Tonne
Mining	$97.00
Milling	$20.00
G&A	$5.00
Total	$132.00

14.6.11 Mineral Resource Statement

The Mineral Resource Estimate for the Phoenix Gold Project is reported in accordance with NI 43-101 and has been estimated in conformity with current CIM "Estimation of Mineral Resource and Mineral Reserves Best Practices" guidelines.

Mineral Resources are not mineral reserves and do not necessarily demonstrate economic viability. There is no certainty that all or any part of this Mineral Resource will be converted into mineral reserve.

Inferred Mineral Resources are too speculative geologically to have economic considerations applied to them to enable them to be categorized as mineral reserves.

The base case Mineral Resource Estimate is reported at a cut-off of 3.0 g/t Au while other cut-offs are provided in order to demonstrate tonnage and grade sensitivities. All Mineral Resource Estimates are reported from within a 2.0 g/t grade shell to account for mineral continuity and potential mineability which excludes isolated blocks with little potential for mining. The Mineral Resource Estimate excludes mineralization within the crown pillar located between the lake bottom and a depth of 40 m below the lake bottom. In addition, all mineralized development that has been mined, has also been removed from the Mineral Resource Estimate.

Table 14-20 states the Measured, Indicated and Inferred Mineral Resources for the Phoenix Gold Project, Table 14-21 summarizes the sensitivity of the Resource Estimate to other potential mining cut-offs and Table 14-22 summarizes the changes from the 2016 Mineral Resource Estimate. The Effective Date of the Resource Estimate is April 30, 2018.

Table 14-20: Phoenix Gold Project 2018 Resource Estimate

Resource Category	Quantity (000'tonnes)	Grade (g/t Au)	Contained Gold Ounces
Measured (M)	188	6.80	41,000
Indicated (I)	1,186	6.30	240,000
M + I	**1,374**	**6.37**	**281,000**
Inferred	**3,884**	**6.00**	**749,000**

Effective date for this Mineral Resource is April 30, 2018
Mineral Resource Estimate uses a break-even economic cut-off grade of 3.0 g/t Au based on assumptions of a gold price of US$1,300 per ounce, an exchange rate of US$/C$ 0.77, mining cash costs of C$97/t, processing costs of C$20/t, G&A of C$5/t, sustaining capital C$10/t, refining, transport and royalty costs of C$53/ounce, and average gold recoverability of 92%
Mineral Resource Estimate reported from within an envelope accounting for mineral continuity
Mineral Resources are not Mineral Reserves and do not demonstrate economic viability
There is no certainty that all or any part of this Mineral Resource will be converted into Mineral Reserve
All figures are rounded to reflect the relative accuracy of the estimates and totals may not add correctly

Table 14-21: Phoenix Gold Project 2018 Resource Sensitivities

	Measured + Indicated Classification			Inferred Classification		
Cut-off Grade (g/t Au)	Quantity (000't)	Grade (g/t Au)	Contained Gold Ounces (000)	Quantity (000't)	Grade (g/t Au)	Contained Gold Ounces (000)
2.0	2,167	4.94	344	6,475	4.58	954
2.5	1,729	5.62	313	5,045	5.24	851
***3.0**	**1,373**	**6.37**	**281**	**3,884**	**6.00**	**749**
3.5	1,119	7.08	255	3,146	6.64	672
4.0	909	7.86	230	2,556	7.31	601
4.5	745	8.65	207	2,070	8.04	535
5.0	623	9.42	189	1,725	8.70	483

*Base Case Scenario: Mineral Resource Estimate uses a break-even economic cut-off grade of 3.0 g/t Au

Table 14-22: Summary of Resource Changes

Cut-off Grade Classification	Quantity (000' tonnes)			Grade (g/t Au)			Contained Gold Ounces		
	2018	2016	Change	2018	2016	Change	2018	2016	Change
***3.0 g/t Au**									
Measured (M)	188	0	N/A	6.80	0	N/A	41,000	0	N/A
Indicated (I)	1,186	719	65%	6.30	5.71	10%	240,000	132,000	82%
Total M+I	**1,374**	**719**	**91%**	**6.37**	**5.71**	**12%**	**281,000**	**132,000**	**113%**
Inferred	**3,884**	**2,491**	**56%**	**6.00**	**5.18**	**16%**	**749,000**	**415,000**	**80%**
3.5 g/t Au									
Measured (M)	155	0	N/A	7.54	0	N/A	38,000	0	N/A
Indicated (I)	964	601	60%	7.01	6.19	13%	217,000	120,000	81%
Total M+I	**1,119**	**601**	**86%**	**7.08**	**6.19**	**14.4%**	**255,000**	**120,000**	**113%**
Inferred	**3,146**	**1,959**	**61%**	**6.64**	**5.71**	**16.3%**	**672,000**	**360,000**	**87%**
4.0 g/t Au									
Measured (M)	129	0	N/A	8.29	0	N/A	35,000	0	N/A
Indicated (I)	779	492	58%	7.78	6.73	16%	195,000	106,000	84%
Total M+I	**909**	**492**	**85%**	**7.86**	**6.73**	**17%**	**230,000**	**106,000**	**117%**
Inferred	**2,556**	**1,519**	**68%**	**7.31**	**6.28**	**16%**	**601,000**	**307,000**	**96%**

*Base case scenario for the 2018 Mineral Resource Estimate is at the 3.0 g/t Au cut-off. Other scenarios are shown for comparison purposes.

Changes between the 2016 and 2018 Mineral Resource Estimates are mainly due to a reinterpretation of geological and structural controls on mineralization, a lowering of the reporting cut-off grade to 3.0 g/t from 4.0 g/t, representing the potential change from narrow-vein mining to bulk mining methods (longhole), the addition of new data from drill holes, underground mapping and chip samples along with changes to the estimation methodology.

14.7 Other Information

Golder is unaware of any known environmental, permitting, legal, title, taxation, socio-economic, marketing, political or any other potential factors that could materially impact the Phoenix Resource Estimate provided in this technical report.

15.0 MINERAL RESERVE ESTIMATES

There are no reserves currently defined for the Phoenix Gold Project.

16.0 MINING METHODS

Mining methods have not been evaluated for the 2018 Mineral Resource Estimate in a current preliminary economic assessment, pre-feasibility study or feasibility study. Please refer to Item 24.1 for other information regarding conceptual mining methods.

17.0 RECOVERY METHODS

Recovery methods have not been evaluated for the 2018 Mineral Resource Estimate in a current preliminary economic assessment, pre-feasibility study or feasibility study. Please refer to Item 24.2 for other information regarding conceptual recovery methods.

18.0 PROJECT INFRASTRUCTURE

Project infrastructure requirements have not been evaluated for the 2018 Mineral Resource Estimate in a current preliminary economic assessment, pre-feasibility study or feasibility study. Please refer to Item 24.3 for other information regarding Project infrastructure.

19.0 MARKET STUDIES AND CONTRACTS

There are no current market studies available at this time.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

These subjects are not supported by a current preliminary economic assessment, pre-feasibility study or feasibility study. Please refer to Item 24.4 for other information regarding these subjects.

21.0 CAPITAL AND OPERATING COSTS

Project capital and operating costs have not been estimated as of the effective date of this Technical Report.

22.0 ECONOMIC ANALYSIS

An economic analysis has not been completed as of the effective date of this Technical Report.

23.0 ADJACENT PROPERTIES

There are no adjacent properties relevant to this technical report.

24.0 OTHER RELEVANT DATA AND INFORMATION

The following information reflects work completed on the Rubicon Gold Project in the past and is not supported by a current preliminary economic assessment, pre-feasibility study or feasibility study.

24.1 Mining Methods

The mining methods discussed are conceptual and further studies will be required to fully assess their viability. A test mining and bulk sample program is scheduled to be completed in 2018, will provide additional mining information and the data collected will be used to potentially confirm mining methods and related parameters such as stope design, dilution and recovery. There is no certainty that a potential mine will be realized or that a production decision will be made. Conceptual mine design and mining schedules may require additional detailed work, economic analysis, and internal studies to ensure satisfactory operational conditions and decisions regarding future production.

24.1.1 Previous Mining

The Phoenix Gold Project Property has never been in commercial production to date, though several bulk samples have been taken in the past on both the F2 gold deposit and the unrelated mineralization that was being assessed at the historic McFinley deposit. Test mining and milling was conducted in 2015 on the F2 gold deposit at the Phoenix Gold Project. 60,580 tonnes of mineralized material was hoisted in 2014 and 2015.

In 1956, a 129-metre deep exploration shaft was sunk by McFinley Red Lake Gold Mines Ltd. and followed up with 414 m of lateral workings on two levels before work was suspended in mid-1957 (G.M. Hogg & Associates Ltd. 1983).

In 1984, the shaft was re-opened as the Phoenix Shaft and an additional 479 m of lateral development was completed on the 46 m (150 ft) and 122 m (400 ft) levels. After a temporary shutdown starting in February 1985, a further 1,151 m of lateral development was completed prior to the decision to take a bulk sample in 1987. The bulk sample program started in July 1988 from prepared stoping areas. Mining exploration activities on the property were terminated in 1989 after test-milling of an estimated 2,500 tonnes of material unrelated to the F2 gold deposit. The level naming convention for the mine was originally measured in feet below the shaft collar. The 400-foot level was the original bottom level of the McFinley mine and is now referred to by its metric equivalent, the 122 level. The Phoenix Gold Project uses the metric system and all measurements are metric.

Rubicon acquired the property in June 2002 and resumed exploration work. In 2009, the existing shaft was dewatered and reconditioned to support an advanced exploration program. In June 2009, shaft sinking started to deepen the existing shaft to 350 m and a loading pocket was installed to support development at the 305 level,

followed by lateral and vertical development on the 244 and 305 levels. This led to two approximately 1,000-tonne bulk samples being excavated on the 305 m level in 2011 using development methods.

Shaft sinking resumed in July 2012 after upgrading the headframe and hoisting plant. It was slowed significantly due to a zone of squeezing ground encountered during this phase of the shaft sinking through ultramafic units. The installation of concrete reinforcing rings and other measures were taken to ensure these issues would not cause potential future delays. The shaft was completed to a depth of 730 m in December 2013.

Lateral and vertical development continued from January 2014. In 2015, the Phoenix Gold Project underwent a period of trial stoping, bulk sampling and milling. In June 2015, Rubicon announced its first gold pour from the bulk sampling. In November 2015, the Company announced it was suspending underground activities at the Project while it enhanced its geological model of the F2 gold deposit. This report provides the result of said enhancements.

Table 24-1 lists total lateral development completed at the Project prior to 2017. Hoisted tonnage for 2014 and 2015 was 60,580 wet tonnes as accounted for in Table 24-2.

Table 24-1: Underground Lateral Development by Level

	Pre2017
Description	***Quantity**
All Ramps	1,359
46 mL	1,742
84 mL	1,549
122 mL	2,909
183 mL	1,210
244 mL	2,022
305 mL	2,393
610 mL	296
685 mL	188
Total (m)	13,668

* To the nearest meter
**Diamond Drill & Safety Bays Excluded

Table 24-2: Mineralized Material Hoisted in 2014 and 2015

Hoisted (wet tonnes)	2014	2015	Total
Waste	166,383	188,192	354,475
Development Material	503	33,670	34,173
Stope Mineralized Material	0	26,407	26,407
Total	**166,886**	**248,269**	**415,055**
Mineralized material	503	60,077	60,580

Mine infrastructure (Figure 24-1) includes muck handling facilities for all levels, a ventilation system, a paste backfill plant and underground distribution system (partially completed), a mid-shaft loading pocket complete with spill pocket, and a shaft bottom loading pocket. Ramp access has been established between the 305 m level and 244 m level. Remaining ramp connections from 244 m level up to the 122 m level are within 380 m of completion. A ramp from surface to the 122 m level has been designed and would be approximately 800 m in length. The black wireframe surface, representing lake bottom, has been included for reference

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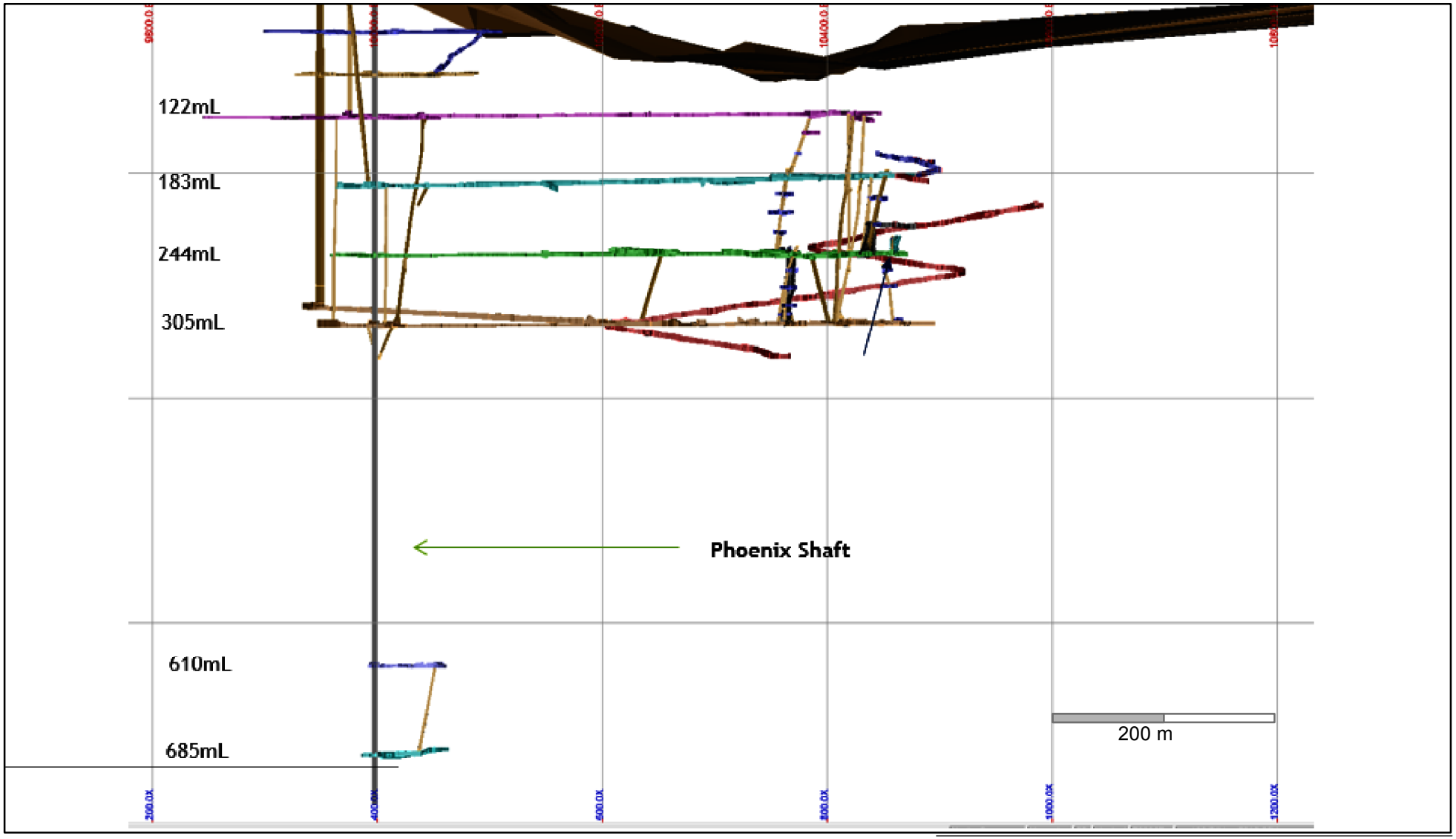

REFERENCE(S)
SOURCE: RUBICON MINERALS 2018

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-12
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
PHOENIX UNDERGROUND (LOOKING NORTH)

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	24-1

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24.1.2 Description of Previous Test Mining

During the initial test mining completed in 2015, eleven mining blocks were in various stages of development and mining. In November of 2015, the decision was made to suspend the underground activities until further evaluation of the deposit was completed. In general, all test stopes were developed for sub-level longhole stope mining method. Access to the mining blocks (sublevels) was gained via Alimak raise climber.

Figure 24-2 shows the location of the 030, 159, 994 and 977 trial stopes relative to the underground workings.

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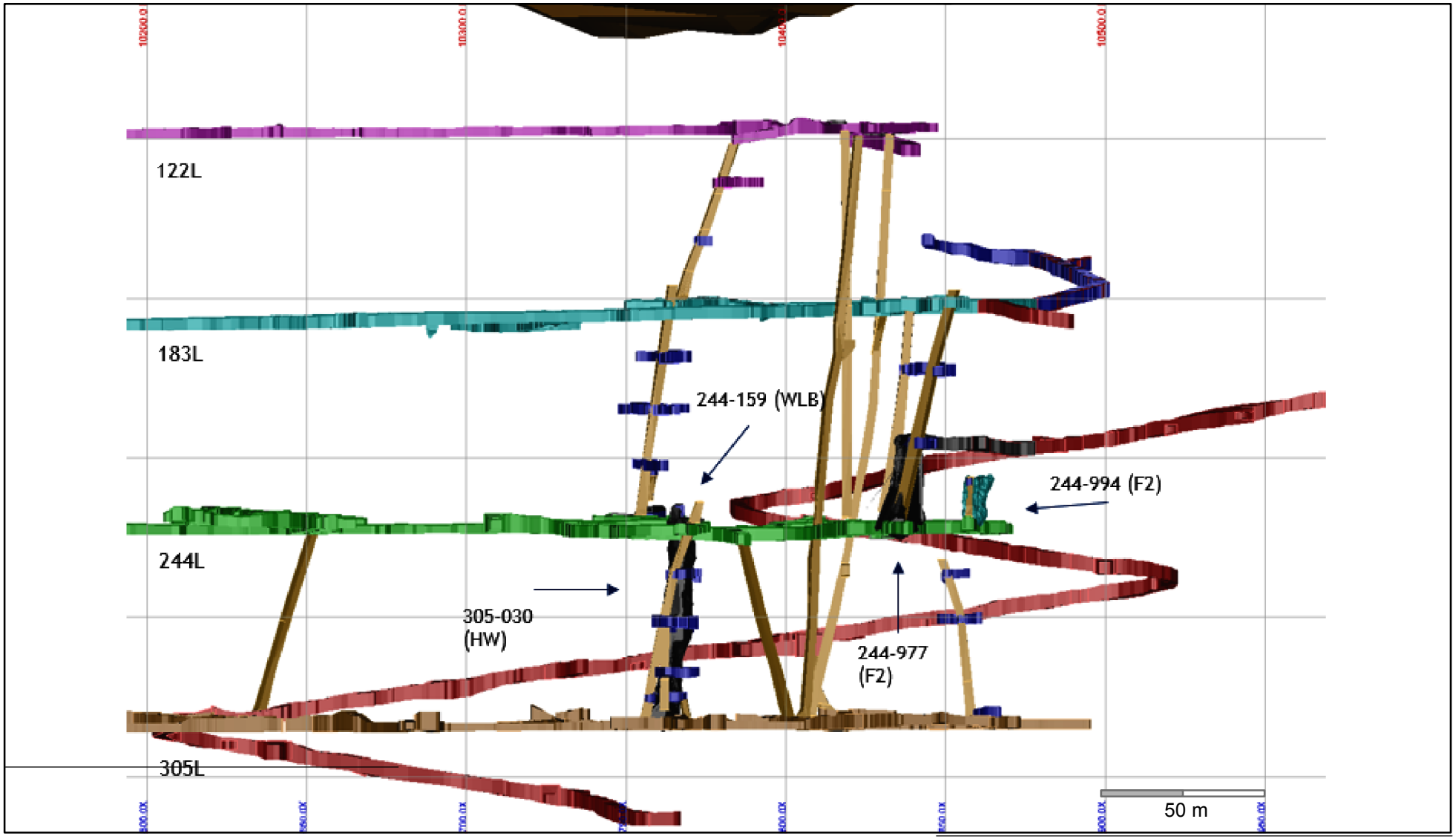

REFERENCE(S)
SOURCE: RUBICON MINERALS 2018

CLIENT
RUBICON MINERALS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-06-12
DESIGNED	JS
PREPARED	JS
REVIEWED	BT
APPROVED	JDW

PROJECT
PHOENIX GOLD PROJECT
2018 TECHNICAL REPORT

TITLE
LOCATION OF 2015 TRIAL STOPES

PROJECT NO.	CONTROL	REV.	FIGURE
1671445	010	01	24-2

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Development of longhole test stopes followed the general sequence below:

- Delineation on the stope with diamond drilling.
- Development of an Alimak raise on the hanging wall contact between the ultramafic and the High-Ti Basalt from one elevation to the next.
- Sublevels developed from the Alimak raise at 15-metre intervals, except for the 244 m level-977 stope which had a sub-level interval of 20 m. All sub-levels were developed using hand held pneumatic drills and slushers.
- The geology department completed geological mapping and face sampling of the development areas associated with each stope block, and integrated all other relative information to produce a geological shape within the High-Ti Basalt which then defined the mining block. Following a geotechnical evaluation, the engineering department then designed a sequence of extraction that best suited local ground conditions and production efficiencies.
- Drilling the mining blocks, from one sub-level to the next, was completed with top hammer pneumatic longhole drills.
- Typically, a slot was opened up at one end of the first block and blasted to the mucking horizon where the mined material was removed via a remote-control load-haul-dump (LHD). The muck was transported to either the ore pass, or direct loaded into ore cars on the 305 m level.
- Following completion of mining, the excavation was surveyed via a cavity monitoring system to enable comparison of the design shape to the actual excavated opening.

24.1.3 Geotechnical Evaluation

24.1.3.1 Introduction

In general, ground conditions at the Phoenix Gold Project can be considered good, in particular in the F2 Basalt Zone (High-Ti Basalt). Within the F2 gold deposit, cavity monitoring surveys in the 305-030 test stope completed in 2015 confirmed the good ground conditions in this area with minimal external dilution. Historic ground stability issues have been encountered in an ultramafic unit west of the F2 zone, largely related to geological structures. These conditions have been mitigated by the application of appropriate ground support.

Geotechnical evaluations completed to date include a scoping level evaluation by SRK in July 2013 (SRK, 2013a), a crown pillar assessment by AMC in December 2014 (AMC, 2014), and Ground Support Standards for Rubicon by AMC (2009), which are currently being used at the site. Detailed information contained in these evaluations can be found in the respective documents.

24.1.3.2 Geotechnical Assessment by SRK

Geotechnical assessment conducted by SRK is available in the preliminary economic assessment for the F2 gold deposit Issued: August 9, 2013. Amended and Restated: February 28, 2014 (SRK, 2013b). Regular monthly ground support audits of the underground workings are being completed by in house engineering staff.

24.1.3.3 Crown Pillar Assessment by AMC

Rubicon commissioned AMC (2014) to conduct an assessment of the crown pillar as the gold mineralization extends to the lake bottom. AMC has recommended a conservative minimum crown pillar thickness of 40 m and certain other risk mitigation options. Special operating procedures are recommended outlining ground support, backfill, and instrumentation monitoring strategies in the moderate to high risk areas. Currently no mining work is planned relative to the crown pillar.

24.1.3.4 Ground Control Management Plan by Rubicon

Rubicon's ground control management plan incorporates standardized ground support applications for the various ground stability issues that are expected at the Phoenix Gold Project. This is based on the various ground support studies that have been completed at the Project and also integrates information that has since been acquired from underground development completed and test stopes developed and mined. Standard ground support methodology includes use of rock bolts, rebar, mesh, cable bolts, and shotcrete. Stope stability analysis has been conducted on all stopes to date.

24.1.4 Planned Mining Methods

Past technical reports described several potential mining methods that could be used to extract the gold mineralization in the F2 gold deposit; from non-mechanized entry type methods to highly mechanized longhole stoping.

Any future mining plan must accommodate for a deposit that is relatively complex in nature. Recent test mining completed in 2015 provided for some preliminary testing of the sub-level longhole stoping method. The stopes excavated during 2015 were not filled prior to shut down and during the last several years, observations were made as to the wall rock competency with no failure being observed in these stope openings.

Two primary mining methods are being considered for the 2018 test mining and bulk sample testing: bulk mining using the sub-level longhole stoping mining method and selective mining in the narrower areas of the deposit using the mechanized cut and fill mining method. Both mining methods will be analyzed and the collection of data will assist in the further assessment of mining the F2 gold deposit though this is not to say that other mining methods will not be considered in the future. Mine design considerations must include flexibility to accommodate variations in grade, width and continuity of mineralization.

A high level of geological effort will be required to properly interpret the economic mineralized zones and generate accurate stope block models. This effort will include closely spaced stope definition drilling, geological mapping, test holes, and chip sampling. This will be key to optimizing the recovery of the Mineral Resource.

The engineering group will be able to optimize the extraction of the Mineral Resources through the employment of multiple mining methods, and variations on those mining methods, to progress from the stope block models to the final stope designs and associated development. Once the design of a stope or group of stopes has been finalized, the computer assisted stope outlines will be used to prepare detailed layouts for stope development and production mining. Development layouts will be executed under survey control with adjustments made as additional geological data becomes available from mapping and sampling the exposed mineralization.

24.1.4.1 Conceptual Mining Method Selection

The main physical characteristics (context) of the gold mineralization that are relevant to the conceptual mining method(s) selection are:

- The deposit is located approximately 400 m east of the existing shaft.
- The deposit is located under a lake; therefore, a stable crown pillar must be maintained.
- Any extraction from the crown pillar should wait until the end of the potential mine life.
- The deposit has been broken down into four stratigraphic zones, each with a separate block model.
- The overall mineralized zone ranges up to 200 m in width, up to 1,100 m along strike and extends down to approximately the 1,750-m level.
- There are three predominant High-Ti Basalt zones that comprise the F2 gold deposit (from west to east): HW Basalt Zone, WL Basalt Zone, and the F2 Basalt Zone.
- The geometry and distribution of the High-Ti Basalt lenses are a result of regional scale deformation events, resulting in the boudinage (the stretching and brittle-ductile deformation of more competent units relative to ductile deformation of surrounding less competent units) of the High-Ti Basalt lenses in the N-S direction. The mineralized zones can pinch and swell rapidly along strike and along dip.
- The deposit dips at between 75° and 80° with the shaft on the hanging wall side.
- Individual mineralized zones range in dip from 65° to vertical.
- The gold mineralization occurs in association with disseminated sulphide replacement and vein mineralization, both of which have been developed in the more competent High-Ti Basalt units, and, to a lesser degree, in the Felsic Intrusive Units.
- The underground is very dry and water inflows do not appear to be an issue as the known geological units have low permeability.
- The 122 m level, 183 m level, 244 m level, and 305 m level are established as main accesses from the shaft station to the F2 gold deposit.
- An internal ramp is connected between above 244 m level to below 305 m level. The remaining ramp to connect the 122 m level, 183 m level and the 244 m level requires approximately 380 m of ramp to complete.
- Muck handling systems are established on all operating levels except 122 m level.
- The paste backfill system has been partially completed within the underground workings with a distribution system in place from surface down to the 244 m level. Following commissioning of the plant, the paste backfill system will be available to deliver backfill to underground.

Conceptual mining methods that could be considered are discussed in the following sections.

24.1.4.1.1 Sublevel Longhole Open Stoping

This method is highly productive (bulk mining) and usually applied to ore widths of 3 m and greater. It involves development of the ore body at regular vertical intervals (sublevels), typically every 15 to 20 m. Several methods can be employed to develop the sublevels from driving raises (as done in 2015) to excavating accesses from main ramps (as planned for the test stoping scheduled in 2018). A blasting slot would be developed at one end of the excavation, and mining of the blocks would retreat along the strike of the stope. Mucking takes place within the undercut of the mining block via remote control load-haul-dump (LHD) equipment. The strike length is dictated by wall stability in the open stope and is initially determined by empirical design. This mining method is applicable to wider areas of the deposit.

24.1.4.1.2 Mechanized Cut and Fill (MCF)

Mechanized cut and fill is a moderately productive mining method, and is generally applied to ore widths more than 2.4 m and less than 10 m. The mining sequence begins by driving an attack ramp either from a level or from a nearby ramp. The attack ramp is generally driven at a -15% gradient to access the bottom or sill cut of the mineralized zone near the center of the stope mass using the same development equipment as that used for ramp and level development. The mineralized zone is developed with sill drifts to the extents of the mineralization. Once the initial lift is mucked, then waste is brought in and used as fill. After backfilling is complete, a section of the attack ramp is back slashed and rebolted to gain elevation for access to the next cut. The waste rock broken while doing this will be generally left in place or stored nearby to provide a road bed in the ramp and rockfill for the next cut. This cycle is repeated until the designed number of cuts has been mined. Mining continues upward by repeating the process from a new attack ramp to access the mineralized zone at the next higher elevation.

24.1.4.1.3 Conventional Captive Cut and Fill (CAF)

This mining method has low productivity and high selectivity and can be applied to narrow mining widths of 1.8 to 2.4 m as dictated by mining equipment. Segregation of ore and waste is possible when combined with a grade control program and active geological input in the mining sequence. The mining sequence begins by driving one or more crosscut drifts into the mineralized zone and silling out the mineralized zone at the main level elevations at the top and bottom. Then a service raise is driven from the bottom level to the top level. The service raise is used as an alternative escapeway from the stope and has a slide compartment for lowering materials into the stope using a tugger hoist located at the top of the raise. Services such as compressed air, water, hydraulic fill, and electric power are carried down the cribbed man-way/steel slide. Once the stope infrastructure is established (installation of mill hole and associated chute), the mining sequence begins by drilling and blasting the stope breast, bolting the back off the muck pile and mucking to the mill-hole with the slusher scraper combination. When one side is mined out, the mill hole on that side is raised, a fill wall is constructed and that side is backfilled while mining continues on the other side of the service raise. Prior to filling the second mined side, the start of the next lift around the service raise is excavated using the cribbed man-way as the escapeway. Once room is created on the filled side, the slusher is slung up to the newly poured floor and the mill-hole is extended upwards with the cribbed manway. As these are completed, filling starts to level off the two sides. The cycle is repeated until the stope breaks through to the upper level, unless a sill pillar is to be left. This method can also be used with a captive LHD in lieu of a slusher scraper combination if the geometry of the stope warrants it.

24.1.4.1.4 Shrinkage Stoping (Alimak)

This mining method can be moderately productive and moderately selective and can be applied to narrow mining widths of 1.8 to 2.4 m. The mining sequence begins by developing the bottom and top cut of the ore body. A bypass drift is typically developed on the footwall of the ore body and drawpoints are driven at approximately 10 m intervals. An access raise is driven in the centre of the ore body using an Alimak. Once the raise is broken through to the top cut, the Alimak is modified to allow a longhole drilling platform to be attached. This unit is then lowered down the raise to the appropriate location where longhole breasts can be drilled and blasted. As the stope is mined upward, the muck swell is removed from the draw points below. Once the entire stope is blasted, the remaining broken muck can be removed from the stope.

24.1.4.1.5 Uppers Longhole Method

This simple method involves driving a drift along the strike of the mineralized zone, positioning an inverse (slot) raise at the stope extremity, and production drilling of 15 m up holes at a 70° dip. Blasting and mucking will retreat towards the stope entrance. These stopes may or may not be backfilled. This method is best used where ore continuity is known and strike length is limited. It can be used in combination with other methods as part of an overall mining strategy.

24.2 Recovery Methods

This section documents the recovery methods developed for the Phoenix Gold Project. Since the 2013 Technical Report, a processing mill was constructed on site, along with ancillary mine waste and tailings storage facilities. Construction of the mill began in 2013 and was completed during 2015. The mill was commissioned and operated between May and November 2015 then placed into care and maintenance. A Technical Report was prepared by SRK which included results from the 2016 mill operation. The Company was restructured and exploration activity resumed at the site in January of 2017. The mill continued to be maintained and some gold locked in the process equipment was recovered. An Actiflo® metals treatment system was installed to operate in conjunction with the previous solids removal system in 2017 and is planned to be commissioned in mid - 2018, to ensure effluent meets discharge limits.

The mill contains an ore handling system feeding a two-stage grinding circuit closed by cyclones. Free gold is recovered by gravity concentration in the grinding section and by cyanide leaching in a carbon-in-leach circuit. The mill is newly constructed and was commissioned in 2015. The mill has been in care and maintenance since November 2015. In general, during the care and maintenance period, reasonable effort has been made to ensure that the integrity of the major equipment has been preserved. Prior to any start up, all equipment must be inspected and any deficiencies found will have to be corrected. These steps effectively would serve as recommissioning of the facility.

24.2.1 Process

The simplified process block diagram for the Phoenix Gold Project is presented in Figure 24-3. The mill was designed with an initial throughput capacity of 1,250 t/d, with provisions in the layout to increase capacity up to 2,500 t/d with modifications and additions to the existing equipment.

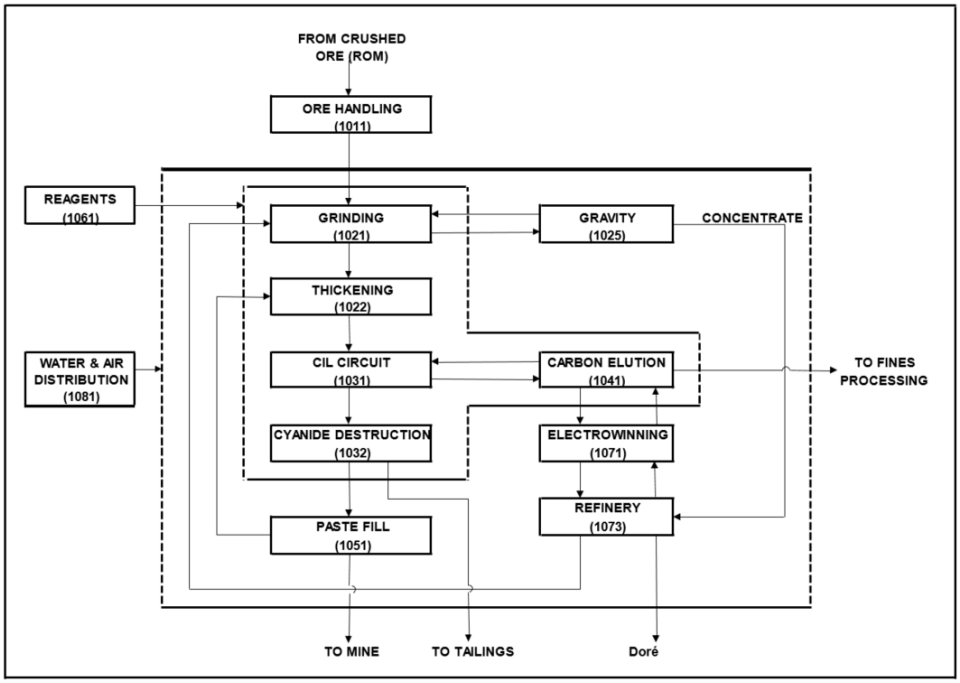

Figure 24-3: Simplified Process Block Diagram

Source: J. Frostiak 2018

24.2.2 Simplified Process Description

The process plant construction commenced in 2013 and was essentially complete in the spring of 2015. The gold recovery plant was commissioned in 2015 and operated intermittently until November 21, 2015 when surface stockpile milling was completed. A paste backfill plant was also constructed to prepare paste backfill for use in the underground. The paste backfill plant construction was not completed and the system has not been commissioned.

The unit operations installed for gold processing are essentially those described in the 2013 Technical Report (SRK, 2013b).

The process consists of a single line, starting with a SAG mill. The discharge from the SAG mill is sent to the ball mill circuit that uses hydrocyclones in closed circuit for classification. A gravity separation circuit is included to partially recover and concentrate any gravity recoverable gold. The remaining gold is extracted in a conventional CIL circuit. The loaded carbon is washed with hydrochloric acid solution to remove carbonates. Gold is then removed from the loaded carbon by elution (stripping) followed by electrowinning. The electrowinning and the gravity circuit both produce a high-grade gold concentrate that is smelted in an electric induction furnace to produce doré. The stripped carbon is regenerated in a reactivation kiln before being reintroduced to the process. Fine carbon is constantly eliminated (and recovered) from the process to avoid gold loss, with fresh carbon being continuously added to the process.

The cyanide contained in the tailings from the CIL circuit is eliminated in a cyanide destruction tank using the SO_2/O_2 cyanide destruction process. Either Liquid SO_2 or sodium metabisulphite can be used as the SO_2 source. Once the cyanide is destroyed, the tailings are pumped to the tailings management facility for storage.

When paste backfill is required, tailings will be diverted to the paste plant where they will be filtered to lower the water content. The filter cake will then be mixed with fly ash and cement to produce a paste. The paste produced will be pumped to the underground for backfilling. The gold recovery plant, cyanide destruction process, and the tailings management facility were commissioned and operated in 2015. The backfill plant has not operated as the Project had not yet required backfill. Major equipment for the tailings filter plant and the paste plant has been installed. However, some minor piping, electrical, and instrumentation connections remain to be completed before this plant can be commissioned.

24.2.3 Process Description

24.2.3.1 Mineralized Material Storage

An underground grizzly screen on the 305 m level with, typically, 23 cm openings (9″ by 9″) and a rock breaker are used to reduce the mineralized material size prior to hoisting it to the surface. A crusher will be installed below the 610 m level to appropriately size the material before it reports to the 685 m level loading pocket. The skipped mineralized material is dumped into a small coarse ore bin adjacent to the headframe, while the waste is dumped into a waste bunker adjacent to the headframe. The mineralized material is discharged from the coarse ore bin via a discharge chute onto a vibratory feeder, which then transfers the mineralized material onto the storage bin feed conveyor. A magnet fitted with a small conveyor is situated above and running perpendicular to the storage bin feed conveyor and is used to remove tramp metal from the coarse mineralized material. The tramp metal is collected in a bin for disposal. The remaining mineralized material is conveyed to the coarse ore bin.

24.2.3.2 Grinding and Thickening

The raw mineralized material from the coarse ore bin is reclaimed by two apron feeders and is discharged onto a first conveyor. The material on the first conveyor is discharged to a second conveyor equipped with a belt scale, which then transfers the mineralized material to the SAG mill mobile feed chute. Mineralized material reclaimed from stockpiles can be fed through a hopper and transfer conveyor to the SAG feed conveyor by-passing the ore bin.

The grinding circuit is a double-stage circuit consisting of a SAG mill and a ball mill. The SAG mill operates in open circuit while the ball mill is operated in closed circuit with hydrocyclones. Process water is added to the SAG mill feed chute to achieve the correct dilution for grinding. The main portion of the hydrocyclone underflow is directed to the ball mill for regrinding while the remaining portion goes to the gravity separation circuit. The hydrocyclone overflow pulp flows to the thickening circuit.

The thickening circuit consists of one trash screen, and one thickener. The trash screen is fed, by gravity, from the hydrocyclone cluster overflow. The screen undersize flows by gravity, via primary and secondary samplers, to the pre-leach thickener feed box. Any oversize trash is dumped into a trash bin.

The pre-leach thickener is fed by the trash screen undersize and the thickening area sump pump. Flocculant is also added to improve the settling rate. The thickener overflow feeds by gravity to the process water tank while the underflow is pumped to the pre-aeration tank in the carbon-in-leach circuit.

24.2.3.3 Gravity Separation

The gravity circuit consists of one vibrating screen, two gravity concentrators, one gravity table, and one gravity table magnet. The underflow from three of the hydrocyclones within the cluster is sent to the gravity circuit (two operational and one standby). The remaining five hydrocyclones underflow is sent to the grinding circuit (three to four operational and one to two standby).

The hydrocycloness underflow flows by gravity to the gravity screen. Dilution water is added to the screen oversize to transport the material to the gravity pump box. This material is directed to the gravity tails pump box and then pumped to the hydrocyclone feed pump box in the grinding circuit.

The gravity screen undersize flows to the gravity concentrator where gravity recoverable gold is recovered. Dilution water is added directly to the gravity screen underflow to facilitate the pulp flow into the concentrator and to adjust the feed pulp %-solids. The gravity concentrator concentrate is pumped to the gravity holding tank while the gravity concentrator tails are directed to the gravity tails pump box and then pumped to the hydrocyclone feed pump box in the grinding circuit.

The gravity concentrate, stored in the gravity holding tank, is fed to the gravity table magnet where the magnetic particles are removed and sent back to the grinding circuit. The non-magnetic portion of the stream is sent to the gravity table to produce an upgraded gold concentrate that is calcined in an oven prior to being smelted into doré in the on-site refinery. The gravity table tails are pumped to the hydrocyclone feed pump box, along with the gravity screen oversize, the gravity concentrator tails and the magnetic particles from the gravity table magnet for reprocessing in the grinding circuit.

24.2.3.4 Carbon-in-Leach (CIL)

The underflow from the pre-leach thickener is pumped to the pre-aeration tank. Slurry from the pre- aeration tank overflows into the first of six agitated CIL tanks arranged in series. Cyanide solution and lime are added, as required, to the pre-aeration tank and to the first and fourth tanks for gold dissolution and pH control. Lead nitrate can be added in the pre-aeration tank to improve the gold leaching kinetics. Gold in the solution is adsorbed onto the activated carbon.

The six tanks have been sized to provide 36 hours of residence time at the design flow rate and solids concentration. Each tank is equipped with a single interstage screen and a carbon-transfer pump and is agitated to maintain the solids in suspension. Air is injected in the bottom of the pre- aeration tank and in each tank for gold dissolution. Interconnecting tank launders are arranged so that any tank in series can be bypassed without having to shut down the entire CIL circuit.

On a regular basis, loaded carbon is pumped counter current to the slurry flow through the tanks in order to increase gold loading. The carbon-forwarding pump of the first tank transfers the slurry onto the loaded carbon screen to recover the loaded carbon from the slurry. Screen undersize flows by gravity back to the first tank while the oversize, containing the loaded carbon, flows by gravity to the acid wash column in the elution circuit. Fresh and regenerated carbon is added into the last tank.

24.2.3.5 Elution and Carbon Reactivation

Loaded carbon recovered by the loaded carbon screen gravitates to the loaded carbon tank which is then pumped to the acid wash column of the elution circuit. The carbon elution circuit treats a 4-tonne batch in approximately 12 hours. The circuit is designed to process one elution per day.

The acid solution is prepared in the dilute acid tank and then pumped through the acid wash column. Once the acid wash is complete, the spent acid is neutralized with caustic. The carbon is transferred from the acid wash column to the strip column for gold desorption. The solution from the barren strip solution tank flows through a series of heat exchangers and a heater in order to reach the right temperature in the strip column. The solution strips the gold loaded onto the carbon which then exits through a Johnson screen from the upper side of the column. The pregnant solution then goes to the electrowinning cells in the refinery for gold recovery.

The stripped carbon is drawn from the bottom of the strip column and goes to the carbon reactivation kiln. After the reactivation, the carbon is discharged into the carbon quench tank. The carbon from the carbon quench tank is pumped and screened out to remove (and recover) fine carbon and then drops by gravity to the last CIL tank. Fresh carbon is added in the carbon quench tank on a regular basis to compensate for the fine carbon removal.

24.2.3.6 Electrowinning and Refinery

The pregnant solution from the strip column flows first by gravity to the electrowinning flash tank and then to two parallel electrowinning cells, where the gold is plated on cathodes. The barren solution from the electrowinning cells is recovered in a pump box and pumped back to the barren strip solution tank in the carbon elution circuit.

After a certain period, the stainless-steel wool cathodes are cleaned with high pressure water and the gold sludge sinks to the bottom of the cells. The gold sludge is then pumped with a diaphragm pump to a filter-press to remove excess water. The filtrate from the filter-press flows to the electrowinning tanks or the barren solution pump box.

The filtered gold sludge from the filter-press is sent to the calcination oven to remove excessive humidity. The dried gold sludge is then mixed with suitable fluxes (typically borax, soda ash, sodium nitrate, and silica sand) and is fed into the crucible of the electric induction furnace. Once the gold is melted, it is poured into the doré moulds. Doré bars are then recovered for shipment.

24.2.3.7 Cyanide Destruction

The safety screen is fed by the last CIL tank overflow. It prevents the loss of carbon in the eventuality of a failure of the last tank interstage screen. The carbon is recovered at the oversize bin.

The screen undersize flows by gravity into the cyanide destruction tank feed pump box and is pumped to the cyanide destruction tank. Oxygen is added at the bottom of the cyanide destruction tank within a dispersion cone. Sulphur dioxide (SO_2) is added in liquid form at the bottom of the tank. Alternatively, a sodium metabisulphite solution can be prepared and added to the reactor. The copper sulphate and the lime are added at the top of the tank.

Once cyanide destruction is complete, the tailings are discharged into the cyanide destruction discharge distributor. When the paste plant is operating, the tailings flow by gravity to the buffer tank feed pump box and are pumped to the buffer tank. When the paste plant is not operating, the tailings flow by gravity to the tailings pump

box and are pumped to the tailings pond. Service water can also be added to the tailings pump box to prevent pump surging.

24.2.3.8 Tailings Filtration (not commissioned)

The construction of the tailings filtration circuit has not been fully completed or commissioned. The tailings filtration system consists of two-disc-filters with two filter feed pumps, two vacuum pumps, two snap blow receivers, two filtrate tanks, and two filtrate pumps.

The tailings from the cyanide destruction circuit are pumped from the buffer tank feed pump box to the buffer tank. The tailings are then pumped to one of the two disc-filters for filtration (one operational, one standby). The filtrate is recovered in the filtrate tank and pumped to the tailings box. The filtered tailings are discharged on the tailings conveyor which feeds the paste mixer.

24.2.3.9 Paste Backfill Preparation (not commissioned)

The construction of the paste backfill plant has not been fully completed or commissioned. The disc filter tailings cake is discharged on the tailings conveyor and then mixed with service water in the paste mixer to produce backfill paste. Fly ash and Portland cement are also added to the mixer to meet underground backfilling strength requirements. The cement and binders discharged from the storage bins are controlled to achieve the proper concentration in the backfill paste. The paste produced by the mixer is then discharged into the paste pump feed hopper.

24.2.3.10 Paste Backfill Distribution (not commissioned)

The construction of the paste backfill distribution system has not been fully completed or commissioned. Once the paste is prepared, one positive displacement pump is used to move the paste into the underground stopes. The pump is equipped with a hydraulic unit.

24.2.3.11 Reagents

Except for the reagents used in relatively small quantities at the electrowinning and refinery sectors, the following reagents are used throughout the process:

Sodium cyanide

Sodium cyanide (NaCN) is supplied in 1 tonne bags and is mixed with water in batches on site in a controlled environment and then transferred to the cyanide distribution tank. The sodium cyanide solution is pumped to the CIL circuit and the barren elution solution tank.

Flocculant

Flocculant is used in the pre-leach thickener to improve the solids settling rate. Flocculant is supplied in bags. The preparation station consists of a wetting unit, mixing tank and distribution tank. The flocculant is then pumped into the pre-leach thickener.

Hydrochloric acid

Hydrochloric acid (HCl) is used for the carbon acid wash. The hydrochloric acid is supplied in totes and pumped to the acid storage tank. The acid is pumped to the dilute acid tank in the carbon elution circuit as required.

Lead nitrate

Lead nitrate ($PbNO_3$) is sometimes used to improve the gold leaching kinetics in the CIL circuit. A $PbNO_3$ handling and addition system has been installed but not used in 2015.

Sulphur dioxide

Liquid sulphur dioxide (SO_2) is used as an oxidizing agent in the cyanide destruction process. The sulphur dioxide is delivered by truck and stored in the sulphur dioxide tank. The sulphur dioxide tank is equipped with a pressure system to keep the sulphur dioxide in liquid form and to deliver the sulphur dioxide to the cyanide destruction tank.

Sodium Metabisulphite

Sodium metabisulphite ($Na_2S_2O_5$) is used as an oxidizing agent in the cyanide destruction process as an alternative to liquid SO_2. The metabisuphite is delivered by truck in bags. The metabisulphite is mixed with water in a mixing tank and the solution is pumped to the cyanide destruction tank.

Lime

Lime, delivered as quicklime (CaO), is used to control the pH in the grinding, CIL and cyanide destruction circuits to prevent cyanide (HCN) gas formation. The lime is delivered in bulk by truck and stored in the lime bin. A screw feed conveyor transfers the lime to the lime slaker to prepare the milk of lime. The milk of lime is stored in the lime distribution tank. Distribution pumps deliver the milk of lime to the CIL circuit and cyanide destruction circuits through a closed loop distribution system.

Copper sulphate

Copper sulphate ($CuSO_4$) is used as a catalyst in the cyanide destruction process. Copper sulphate is supplied in bags and is mixed in batches with water on site in a controlled environment then transferred to a distribution tank. The copper sulphate solution is pumped to the cyanide destruction tank as required.

Sodium hydroxide

Sodium hydroxide (NaOH) is used for carbon stripping and to neutralize the residual acid in the dilute acid tank and the acid wash column. The caustic is supplied in drums and pumped to the caustic storage tank. A distribution pump transfers the caustic to the dilute acid tank and to the barren strip solution tank.

Descalant

A descalant reagent is used to reduce calcium carbonate deposits. The descalant is supplied in totes and pumped to the process water tank and barren strip solution tank as required.

Cement

Cement will be used at the paste plant to enhance the strength of the paste backfill. Cement will be delivered in bulk by truck and will be stored in a bin. A screw conveyor will deliver the cement to the paste mixer. This system has been constructed but has not been commissioned or operated.

Fly Ash

Fly ash will be used at the paste plant to enhance the strength of the paste backfill. Fly ash is delivered in bulk by truck and will stored in a bin. A screw conveyor delivers the slag to the paste mixer. This system has been constructed but has not been commissioned or operated.

24.2.3.12 Utilities

Fresh Water

A fresh water system is required in order to store and distribute fresh water to various areas of the mill and Project site. The existing fresh water tank is situated at the highest topographical location, south of the hoist room. The fresh water tank is fed by the redesigned pump system that draws water from East Bay of Red Lake. Two fresh water pumps (one operational, one standby) distribute fresh water to the processing plant and various other areas at the Project site. Fresh water is used for reagent preparation, cooling, and washbasins.

Reclaim Water

The water recovered from the tailings pond (reclaim water) is pumped into the service water tank by one of the two reclaim water pumps located in the pond. The remaining reclaim water pump is used either as a spare or for feeding the water treatment plant for the treatment and discharge of surplus water from the tailings management facility to the environment.

Service Water

The service water tank is used to store reclaim water that contains low values of cyanide. It is fed by reclaim water from the tailings pond, and by fresh water when required. The service water tank overflows into the process water tank and serves as make-up process water. The service water is also pumped and distributed throughout the concentrator.

Process Water

The process water is stored in the process water tank located on the west side of the pre-leach thickener to allow any overflow from the thickener to gravitate into the process water tank. The process water tank is also fed by the service water tank overflow, if additional water is required. Two process water pumps (one operational, one standby) distribute the water to various process areas. Process water is used in the grinding, gravity, and thickening circuits.

Domestic Water for Emergency Showers

Domestic (potable) water feeds the domestic water heaters. Two domestic water pumps (one operational, one standby) distribute domestic water to the emergency showers throughout the concentrator as well as the rest of the Project site.

Air Service

Mine air compressors supply compressed air at 125-pounds per square inch gage (psig) to the process plant as service air and to an air dryer. The air dryer supplies dry air to a dry air receiver that stores and supplies dry air for instrumentation requirements. Two air blowers are used for the air distribution to the CIL circuit. One blower is in service and the other on standby.

24.2.4 Concentrator Design

24.2.4.1 Design Criteria

Table 24-3 presents the main design criteria used for the concentrator design. The design criteria are identical to those described in the 2013 technical report (SRK, 2013b).

Table 24-3: Concentrator Main Design Criteria

Parameter	Value	Units
Feed Characteristics		
Gold Head Grade (Nominal)	8.06	g/t
Gold Head Grade (Maximum)	20	g/t
Mineralized Material Moisture	5	% w/w
Mineralized Material Specific Gravity	2.9	
Draw Down Angle	50	o
Repose Angle	40	o
Operating Schedule		
Scheduled Operating Days	365	day/yr
Operating Hours	24	hr/day
Plant Availability	92	%
Shifts	2	shift/day
Production Rate		
Plant Feed Rate (Nominal)	1,250	t/d
Plant Feed Rate (Operation)	1,359	t/d
Plant Feed Rate (Future Expandable)	2,500	t/d
Production Target (Dry)	456,250	t/y
Gold Recovery	92.5	%
General Characteristics		
Ambient Temperature	10 to 30	°C
Outdoor Temperature	-36 to 28	°C
Relative Humidity	20 to 100	%
Altitude Above Sea Level (shaft collar)	369	m

24.2.4.2 Mass Balance

Table 24-4 is the theoretical mass balance developed for the mill as presented in the 2013 technical report (SRK, 2013b). The mass balance is based on a concentrator availability of 92% and a nominal feed rate of 1,250 t/d. The clarifier which is shown in the mass balance was not installed. The effect is not material to the overall mass balance. This stream now reports directly to the tailings box.

Table 24-4: Concentrator Mass Balance

Stream Description	Solids (t/h)	Solids (m^3/h)	Solution (t/h)	Pulp (t/h)	Pulp (m^3/h)	Solids (%w/w)
Grinding Circuit						
SAG Mill						
SAG Mill Feed	56.6	19.5	2.98	59.6	22.5	95
SAG Mill Discharge	56.6	19.5	23.9	80.5	43.4	70.3
Ball Mill						
Hydrocyclone Underflow to Grinding Circuit	127.4	43.9	54.6	182	98.5	70
Ball Mill Discharge	127.4	43.9	59.6	187	103.5	68.1
Hydrocyclone Feed Pump Box						
SAG Mill Discharge	56.6	19.5	23.9	80.5	43.4	70.3
Ball Mill Discharge	127.4	43.9	59.6	187	103.5	68.1
Gravity Circuit Tailings	42.5	14.6	66	108.5	80.7	39.1
Hydrocyclone						
Hydrocyclone Feed	226.4	78.1	177.9	404.4	256	56
Hydrocyclone Underflow	169.8	58.6	72.8	242.6	131.4	70
Hydrocyclone Underflow to Grinding Circuit	127.4	43.9	54.6	182	98.5	70
Hydrocyclone Underflow to Gravity Circuit	42.5	14.6	18.2	60.7	32.8	70
Hydrocyclone Overflow	56.6	19.5	105.1	161.7	124.7	35
Gravity Circuit						
Hydrocyclone Underflow to Gravity Circuit	42.5	14.6	18.2	60.7	32.8	70
Gravity Circuit Tailings	42.5	14.6	66	108.5	80.7	39.1
Gravity Table Concentrate	0.0011	0.00011	0.00006	0.001	0.0002	95
Thickening Circuit Trash Screen						
Hydrocyclone Overflow	56.6	19.5	105.1	161.7	124.7	35
Trash Screen Undersize	56.6	19.5	110.1	166.7	129.7	34
Clarifier (not installed)						
Clarifier Feed (Filtrate + Vacuum Seal Water)	0.014	0.00484	31.2	31.2	31.2	0.04
Clarifier Overflow	-	-	27.9	27.9	27.9	-
Clarifier Underflow	0.014	0.00484	4.12	4.13	4.13	0.34
Pre-Leach Thickener						
Thickener Feed	56.6	19.5	115.4	172	134.9	32.9
Thickener Overflow	0.012	0.0041	58.8	58.8	58.8	0.02
Thickener Underflow	56.6	19.5	56.6	113.2	76.1	50
CIL Circuit						
Pre-Aeration Tank A Feed	56.6	19.5	58.1	114.7	77.6	49.3

Stream Description	Solids (t/h)	Solids (m^3/h)	Solution (t/h)	Pulp (t/h)	Pulp (m^3/h)	Solids (%w/w)
Loaded Carbon Screen Undersize	7.94	2.66	8.65	16.6	11.3	47.9
CIL Tank A Feed	56.6	19.5	59	115.6	78.5	49
CIL Circuit Tailings to Safety Screen	56.6	19.5	59	115.6	78.5	49
Loaded Carbon Screen						
Pulp Transfer (with Carbon) to the Loaded Carbon Screen	8.12	2.8	8.46	16.6	11.3	49
Carbon Feed to Acid Wash Column	0.181	0.139	0.725	0.906	0.864	20
Loaded Carbon Screen Undersize	7.94	2.66	8.65	16.6	11.3	47.9
Cyanide Destruction Safety Screen						
CIL Circuit Tailings to Safety Screen	56.6	19.5	59	115.6	78.5	49
Safety Screen Oversize	0.00068	0.000523	0.00008	0.00075	0.0006	90
Safety Screen Undersize	56.6	19.5	60.5	117.1	80	48.3
Cyanide Destruction Tank						
Cyanide Destruction Tank Feed	56.6	19.5	62	118.6	81.5	47.7
Cyanide Destruction Tank Discharge	56.6	19.5	62.1	118.7	81.6	47.7
Buffer Tank Feed	31.1	10.7	35	66.1	45.7	47.1
Tailings Pond Feed	25.5	8.78	53.7	79.1	62.4	32.2
Carbon Regeneration and Attrition Carbon Reactivation Kiln						
Carbon Reactivation Kiln Feed	0.09	0.0692	0.0047	0.095	0.0739	95
Carbon Reactivation Kiln Discharge	0.09	0.0692	-	0.09	0.0692	100
Carbon Quench Tank						
Fresh Carbon Dewatering Screen Oversize	0.0935	0.072	0.0104	0.1039	0.0823	90
Carbon Reactivation Kiln Discharge	0.09	0.0692	-	0.09	0.0692	100
Regenerated Carbon Fines Screen Feed	0.184	0.141	0.734	0.918	0.875	20
Regenerated Carbon Fines Screen						
Regenerated Carbon Fines Screen Feed	0.184	0.141	0.734	0.918	0.875	20
Regenerated Carbon Fines Screen Oversize (to CIL Tank F)	0.182	0.14	0.0321	0.214	0.172	85
Regenerated Carbon Fines Screen Undersize (to carbon fines tank)	0.00152	0.00117	0.742	0.744	0.743	0.2
Acid Wash Column						
Carbon Feed to Acid Wash Column	0.181	0.139	0.725	0.906	0.864	20
Carbon Transferred to Elution	0.181	0.139	0.725	0.906	0.864	20
Acid Wash Flow	-	-	3.03	3.03	2.72	-
Acid Solution Recirculation	-	-	3.03	3.03	2.72	-
Elution Strip Column A						
Carbon Transferred to Elution	0.181	0.139	0.725	0.906	0.864	20
Eluted Carbon Transfer to Unloaded Carbon Dewatering Screen	0.0906	0.0697	0.362	0.453	0.432	20

Stream Description	Solids (t/h)	Solids (m^3/h)	Solution (t/h)	Pulp (t/h)	Pulp (m^3/h)	Solids (%w/w)
Eluted Carbon Transfer to Fresh Carbon Dewatering Screen	0.0906	0.0697	0.362	0.453	0.432	20
Barren Strip Solution Flowrate	-	-	8.7	8.7	8.7	-
Eluate Solution to Electro winning (electrowinning feed)	-	-	8.7	8.7	8.7	-
Refinery Electro winning						
Eluate Solution to Electro winning (electrowinning Feed)	-	-	8.7	8.7	8.7	-
Electro winning Solution Discharge Pump to Barren Strip Solution Tank	-	-	8.7	8.7	8.7	-
Sludge Filter Pump Discharge (electrowinning conc.)	0.00036	0.00002	0.0015	0.0018	0.0015	20
Paste Plant Buffer Tank						
Buffer Tank Feed	31.1	10.7	35	66.1	45.7	47.1
Filter Feed	31.1	10.7	35.8	66.9	46.5	46.5
Disc Filter	-	-	-	-	-	-
Filter Feed	31.1	10.7	35.8	66.9	46.5	46.5
Cake	31.1	10.7	7.78	38.9	18.5	80
Tailings Box Feed (filtrate + vacuum seal water)	0.014	0.00484	28	28	28	0.05
Mixer						
Cake	31.1	10.7	7.78	38.9	18.5	80
Water Addition to the Mixer	-	-	2.97	2.97	2.97	-
Slag Feed	0.903	0.31	-	0.903	0.31	100
Cement Feed	0.226	0.0717	-	0.226	0.0717	100
Paste Production	32.3	11.1	10.8	43	21.9	75
Water Management Tailings Pond						
Tailings Pond Feed	25.5	8.78	53.7	79.1	62.4	32.2
Reclaim Water from the Tailings Pond to the Service Water Tank	-	-	51.3	51.3	51.3	-

24.2.4.3 Equipment List

The equipment list presented in Table 24-5 was initially developed for the conceptual mill presented in the 2013 technical report (SRK, 2013b).

The equipment was selected based on design criteria outlined in Table 24-4 above for a 1,250 t/d throughput and an availability of 92%. Some major equipment was designed for an expansion to 2,500 t/d. A major equipment list with a brief description of the equipment is presented in Table 24-5.

In the design of the mill that was constructed, certain components were added or deleted (noted with an asterisk in Table 24-5). The notable changes were:

- the number of cyclones installed increased from 6 to 8
- a loaded carbon tank was added
- a second gravity concentrator was added
- a gravity concentrator feed screen was added
- the storage bin designated for slag will be used for fly ash as a slag supply is unavailable
- one paste pump was installed to meet the initial requirements for paste fill

Table 24-5: Major Process Equipment

Equipment No.	Equipment Name	Equipment Description	Changes*
1011-BIN-002	Ore Storage Bin	10.7 m (35 ft) diameter by 18.1 m (59.5 ft) high, 2,300 tonnes capacity	
1011-CVO-002	SAG Mill Feed Conveyor A		
1011-CVO-003	SAG Mill Feed Conveyor B		
1011-FED-002	Apron Feeder A		
1011-FED-003	Apron Feeder B		
1011-FED-004	Apron Feeder C		
1011-FED-005	Apron Feeder D		
1021-CLU-001	Hydrocyclone Cluster	8 cyclones installed (each 381 mm (15 in) in diameter)	
1021-MIL-001	SAG Mill	6.1 m (20 ft) diameter by 3.35 m (11 ft) (F/F), 3.0 m (10 ft) (EGL), 1,790 kW (2,400 hp)	
1021-MIL-002	Ball Mill A	3.2 m (10.5 ft) diameter by 4.9 m (16 ft) (F/F), 4.7 m (15.5 ft) (EGL), 597 kW (800 hp)	
1022-CLA-001	Loaded Carbon Tank		*
1022-SCR-005	Trash Screen	Linear, 1.2 m by 2.4 m (4 ft by 8 ft)	
1022-THK-001	Pre-Leach Thickener	High rate, 14.0 m (46 ft) diameter	
1025-GCO-001	Gravity Concentrator A & B		*
1031-SCR-006	Loaded Carbon Screen	Vibrating, 0.9 m by 1.8 m (3 ft by 6 ft)	
1031-SCR-010	Gravity Screen	Vibrating, 0.9 m by 1.8 m (3 ft by 6 ft)	*
1031-TNK-004	Pre-Aeration Tank A	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-005	CIL Tank A	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-006	CIL Tank B	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-007	CIL Tank C	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-008	CIL Tank D	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-009	CIL Tank E	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1031-TNK-010	CIL Tank F	8.5 m (28 ft) diameter by 9.6 m (31.5 ft) high	
1032-SCR-015	Safety Screen	Linear, 1.2 m by 2.4 m (4 ft by 8 ft)	

Equipment No.	Equipment Name	Equipment Description	Changes*
1032-TNK-011	Cyanide Destruction Tank	7.0 m (23 ft) diameter by 7.6 m (25 ft) high	
1041-COL-001	Acid Wash Column	4 t	
1041-COL-002	Strip Column A	4 t	
1041-KIL-001	Carbon Reactivation Kiln	2 t, 7.46 kW (10 hp) (Rotation), 130 kW (heat)	
1041-TNK-012	Dilute Acid Tank		
1041-TNK-013	Barren Strip Solution Tank		
1041-TNK-016	Carbon Quench Tank	2 t, 1.5 m (5 ft) diameter by 2.3 m (7.5 ft) high	
1051-BIN-011	Cement Storage Bin		
1051-BIN-012	Fly Ash Storage Bin		*
1051-FIL-002	Disc Filter A		
1051-FIL-003	Disc Filter B		
1051-MIX-001	Paste Mixer	2 motors at 56 kW (75 hp)	
1051-PMP-040	Paste Pump A	Putzmeister	*
1051-TNK-017	Buffer Tank		
1071-EWC-001	Electrowinning Cell A		
1071-EWC-002	Electrowinning Cell B		
1073-FUR-001	Smelting Furnace	340 kg (750 lb), 125 kW	
1073-GTA-001	Gravity Table	shaking table	

*Addition and deletions in equipment from the conceptual design of the 2013 preliminary economic assessment

24.3 Project Infrastructure

This section updates the Project infrastructure at the site. In each section a brief description of the infrastructure is given, with an update near the end of the section.

24.3.1 Surface infrastructure

The Phoenix Gold Project site is accessed via a dedicated 8-km gravel road from Nungesser Road in the Municipality of Red Lake. The road is nominally 10 m wide within a 50 m right-of-way. Entry into the Project facilities is via a single-entry point onto the property. Access to the property and plant is secured by fencing and gates on both accesses and security on 24-hours service. A network of gravel roads on site provides vehicular access to the Project infrastructure. A significant amount of infrastructure has been constructed. The main surface infrastructure includes (Figure 24-4 and Figure 24-5):

- hoist, headframe, and hoist house
- processing plant
- tailings management facility
- effluent treatment plant
- electric power supply and substation
- propane storage tanks

- fibre optic communications cable
- compressed air supply
- process and potable water supplies
- mine ventilation fans and heater house
- offices, shop, core shack, and storage buildings provide housing for related site activities
- 200-person camp (currently shuttered)

24.3.1.1 Hoisting Facility

The Phoenix shaft hoist is a Canadian Ingersoll Rand double drum hoist with 4.27 m (14 ft.) diameter drums and two 932 kW (1,250 hp) motors.

The hoist control system, provided by Hepburn Engineering, consists of dual Allen Bradley programmable logic controllers operating TMEIC fully regenerative master/slave IGBT AC drives. The three-compartment shaft was deepened in 2013 to 730 m below surface and includes operational loading pockets at the 337 m level and 685 m level. The production conveyances include a skip over double deck cage combination and second identical skip, operated in balance. Each skip has a capacity of 10 tonnes. Development waste rock hoisted to surface is dumped into a waste bunker beside the headframe. Waste rock is currently stockpiled on site in designated areas. Mined material hoisted to surface can either be dumped into the waste bunker beside the headframe and moved to a designated surface ore storage location, or can be hoisted and dumped in a small coarse ore bin adjacent to the headframe, whereby it then can be conveyed into the mill for processing.

There are a number of alternatives for access to depths below the current shaft bottom of the 730 m level. These include a third phase of shaft deepening, sinking of an internal winze closer to the mineralized zone, ramp access, or a new shaft. Economic and logistic viability of each of these alternatives has not been conducted.

Figure 24-4: Project Site Plan (Looking south)

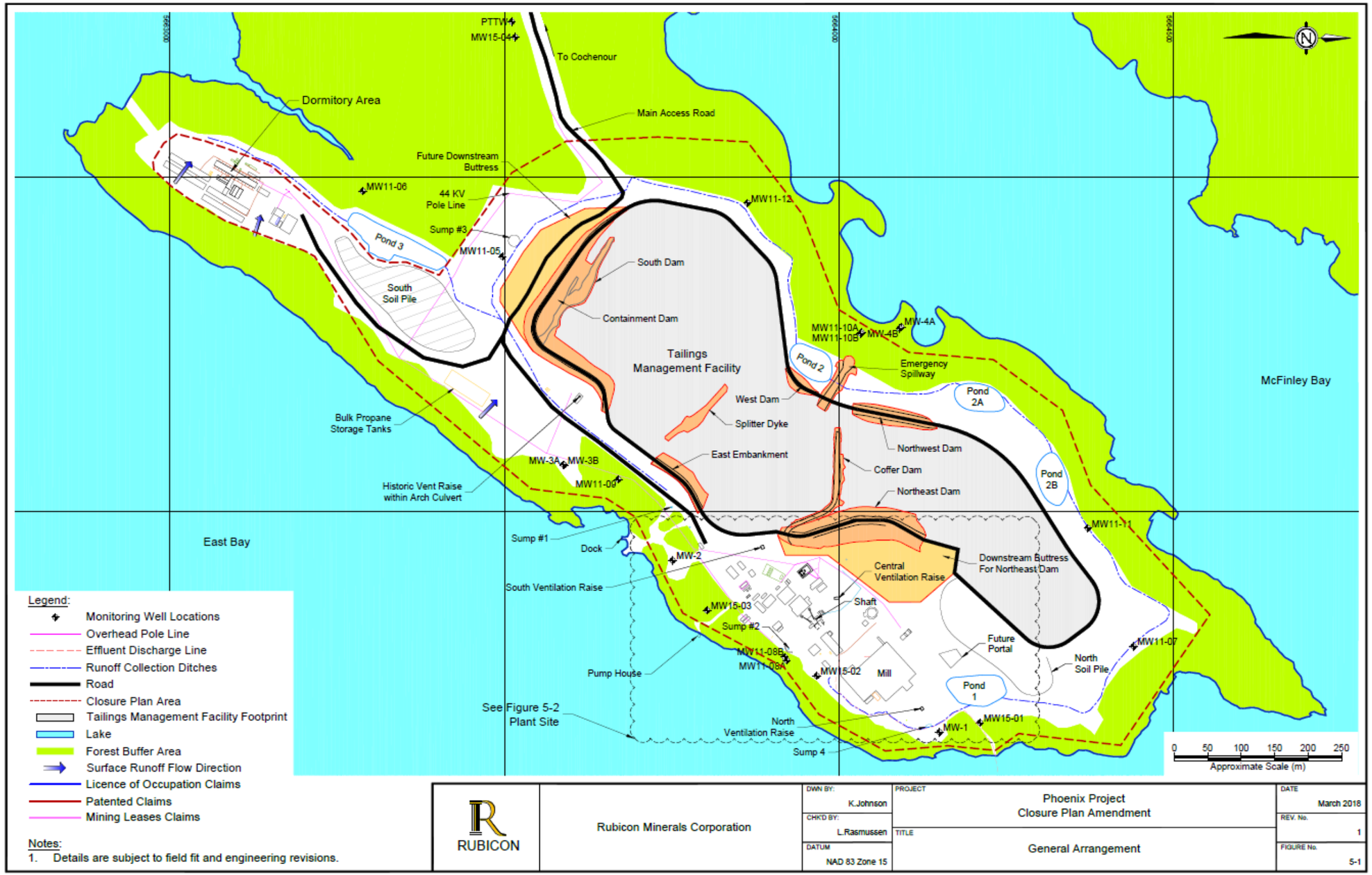

Figure 24-5: Detailed Project Site Plan of Project Area (need a magnetic north arrow or rotate drawing to north)

24.3.1.2 Processing Plant

The mill is designed for a base processing rate of 1,250 t/d and can be upgraded incrementally to handle a processing rate of 1,800 t/d and 2,500 t/d. The mill has been constructed and is permitted to process 1,250 t/d of ore on average. Details of the processing facility design and recovery methods are presented in Section 24.2.

The mill houses a paste backfill plant that will produce a cemented paste fill product from the tailings. The paste fill will be pumped underground for placement into voids.

24.3.1.3 Tailings Management Facility

The historic tailings management facility consisted of a dam and pond. The containment pond was constructed by McFinley Mines Ltd. in 1988 and operated under a Certificate of Approval. After test milling a bulk sample in 1989, the facility received minimal use. The tailings management facility was re-activated by Rubicon, upgraded, and the necessary government approvals were obtained.

The tailings dam will be raised in planned stages periodically over the life of the mine to increase the capacity of the tailings management facility as more tailings are produced. Foundation investigation has been carried out for the current design. For future dam raises, similar foundation investigations will be required to refine the designs. The location of the tailings management facility and related facilities are presented in Figure 24-5.

The tailings management facility design utilizes mine rock that was hoisted to surface for the construction of the tailings management facility dams, buttresses, etc.

The tailings management facility is designed to withstand a 30-day duration of a 1-in-100-year rain or snow event. The mill has a cyanide destruction system that treats tailings slurry prior to discharge to the tailings management facility. Discharge from the tailings management facility is processed by an Actiflo® clarification and metals precipitation system with a capacity of between 780 and 3,100 m^3/day. This system is designed to remove total suspended solids and metals from the water prior to discharging it to the environment. Rubicon is permitted to discharge a maximum of 3,100 m^3/day of water to the environment from March to November. The metals precipitation component of this system was installed in 2017 and commissioning will occur in 2018.

24.3.1.4 Power and Communications

Electricity Supply

Rubicon has an agreement with Hydro One to supply power to the site and has been granted an allocation of 5.3 Mw of power. The on-site electrical supply is from the 44 kV M6 Hydro One line fed from the Red Lake Distribution Station (DS). This feeds the main substation that contains two 18 MW transformers feeding a common 5 kW bus supplying the site.

The underground electrical distribution system consists of:

- one - 3 conductor 4/0 AWG 5 kV teck 90 cable installed in the shaft from the surface winch room to the 305 m level (4,160 volts)

- one - 3 conductor 350 MCM 5kV Teck 90 cable installed in the shaft and goes from the surface winch room down to the 610 m level (4,160 volts)
- one - 3 conductor 500 MCM 1kV Teck 90 cable from surface to 122 m level (600 volts).

The underground power distribution system will need to be upgraded once the mine goes into full production. The design necessary for the expansion includes the installation of 2 – 500 MCM 5kV Tech 90 cables from the surface powerhouse down drill holes to the 122 m level, continuing down the emergency escape-way to all accessible levels. A disconnect is planned for each of the 122 m, 183 m, 244 m and 305 m levels. A substation has been installed on the 610 m level for diamond drilling in the area.

Provision for a future feeder upgrade to 13.8 kV for the underground distribution has also been procured with the necessary switchgear and shaft cabling presently being stored on site.

Propane

The main propane tank farm, located at the south end of the property, has a capacity of 226,000 litres. This facility is used to provide propane to the Project site for heating the ventilation air going underground during the winter, and also provides heating fuel to all of the buildings used on site. There are also three 6,000-litre tanks located at the dormitory (camp) and a 3,000-litre tank at the pole barn, but these are not in use at this time.

Natural Gas

Natural gas supply is available in the Red Lake area and could be considered an energy alternative in the future.

Fuel Storage

A 25,000 litre above ground diesel fuel storage tank and dispensing station is currently located beside the electrical warehouse building. The facility has the requisite spill storage capacity and meets other fuel storage requirements of the Technical Standards & Safety Authority (TSSA).

There is a small (4,100 litre) gasoline dispensing facility on site, adjacent to the diesel fuel storage tank. The facility has the requisite spill storage capacity and meets other fuel storage requirements of the Technical Standards & Safety Authority (TSSA).

Communications

Site surface communication is via a VOIP telephone system. The system is connected by a fiber optic cable installed along the same route as the electrical power supply line. Radios are used for site-wide communications.

Communication systems underground include a leaky feeder system and FEMCO telephones located in shaft stations and refuge stations. The Emergency Control Centre, which is located in the technical services building, is also equipped with a FEMCO phone, as is the security gatehouse.

Fiber optic cable has been installed throughout the site, including in the shaft. It is in operation with provision for additional expansion for future communications and instrumentation applications on surface and underground.

24.3.1.5 Compressed Air Supply

The Project currently has two 261kW (350 hp) air compressors (Sullair TS32-350) rated at 3,186 m^3/hr (1,875 cfm) each, and a small back-up compressor unit (Atlas Copco GA160). These units provide adequate volumes for the work being completed presently at site. Additional compressors will need to be added to the system relative to the tonnages that will be planned to be mined in the future. The compressors are housed in a permanent structure with temperature controlled louvers to exhaust heat from the building. The compressors operate on a cascading system controlled by local controllers on each unit. The two larger units operate on a continuous basis and cycle between loaded and unloaded. Status of the underground distribution system is described under Underground Infrastructure Section 24.3.2.

24.3.1.6 Process and Potable Water Supply

Lake water is pumped from the adjacent East Bay of Red Lake to feed the process water and underground activities. The authorized pumping rate from the lake through Rubicon's Permit to Take Water 3585-85KGHG, is 695 litres per minute (L/min) with a maximum daily total of 1,000,000 litres per day (L/day).

When the mill is in operation, process water in the mill and water accumulated in the tailings management facility is recirculated back into the mill process water supply system, thereby minimizing the amount of water pumped from the lake. The underground dewatering system reports to the tailings management facility (TMF) and is authorized by Permit to Take Water 3812-9C9KVF for a maximum pumping rate of 2,917 L/min, up to a maximum of 2,100,000 L/day.

Currently, water discharged to the environment from the TMF comes under regulatory control, and can only be discharged to the environment between the months of May to November. It must meet objectives and limits outlined in the Environmental Compliance Approval #1362-AA2HXS.

Potable water for the site is taken from East Bay and is conditioned by a Culligan system of nano membrane modules, UV bacterial disinfection and chloring addition prior to use.

24.3.1.7 Sewage Treatment Facility

The project's domestic and industrial sewage systems are regulated by Environmental Compliance Approval #1362-AA2HXS.

Currently all domestic sewage is collected on site at two collection tanks until regular pump outs are conducted by a third party, and the sewage is taken off site to permitted sewage treatment facilities. This process is covered under Provincial Officer's Order #7655-AMAQDJ.

24.3.1.8 Mine Ventilation Facilities

Mine ventilation is currently being supplied via a fresh air surface installation on the 122 m level Fresh Air Raise. The system consists of one 54-inch diameter 250 hp fan, complete with an associated propane-fired heater and ancillary equipment. This system is providing approximately 115,000 cfm to the underground workings and is adequate for the ongoing work program. When the mine is commissioned for full production, it will require up to 370,000 cfm which will be supplied by two 72-inch diameter 250 hp fans and associated heater and ancillary equipment.

24.3.1.9 Other Site Buildings

Facilities provided by other buildings in the vicinity of the Phoenix shaft include:

- processing plant (including muck handling and coarse ore storage system)
- dry
- offices
- core shack and core storage
- maintenance shop
- cold storage
- bunkhouse and kitchen (closed at this time)

24.3.1.10 Waste Rock Stockpiles

The waste rock storage area is located on the northwest corner of the peninsula in a containment area previously referred to as the quarry. All future waste will be placed there for further assessment as potential construction material.

24.3.1.11 Production Material Stockpiles

There are no stockpiles of mineralized production material on the site as all stockpile material was milled on or before November 21, 2015. Stockpiles for ore, mineralized rock and waste will be re-established for a bulk sampling test that will be conducted in 2018.

24.3.1.12 Explosives Magazines

No surface explosive magazines are planned. Upon delivery to site, explosives are moved to authorized magazines underground for storage.

24.3.1.13 Assay Laboratory

An assay laboratory is located off site in a commercial mall in Balmertown. It has facilities for crushing, pulverizing, fusion, cupellation, acid digestion and atomic absorption analyses. The two fusion furnaces each have capacity for 42 crucibles, heated to temperatures from 850° to 1,060°C. The laboratory is capable of processing a maximum of 252 samples every three hours. Currently the assay lab is closed and third-party faculties are being utilized for all assay work.

24.3.2 Underground Infrastructure

The underground infrastructure required to support production mining includes material handling facilities, mine dewatering system, a paste backfill distribution system, equipment repair shops, ventilation system, supply lines for compressed air and process water, electrical power supply, and miscellaneous facilities.

24.3.2.1 Material Handling

The material handling system is divided into the upper material handling system from 122 to 305 m levels, the lower material handling system from 366 m to 685 m levels, and the material handling below the 610 m level.

Upper Material Handling System

The upper material handling system consists of a series of connected raises between the 122 m and 305 m levels where the ore and waste is then transported by rail. This system allows both ore and waste movement from each level to the mid-shaft loading pocket on the 337 m level. Construction of ore and waste passes on the 122 m level is 10% complete. The 183 m and 244 m levels ore and waste passes are operational. Chutes are installed and operational on the ore and waste passes on the 305 m level. Haulage to the shaft is operational with two rock breaker/grizzly installations complete, one for ore and one for waste.

Lower Material Handling System

To date, a 10-tonne loading pocket has been commissioned on the 685 m level. This system is currently in operation and handling waste material from the 610 m level and 685 m level. The future design includes a rock breaker/grizzly screen combination on 610 m level with a chute at the bottom of the waste pass raise on 685 m level. This chute will transfer waste rock to a conveyor arrangement that will feed the 685 m Level loading pocket.

An ore system is also designed that will accept material from the 610 m level through a raise to the 640 m elevation, where a jaw crusher will be installed to size the material to -4 inches. The sized material will be placed in a raise with a chute on 685 m level. This chute will transfer the crushed ore material to a single conveyor arrangement (same one that moves the waste material) that will feed the 685 m Level loading pocket.

Below 610 m Level Material Handling System

Pending continued exploration, alternatives for accessing the mineralized zone at depths deeper than the 610 m level will be evaluated.

24.3.2.2 Mine Dewatering

Main dewatering stations are located at shaft bottom, the 610 m level, 305 m level and 122 m level. This system is capable of pumping at a maximum flow rate of approximately 757 L/min (200 US gpm) and is adequate for the current Project work.

An upgraded system capable of pumping 3,028 L/m (800 US gallons per minute [gpm]) from the 305 m level to surface is partially complete. The current Project permit allows dewatering at a rate of 2,917 L/min (771 US gpm) and a maximum of 2.1 million L/day (0.56M US gallons per day [gal/day]). Further engineering work will be required to finalize the mine dewatering system for production.

24.3.2.3 Compressed Air Distribution System

The main compressed air line is installed in the shaft and consists of a 150 mm (6-inch) line from surface to the 305 m level and a 200 mm (8-inch) line from there to shaft bottom. While adequate for exploration purposes, the system will require additional capacity to accommodate expected production rates. Construction of the compressed air distribution system upgrade is approximately 20% complete and would be finished prior to commissioning of the mine.

24.3.2.4 Refuge Stations

There are four completed refuge stations located underground, on the 122 m, 183 m, 244 m, and 305 m levels, Additional refuge stations will be required once mine development progresses. The constructed refuge stations meet Ministry of Labour requirements.

24.3.2.5 Paste Backfill Distribution System

The paste backfill distribution system has been significantly completed for supplying material to workings above the 305 m level. Piping has been run on all but one level underground and all but one pipe interconnection is prepared. This work would be completed prior to commissioning of the mine.

The surface plant requires final connections and initial run testing before backfill can be consistently delivered underground. The final connections would be completed prior to commissioning of the mine.

Laboratory testing of binder types and mixtures have been completed. Operational testing will be required to achieve optimal binder addition to achieve desired backfill strengths and costs.

24.3.2.6 Underground Equipment Servicing

There are three service bays areas located on the 183 m, 244 m and 305 m levels. Equipment servicing is completed at these locations. A review for the need of an underground repair shop will be completed prior to the commissioning of the mine, as it is possible to do major servicing on surface should a ramp be completed.

24.3.2.7 Miscellaneous Facilities

Other underground facilities not covered above include but are not limited to: storage bays for supplies and equipment, electrical substations, diamond drill stations, local electrical panels, charging stations, and toilet facilities which are conveniently located adjacent to active headings.

24.4 Environmental Studies, Permitting, and Social or Community Impact

The information presented in this section is extracted from the 2016 Technical Report and was updated, where appropriate to reflect the current status of the property. There is no reason not to rely on this information.

24.4.1 General

The Phoenix Gold Project is located on the McFinley Peninsula in East Bay of Red Lake. Neighbouring land and water are generally used for wilderness/recreation, Mineral Resource development, and forestry. The Project is a brownfield site that was developed intensively in the 1980s prior to the acquisition by Rubicon in 2002. Rubicon has assumed full ownership of the site and all known environmental liabilities have been identified and addressed by Rubicon.

The Project commenced an advanced exploration phase in 2009, a development phase from 2011 to 2015, and moved to temporary suspension at the end of 2015. As of July 1, 2018, the Project is permitted for commercial production at a rate of 1,250 t/d.

24.4.2 Environmental Regulatory Setting

The environmental assessment and permitting framework for metal mining in Canada is well established. The federal and Ontario provincial environmental assessment processes provide a mechanism for reviewing major projects to assess and resolve potential environmental impacts. Following a successful environmental assessment, a Project undergoes a licensing and permitting phase for the legal and environmental aspects of the Project. The Project is then regulated through all life cycle phases (construction, operation, closure, and post-closure) by both federal and provincial agencies.

24.4.2.1 Current Regulatory Status

The advanced exploration phase, which commenced in Q1 2009, was in accordance with regulatory approvals. In Q1 2011, a Form 1 Notice of Project Status was submitted to the Ontario Ministry of Northern Development and Mines to move the Project from advanced exploration status to production status in accordance with Section 141

of Ontario's *Mining Act*. In Q4 2015, a Notice of Project Status form was submitted to Ontario Ministry of Northern Development and Mines to move the Phoenix Gold Project to temporary suspension status.

The site remained in care and maintenance in 2016 and 2017 with minimal staff on site and some minor underground development commencing in Q4 of 2017. New management implemented an 18- to 24-month plan that included a drilling campaign to characterize and confirm a new Mineral Resource model. The plan for 2018 includes the processing of a bulk sample from selected stopes to confirm grades and test the efficacy of a variety of mining methods. Consultation with the Ministry of Northern Development and Mines revealed that the Project would need to re-enter production status in order to operate the mill under current legislative guidelines. Rubicon has therefore submitted a Notice of Project Status form to this effect, and will re-enter the production phase effective July 1, 2018. This status is expected to be temporary, as a number of clauses in the provincial Ministry of Environment and Climate Change's Environmental Compliance Approval (approving sewage works for the site) are required to be fulfilled prior to the Project entering commercial production. At this time, Rubicon has received the necessary relief from these clauses in order to proceed with the bulk sample processing in 2018.

Approvals currently in force for the Project are presented in Table 24-6. The approvals generally relate to a 1,250 t/d production rate and amendments will be required if a production increase is required. It is specifically noted that title was secured to the access road and power line right-of-way for the connection to the grid through Section 21 of the *Public Lands Act* for the Crown land portion and a negotiated agreement was reached with the landowners and leaseholders for the private land portion of the right-of-way.

Table 24-6: Current Approvals

Permit	Regulatory Agency	Relevant Legislation	Date of Issuance	Rationale
Permit to Take Water 3812-9C9KVF	Ministry of Environment and Climate Change	Ontario Water Resources Act	December 11, 2008 (Renewed November 20, 2013)	Withdrawal of water from shaft.
Permit to Take Water 3585-85KGHG	Ministry of Environment and Climate Change	Ontario Water Resources Act	November 19, 2008 (last amendment May 21, 2010)	Withdrawal of water from East Bay of Red Lake.
Environmental Compliance Approval 1362-AA2HXS	Ministry of Environment and Climate Change	Environmental Protection Act	August 5, 2016 (Amendment in progress)	Approve industrial and domestic sewage works.
Environmental Compliance Approval 6656-8RVMES	Ministry of Environment and Climate Change	Environmental Protection Act	January 27, 2009 (last amendment February 28, 2012)	Approve air emissions from site.

Permit	Regulatory Agency	Relevant Legislation	Date of Issuance	Rationale
Environmental Compliance Approval 0244-8YWLBB	Ministry of Environment and Climate Change	Environmental Protection Act	December 21, 2012 (ownership transferred to Rubicon Minerals effective October 16, 2014)	Approve air emissions from the assay lab
Easement over Crown Land	Ministry of Natural Resources and Forestry	Public Lands Act	September 2, 2011	Approve easement over Crown owned surface rights for access corridor.
LRIA Approval No. RL-2014-01, RL-2014-01C	Ministry of Natural Resources and Forestry	Lakes and Rivers Improvement Act	January 23, 2009 (last amended November 6, 2015)	Approve Stage 1 construction of the tailings management facility dams and emergency spillway.
Phoenix Gold Project (production) Closure Plan	Ministry of Northern Development and Mines	Mining Act	December 2, 2011 (Amended June 16, 2016; further amendments in progress)	Approve development and closure of the production phase of the Project.
Amendment to the Zoning By- Law 1277-10	Municipality of Red Lake	Municipal By-Law 1277-10	Process completed in February 2011	Necessary to change the zoning of the Project site to mineral mining from hazard land. The new zoning is more appropriate because the entire Project site is now subject to a filed closure plan and is no longer considered an abandoned mine site. The amended zoning will also allow the issuance of building permits for the subject land.

Permit	Regulatory Agency	Relevant Legislation	Date of Issuance	Rationale
Land Use Permit 1204-1010939	Ministry of Natural Resources and Forestry	Public Lands Act	October 1, 2015 (Expires September 30, 2020)	Approve use of crown land for monitoring water wells at Project Site
Land Use Permit 1204-1010995	Ministry of Natural Resources and Forestry	Public Lands Act	October 1, 2017 (Expires September 30, 2018)	Approve use of crown land for pumphouse to provide water to Project site
Land Use Permit 1204-1010951	Ministry of Natural Resources and Forestry	Public Lands Act	February 1, 2016 (Expires January 31, 2021)	Approve use of crown land for effluent discharge pipeline

In addition to the approvals noted above, Rubicon completed a Class Environmental Assessment pursuant to *O. Regulation 116/01* to allow it to seek and ultimately be issued an Air ECA for contingency diesel-fired generators (< 5 MW cumulative capacity). Also, Rubicon completed Class Environmental Assessments in accordance with the environmental assessment for Resource Stewardship and Facility Development projects for the activities within the access corridor. The environmental assessment process was completed regarding the 2015 application to re-locate the effluent discharge line to an optimized location in East Bay where improved mixing would be provided. This new discharge location was commissioned in the summer of 2016 with the land currently tenured under a Land Use Permit. A legal survey of the shoreline and lake bottom was completed in 2017 in support of the acquisition of the crown shoreline as well as the easement for the lake bottom where the discharge pipe lies. Both of these land tenure projects remain underway in 2018.

In May of 2017, Rubicon received a Provincial Officer's Order (number 7655-AMAQDJ) relative to the lack of domestic sewage treatment at the site. The main peat moss treatment system was inoperable during winter months due to low flows into the system (with reduced staff on site) and other approved treatment systems were never installed as planned due to the shut down in 2015. The Order allows Rubicon to continue using septic tanks as temporary holding tanks until such time as an approved sewage disposal system is installed and operational. All tanks have high-level alarms installed and Rubicon has entered into a service contract with a licensed sewage hauler as per the Order. The Ministry of Environment and Climate Change has confirmed that Rubicon can operate with these temporary holding tanks until a permanent production state is reached. At this time, Rubicon must have appropriate and approved sewage treatment in place and operational at the Project Site prior to entering commercial production, as per the Order.

There are no other outstanding environmental compliance issues on the Phoenix Gold Project Site. Rubicon is currently in material compliance and has fulfilled the monitoring and reporting obligations of the approvals listed in Table 24-6. The obligations under federal and provincial legislation including the *Metal Mining and Effluent Regulations* and the *Environmental Protection Act* have been fulfilled to date. On September 8, 2015 a Director's

Order was received from the Ministry of Environment and Climate Change (last amended on January 25th, 2016). The requirements of the Order to date have been completed within the specified timelines. However, as outlined in the Order, there are still some items that need to be complied with, including the requirement to install and commission a long-term ammonia treatment plant if the Project proceeds to Mine Production and Development status, as defined in the *Mining Act*.

24.4.2.2 Federal Environmental Assessment Process

In 2011, the Canadian Environmental Assessment Agency confirmed that the 1,250 t/d production phase of the Project will not trigger an environmental assessment pursuant to the *Canadian Environmental Assessment Act*. The Project has been advanced since this time, and is currently regarded as a mine and is therefore subject to mining sector legislation, including the *Metal Mining and Effluent Regulations* that have been promulgated under the *Fisheries Act*.

In the spring of 2012, the 1992 *Canadian Environmental Assessment Act* was amended and replaced by Canadian Environmental Assessment Agency, 2012. Two significant results of the updated Act were the redefinition of conditions that would trigger a federal environmental assessment and the introduction of legislated time periods within the federal environmental assessment process. With respect to the Phoenix Gold Project, there are two methods for which a federal environmental assessment could be required under Canadian Environmental Assessment Agency, 2012:

- A proposed Project will require an environmental assessment if the Project is described in the Regulations Designating Physical Activities
- Section 14(2) of Canadian Environmental Assessment Agency, 2012 allows the Minister of Environment to (by order) designate a physical activity that is not prescribed by regulation if, in the Minister's opinion, either the carrying out of that physical activity may cause adverse environmental effects or public concerns related to those effects may warrant the designation

With respect to the first method above, the Regulations Designating Physical Activities (2012) have been amended. The Regulations Amending the Regulations Designating Physical Activities state:

> *17. The expansion of an existing*
>
> *(a) metal mine, other than a rare earth element mine or gold mine, that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 3 000 t/day or more*
>
> *(b) metal mill that would result in an increase in the area of mine operations of 50% or more and a total ore input capacity of 4 000 t/day or more*
>
> *(c) rare earth element mine or gold mine, other than a placer mine, that would result in an increase in the area of mine operations of 50% or more and a total ore production capacity of 600 t/day or more*

Federal environmental assessment requirements would have to be satisfied prior to seeking any permits in the event that an increased production rate is desired. Due to the required increase in the area of operations and

given that the site occupies a peninsula with little to no opportunity for material expansion to the operations area, a federal environmental assessment is not likely to be required under 17(a) above.

With respect to the second method above, it is not anticipated that the federal Minister of the Environment would designate the Project for environmental assessment due to the relatively minute footprint, the benign nature of concerns expressed by the public to date and the absence of discernible, significant adverse environmental effects during the operations to date and in the foreseeable future.

In preparation for potential future increases to the production rate, the engineering work that is required to support planning and environmental permitting for increasing the throughput to 2,500 t/d is materially complete.

24.4.2.3 Provincial Environmental Assessment Process

The *Environmental Assessment Act* is administered by the Ministry of the Environment and Climate Change and the Ministry of Natural Resources and Forestry. The *Environmental Assessment Act* promotes responsible environmental decision making and ensures that interested parties have an opportunity to comment on projects that may affect them. Interested parties may make a designation request to the Ministry of the Environment and Climate Change to have a Project referred to an individual environmental assessment. The Ministry of the Environment and Climate Change assesses the merits of the request and may make a recommendation to the Minister, as outlined on the Ministry of the Environment and Climate Change's website under the tab titled Environmental Assessments under Designating Regulations and Voluntary Agreements.

The consultation for the advanced exploration permits as well as the numerous other permits issued to date (Table 24-6) have not resulted in designation requests for an individual environmental assessment.

A Class Environmental Assessment for Resource Stewardship and Facility Development Projects was completed in 2011 for a portion of the corridor to connect the Project site to Nungesser Road and the work associated therein. No negative comments were received during this process, which was conducted in accordance with the Ministry of Natural Resources and Forestry process outlined in MNR (2003). An environmental assessment process was completed in relation to the shoreline land tenure that Rubicon continues to pursue, as well as the 2015 application to re-locate the effluent discharge line to an optimized location in East Bay where improved mixing would be provided.

A Class Environmental Assessment was completed in 2011 pursuant to *Ontario Regulation 116/01* for the use of less than 5 MW of diesel generation at the Project site. No negative comments were received during the process.

24.4.2.4 Environmental Assessment Requirements for the Project

The Project is currently permitted for a production rate of 1,250 t/d on an annual average basis. Federal and provincial environmental assessment requirements would have to be satisfied prior to seeking any permits in the event that an increased production rate is desired.

24.4.3 Environmental Approvals Process

This section describes the federal and provincial approvals processes for potential production rate increases that may be contemplated in future economic assessments.

24.4.3.1 Federal Approvals Process

Federal environmental assessment requirements would have to be satisfied prior to seeking any permits in the event that an increased production rate is required (refer to Section 20.2.2).

Permits would need to be maintained pursuant to the *Nuclear Source Control Act* for the use of density gauges in the concentrator that utilize nuclear sources.

24.4.3.2 Provincial Approvals Process

Provincial environmental assessment requirements would have to be satisfied prior to seeking any permits in the event that an increased production rate is required.

In preparation for a potential future increase to the production rate, the engineering work that is required to support planning and environmental permitting for increasing throughput to 2,500 t/d is materially complete. However, limited refined engineering is required to determine the nature of the amendments to the provincial approvals required to increase the production rate. As a minimum, it is envisioned that amendments would be required to the approvals listed in Table 24-7.

Table 24-7: Anticipated Amendments to Approvals

Permit	Regulatory Agency	Relevant Legislation	Rationale for Permit Issuance	Rationale for Amendment
Permit to Take Water 3585-85KGHG	Ministry of Environment and Climate Change	Ontario Water Resources Act	Withdrawal of water from East Bay of Red Lake.	Increased withdrawal of fresh water from East Bay.
Environmental Compliance Approval 1362-AA2HXS	Ministry of Environment and Climate Change	Environmental Protection Act	Approves industrial and domestic sewage works	Increased production rate (administrative amendment), potential changes associated with changes to water balance, approve engineering design for tailings management facility modifications during late stages of the mine life.

Permit	Regulatory Agency	Relevant Legislation	Rationale for Permit Issuance	Rationale for Amendment
Environmental Compliance Approval 6656-8RVMES	Ministry of Environment and Climate Change	Environmental Protection Act	Approve air emissions from site	Modifications to mine ventilation and increased return air volume; additional potential sources of fugitive dust and gaseous emissions.
LRIA Approval No. RL-2014-01, RL-2014-01C	Ministry of Natural Resources and Forestry	Lakes and Rivers Improvement Act	Approve Stage 1 construction of the TMF dams and Emergency Spillway	Ongoing tailings management facility construction.
Phoenix Gold Project (production) Closure Plan	Ministry of Northern Development and Mines	Mining Act	Approve development and closure of the production phase of the project	Increased production rate and modified dimensions of the tailings management facility upon closure, along with modified financial assurance requirement. The spatial extent of the Project footprint will not be materially affected by the increased production rate.

24.4.4 Environmental Studies and Management

24.4.4.1 Environmental Studies

The Project closure plan describes current conditions at the property. Baseline monitoring activities and areas of study to date are listed below and have been incorporated into the closure plan, annual environmental performance reports, and other submissions to regulatory agencies:

- monthly surface water monitoring since 2007 in the vicinity of the Project site
- semi-annual sampling of groundwater monitoring wells since 2009
- archaeological assessment by Ross Associates
- annual species at risk assessment by Northern Bioscience
- background conditions study by BZ Environmental
- aquatic biological assessment by EAG
- effluent mixing and plume delineation studies by EAG and Story Environmental

- assessment of risks to the downstream environment from the Project by Novatox
- hydrogeological characterization by AMEC Earth and Environmental
- Phase 1 and Phase 2 environmental site assessments by True Grit Consulting
- risk assessment of the groundwater and soils at the Project site in accordance with *O. Regulation 153/04* by Novatox
- geochemical characterization of development rock associated with the Advanced Exploration phase by AMEC Earth and Environmental
- geochemical characterization of development rock, ore, tailings and quarried surface rock by Chem-Dynamics
- geotechnical assessments of underground workings by AMEC Earth and Environmental and AMC Mining Consultants
- Project reviews by WESA Consultants and ArrowBlade Consulting Services

No biological values, i.e., species at risk, ecologically significant features, regionally significant wetlands, significant wildlife habitat, environmentally sensitive areas, etc., that would preclude the re-development of the Project site have been identified to date. Ongoing field studies have been conducted with input from the Ministry of Natural Resources and Forests to ensure adherence to the provincial *Endangered Species Act, Public Lands Act, Crown Forest Sustainability Act,* and the Provincial Policy Statement that has been issued pursuant to Section 3 of the *Planning Act*.

Consultation to date with Aboriginal communities has not identified the presence of cultural heritage values in the vicinity of the Project site. In addition, the desktop and field work by Ross Archaeological Research Associates did not identify any areas with a high potential to host cultural heritage values on McFinley Peninsula (Ross Associates, 2010). As the Project involves the re- development of the existing footprint with only moderate expansion, the potential for impacts to cultural heritage values as a result of the re-development of the brownfield Project site are considered to be negligible.

24.4.4.2 Environmental Management

Rubicon has developed and adheres to an environmental management system for the Project (Rubicon, 2017). The environmental management system is a simple, plain language tool that has been prepared internally to identify and help manage environmental compliance obligations for the Phoenix property. The extent of the property covered by the environmental management system includes the Project site on McFinley Peninsula as well as off-site areas within the larger Phoenix lands and along the access corridor.

The elements of the environmental management system are:

- lists of the relevant legislation, approvals, agreements and documents that contain Rubicon's environmental obligations
- division of the property into discrete environmental management areas, each area having a description of the environmental obligations and the corresponding inspection frequency

- designated inspectors and documented inspection protocols
- procedures to deal with non-compliance issues and conditions
- guidance for documentation requirements, regular updates, and regular internal reporting on performance and auditing

The environmental management system identifies the Project's compliance obligations and outlines inspection/audit protocols to ensure compliance issues are identified, reported, mitigated, and documented. The environmental management system also addresses community engagement/consultation obligations and includes a commitments registry of Aboriginal agreements, community commitments, etc. The environmental management system is expected to evolve into a tool to manage corporate social responsibility commitments and obligations.

24.4.5 Social Setting

This section summarizes Rubicon's consultation and outreach program, which began on a formal basis in 2008.

24.4.5.1 Aboriginal Consultation

Rubicon has undertaken consultation with Aboriginal communities under the guidance of government agencies. To supplement the guidance, Rubicon commissioned an independent traditional use study that concluded the Project site is within the traditional territory of Lac Seul First Nation and Wabauskang First Nation (Forbes, 2011).

An archaeological study of the McFinley Peninsula was commissioned by Rubicon. The study did not identify any sites with a high potential to have cultural heritage value within the development footprint (Ross Associates, 2010). Also, as the Project involved the re-development of the existing footprint with only moderate expansion, the potential for impacts to cultural heritage value sites as a result of the re-development of the area were considered to be negligible. Accordingly, it was deemed reasonable to solely engage Lac Seul First Nation, Wabauskang First Nation, and the Métis Nation of Ontario to further discuss and identify potential areas of cultural heritage values within the development footprint that may have warranted protection.

Rubicon commissioned an independent conservative risk assessment to quantify the potential risks to valued environmental components identified in Forbes (2011) and to human habitations downstream of Red Lake. The study identified effluent discharge as the sole credible pathway for exposure of the downstream valued environmental components and communities to potential contaminants of concern. The study concluded that the additional, incremental ecological and human health risk that the planned operation of the Project poses to the environment downstream of Red Lake is not significant (Novatox, 2011). Accordingly, Rubicon has not engaged Aboriginal communities with traditional territory downstream of Red Lake regarding potential impacts as a result of the Project.

Rubicon believes in the value of establishing and maintaining meaningful relationships with Aboriginal communities in the Red Lake district where the Project is located. In January 2010, Rubicon became the first public company in the Red Lake district to sign an Exploration Accommodation Agreement with the Lac Seul First Nation. In January of 2012, Rubicon signed a Letter of Intent with the Métis Nation of Ontario. In 2014, Rubicon signed an Exploration Accommodation Agreement with Wabauskang First Nation and also settled the judicial review of the closure plan that was launched in 2012. Rubicon has established a successful history of consultation

with the local Aboriginal communities and is committed to continued consultation over the life of the Project. Rubicon has set a goal to establish benefits agreements with neighbouring Aboriginal communities as the Project moves forward.

24.4.5.2 Rubicon's Aboriginal Policy

Rubicon formalized its Aboriginal policy in 2008. The current policy is reproduced as follows:

- Rubicon management endeavors to responsibly develop and operate projects that meet high economic, environmental, and social standards.
- We respect and value the communities that neighbor our projects, and recognize the unique status of Aboriginal people as the original members of those communities.
- Whenever our operations might affect an Aboriginal community, Rubicon seeks to develop enduring relationships with those communities built upon trust and respect.

Rubicon will:

- identify and engage the Aboriginal communities with an interest in the area of our projects
- maintain ongoing, transparent and good faith communications with the Aboriginal communities that we engage
- provide thorough, accurate and understandable information regarding Rubicon's activities and plans
- seek a clear understanding of the interests of the Aboriginal communities and duly consider these interests during all stages of our projects
- respect the traditional knowledge, cultural practices, and culturally-significant sites of the Aboriginal communities that we engage

Additional details regarding Rubicon's First Nation agreements, related economic development, capacity funding and outreach efforts continue to be available on Rubicon's website www.rubiconminerals.com.

24.4.5.3 Public Consultation

Public information sessions have been held annually in the Red Lake community since 2008. No unresolved negative comments have been received to date during these sessions. Rubicon maintains an open-door policy to proactively identify and address stakeholder concerns regarding the Project. Formal public consultation to date is summarized in Table 24-8.

Table 24-8: Summary of Public Consultation

Date	Summary of Public Consultation	Summary of Information Provided	Summary of Comments that were Received (if any)
December 2008	Public information session in Cochenour, in accordance with Section 140 *Mining Act* and Section 8 *O. Regulation 240/00*.	Overview PowerPoint presentation of the project, including the diesel generator aspect.	No comments received in relation to any aspect of the Project. There was a general discussion regarding the modernization of the Mining Act.
December 2009	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Overview PowerPoint presentation of the project, including the diesel generator aspect.	No comments received in relation to any aspect of the Project.
2008 to 2010	Class environmental assessment in accordance with MNR (2003) and Environmental Registry postings.	The Environmental Registry postings include that associated with Air Certificate of Approval 9500-7NGTTC, which included diesel generators.	One comment was received by MNR as part of their Class environmental assessment process in March – April 2010. The comment was positive, in support of the Project.
September 2010 to March 2011	Notice of Commencement of Screening and Notice of Completion, Class environmental assessment process pursuant to *O. Regulation 116/01*.	Publish newspaper article, mail notices to nearby landowners, notify relevant government agencies.	No comments received in relation to the supplemental diesel generators or the Project.
December 2010	Public information session in Red Lake, in accordance with Section 141 *Mining Act* and Section 8 *O. Regulation 240/00*. This session was also held as part of the Class environmental assessment process required pursuant to *O. Regulation 116/01*.	Publish newspaper article, mail notices to nearby landowners, notify relevant government agencies.	No written comments. The sole question posed following the session was to inquire if water sampling would be conducted in East Bay and in the future tailings management facility.
December 2011	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Overview PowerPoint presentation of the project, the potential production phase, road upgrades and the PEA.	No comments received in relation to any aspect of the Project.

Date	Summary of Public Consultation	Summary of Information Provided	Summary of Comments that were Received (if any)
December 2012	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Published newspaper notice of meeting. Overview PowerPoint presentation of the Project highlighting infrastructure updates (mill foundation and camp), consultation and anticipated update and optimization of the PEA.	Comments and questions regarding employment opportunities associated with Project.
December 2013	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Published newspaper notice of meeting. Overview PowerPoint presentation of the project, the potential production phase, the updated PEA, schedule for upcoming work and anticipated milestones.	Comments and questions regarding employment opportunities associated with project, economic viability of Project and market conditions.
December 2014	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Overview PowerPoint presentation of the Project, the potential production phase, schedule for upcoming work and anticipated milestones.	Comments and questions regarding employment opportunities associated with project, mining methods, economic viability of Project.
December 2015	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Local community outreach prior to the information session. Overview PowerPoint presentation to provide an infrastructure update, suspension of mining activities, initiation of Phoenix Gold Project Implementation Plan.	Comments were received regarding employment and business concerns if the Project does not re-start.

Date	Summary of Public Consultation	Summary of Information Provided	Summary of Comments that were Received (if any)
January 2017	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Overview PowerPoint presentation of the Project, discussed health, safety and environment, CEO vision and strategy, exploration path forward, and proposed development and trial mining.	
February 2018	Voluntary Annual Public Information Session. Notice was in general accordance with Section 8 of *O. Regulation 240/00*.	Overview PowerPoint presentation of the Project, discussed test mining and bulk sample plans for 2018 (including move to Mine Development and Production as required by MNDM).	

Public complaints received to date are summarized below:

- One complaint was received by Rubicon in relation to noise from the construction activities at the Project site. Rubicon has planned the Project features to mitigate noise emissions and expects that noise emissions will be within government criteria during routine operation of the Project site.
- One comment was received regarding noise from Rubicon's regional exploration activities in close proximity to the Project site. The nuisance noise has been effectively mitigated and no subsequent comments have been received.
- One comment was received regarding fan noise north of the site, the source of which was clearly identified and mitigated.

Rubicon maintains an issues-tracking matrix as part of its environmental management system to effectively track and manage potential concerns as they arise.

24.4.6 Tailings Disposal

A tailings management facility consistent with contemporary regulatory requirements was constructed at the Project site by McFinley Mines Ltd. in 1988 in preparation for a bulk sampling program. The site chosen was an extensive topographic depression lying immediately west of the shaft site, and a retaining dam was constructed to impound tailings and effluent prior to ultimate drainage south into the waters of East Bay. The disposal area received a Certificate of Approval in 1988. The termination of activities on the Project in 1989, after test-milling of an estimated 2,500 tonnes of the bulk sample, resulted in minimal use of this area.

The tailings management facility, and other sewage works, have been re-activated and approved by an Environmental Compliance Approval issued pursuant to the *Environmental Protection Act*. The tailings management facility has been constructed to Stage 1 design elevation in accordance with an approval issued pursuant to the Ontario *Lakes and Rivers Improvement Act*. Approximately 57,000 tonnes of tailings were deposited in 2015, during mill operation. Further tailings will be added in 2018 when the bulk sample is processed.

24.4.7 Environmental Sensitivities

The Project site is situated on a peninsula in a valued recreational lake. As such, emphasis has been placed on potential off-site discharges of water, fugitive dust, and noise.

24.4.7.1 Water Discharge

Responsible management of water discharges will be a priority during production and closure. Project features related to mitigating potential risks to local water quality are summarized in the bullets below.

- An engineered runoff collection system has been constructed around the perimeter of the Project site to effectively collect runoff from the operations area where ore, tailings, and waste rock will be handled. Collected runoff is pumped to the tailings management facility prior to use as process water, or being treated and discharged to the environment in accordance with regulatory requirements. The effluent treatment system combined with the storage capacity in the tailings management facility has the ability to contain and manage a robust environmental design flood.
- The effluent treatment system that treats surplus water from the tailings management facility is regarded as best-in-class and has been proven to be effective for the removal of metals and suspended solids at other sites in Canada.
- The tailings management facility has been designed in accordance with appropriate design criteria based on the Hazard Potential Classification that was determined in accordance with MNR 2011 and CDA 2007.
- Cyanide will be destroyed in tailings slurry using the proven SO_2/O_2 cyanide destruction process prior to the tailings being discharged from the mill building envelope.
- Ammonia in the tailings management facility water that is present due to underground water inputs and the hydrolysis of cyanate generated by the SO_2/O_2 cyanide destruction process. Rubicon continues to pursue a viable and permanent ammonia treatment system.
- Ammonia in mine water due to blasting products will be managed by worker education/good housekeeping practices, good blasting practices with regular audits, product selection, absorbent media (zeolite) at blast faces and in sumps, biological treatment, and other approved treatment methods.
- Mine water pumped from underground and water reclaimed from the tailings management facility will be recycled for use in the mill to the maximum extent practical to reduce water intake from East Bay.

24.4.7.2 Fugitive Dust

Air emission sources are comprised of diesel-fired equipment, emergency diesel generators, propane- and natural gas-fired combustion heating units, return air from the underground workings, and fugitive dust emissions from vehicle operation, the tailings management facility, and crushing and material handling typically associated with an underground mining and milling operation. Rubicon has implemented a best practices management plan for the control of fugitive dust.

Practices to minimize fugitive dust are listed in the bullets below:

- minimize vehicle speed and travel time, utilize dust suppressants on travelled roads, minimize track-out of fines from material handling areas
- minimize stockpile size and utilize buildings and treelines as windbreaks to the maximum extent practical
- frequent relocation of the tailings discharge location in order to maintain a wetted tailings surface
- tackifier and/or binder (cement or fly ash) could be added to deposited tailings to bind together the tailings solids and prevent entrainment by wind
- enclose material transfer points and utilized water sprays to suppress dust
- other applicable best practices listed in Ministry of the Environment and Climate Change (2009) and Environment Canada (2009)

24.4.7.3 Noise

There are seasonal residential interests on East Bay with potential for exposure to noise. Rubicon has designed infrastructure for the Project so that noise emissions from the site are largely controlled in order to protect the residential interests. Modern noise abatement measures have been integrated into the Project design.

24.4.8 Closure Plan

Rubicon has planned and intends to execute the Project in a manner that is consistent with industry best practices and conducive to a walk-away closure conditions. Chemical and physical stability requirements will be satisfied and monitored in accordance with regulatory requirements and the amended closure plan, which was filed by the Ontario Ministry of Northern Development and Mines on June 16, 2016 in accordance with Section 141 of the *Mining Act*.

Close-out rehabilitation activities will be completed within approximately 36 months of Project closure. Major activities are presented below in general chronological order:

- Buildings, trailers, intermodal shipping containers, storage tanks, equipment, and any chemicals/consumables will be removed and salvaged, recycled or disposed of in accordance with applicable legislation. Concrete foundations will be demolished to grade as is necessary and used to backfill local depressions.

- Hydrocarbon contaminated soil will be identified and remediated in accordance with applicable legislation (*Environmental Protection Act*).
- Equipment in the underground workings will be purged of all operating fluids and salvaged to the maximum extent practicable. Consumables will be removed from the underground workings and salvaged.
- Mine openings will be sealed to prevent access, in accordance with *O. Regulation 240/00*.
- Impounded water within the tailings management facility may be partially treated to reduce metal concentrations based on consultation with Ministry of the Environment and Climate Change and MNDM and directed to the underground workings. The dewatered tailings surface will be covered with a dry cover and native topsoil from the established stockpiles and re-vegetated. Downstream embankments will be progressively rehabilitated during the production phase to the extent practical to reduce work that will be required at closure. Post-closure, the spillway channel will be lowered to prevent ponding of runoff water. An engineered overflow channel will be constructed to direct runoff from the surface of the tailings management facility to the downstream toe of the existing dam to effectively return the local drainage pattern to the pre-development condition. While the dry cover is being constructed, the small volume of residual seepage that is expected to be collected in the tailings management facility seepage collection system will be pumped underground. The operation of the tailings management facility seepage collection system will cease in consultation with Ministry of the Environment and Climate Change and Ontario Ministry of Northern Development and Mines post-closure, once the seepage rate decreases and is demonstrated that it does not pose an environmental risk.
- Ancillary areas within the closure plan area that are overlain with development rock will be scarified and any modest embankments will be sloped for long-term physical stability. These prepared areas will be re-vegetated after placement of native soil from the established stockpiles on McFinley Peninsula. Accumulations of soil-sized particles in rock embankment crevices will be planted with native tree seedlings in accordance with established silvicultural practices.
- Site roads will be rehabilitated in general accordance with Ministry of Natural Resources (1995). Power lines will be removed.
- Pipelines (water, compressed air) on the site will be purged and left in place. Fuel pipelines (propane / natural gas) will be decommissioned as per legislative requirements and Technical Standards and Safety Association standards as applicable.
- Domestic sewage disposal system components will be salvaged. The septic tank will be purged of its contents and backfilled with locally available soil and/or rock.
- Remaining liquid and solid waste at the Project site will be removed for recycling or disposal with licensed contractors in accordance with legislative requirements. No mineralized material will be left on site at mine closure.
- The long-term chemical and physical stability monitoring program will be continued to completion, in accordance with the closure plan.

24.4.8.1 Closure Cost Estimate

Approximately $CAD7.7M of financial assurance was previously provided to the Ministry of Northern Development and Mines as part of the closure plan and this was confirmed by an independent professional engineer in January 2016 to be adequate to rehabilitate the current, as-built site.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Interpretations

The Phoenix Gold Project had previously been on care and maintenance since operations ceased in late 2015. Since the completion of financial restructuring in late 2016, Rubicon initiated a two-year advanced exploration program beginning in early 2017. This included a structural drill program, structural re-logging of historical core, and an oriented core exploration and definition drill program. Rubicon completed underground clean-up work and infrastructure upgrades to allow the advanced exploration program to commence.

During the first quarter of 2017, Golder was hired as a third-party external consultant to the Project, with the mandate to complete the following assignments:

- Provide an updated interpretation of the structural geology of the F2 gold deposit (Structural Interpretation) to further understand the distribution of the gold mineralization. The Structural Interpretation would utilize new information gathered from the 2017 exploration program. This included the re-logging of historical core, oriented core drill programs, underground structural mapping and structural geological interpretation and modelling.
- Prepare a new geological model and an updated Mineral Resource Estimate. The new geological model and updated Mineral Resource Estimate is based on the Structural Interpretation, new information from the exploration program, and historical data.

This Technical Report is being issued as a result of new information that has been made available from the exploration program conducted in 2017. This includes the Structural Interpretation, which supersedes the interpretations from previous reports for the Project, namely, *Interim Report on 3D Structural, Lithological and Alteration Modelling of the F2 Core Zone, Red Lake, Ontario, prepared by SRK Consulting (Canada) Inc. (SRK) in December 2012 (SRK 2012)* and *Technical Report for the Phoenix Gold Project, Red Lake, Ontario, prepared by SRK in January 2016 (SRK, 2016)*. The 2018 geological model benefits from information that was not previously available in 2016, including approximately 3,500 m of oriented structural drilling, 20,000 m of oriented infill and step out drilling, the structural re-logging of 10,000 m of historical core, and detailed structural mapping of all of the current accessible exposed underground levels, all carried out in 2017. The Rubicon believes, with the QPs having no reason not to adopt or rely on such belief, that the new geological information provides a better understanding of the structural and lithological controls on the distribution of the gold mineralization, grade, and continuity, of the F2 gold deposit.

According to the Structural Interpretation, the primary controls on the gold mineralization are the well-established dextral Riedel vein system of quartz-actinolite veins that occur within High-Ti Basalt units (the main host rock for gold mineralization) and the Felsic Intrusive units (to a lesser extent). The Riedel vein system demonstrates greater continuity of gold mineralization within the High-Ti Basalt units compared to the 2016 structural interpretation. There are 3 main basalt lenses hosting mineralization including, from West-to-East: Hanging Wall

Basalt Zone, West Limb Basalt Zone, and F2 Basalt Zone. These lenses make up the majority of the mineralization and define the following modelling zones: Zone 1 (F2) and Zone 2 (HW, WLB). Zone 3 is a small, narrow zone hosted in Felsic Intrusive rocks between the F2 and WLB basalts and Zone 4 is located in the F2 basalts to the north of the main mineralized area of Zone 1 (see Figure 25-1).

Other key elements identified include:

- A revised interpretation of the High-Ti Basalt units compared to the 2016 structural interpretation.
- D2 deformation was associated with dextral transpression along the regional scale N-S oriented EBDZ.
- Strain partitioning resulted in ductile deformation of ultramafic volcanic units and boudinage and brittle deformation (fracturing, veins) of the High-Ti Basalt unit.
- Ultramafic Flows and High-Ti Basalt units were intruded by Felsic Intrusive unit dykes and sills pre- to syn-mineralization.
- The gold mineralization occurs in association with disseminated sulphide mineralization in the High-Ti Basalt and also in gold bearing quartz-actinolite veins in the High-Ti Basalt and Felsic Intrusive units. The mineralized veins occur in several orientations, with the east striking, steeply dipping vein arrays being associated with higher grade gold mineralization.
- E-W structures are limited to the High-Ti Basalt units and Felsic Intrusive; those structures are interpreted as R' shear veins associated with the regional dextral transpression. No regional or through-going deposit scale E-W structures were identified.
- The entire sequence was folded during D3 by a later broad open fold with a N-S trending, sub-horizontal fold axis.
- Late brittle offsetting structures are very limited in extent based on mapping and drilling.

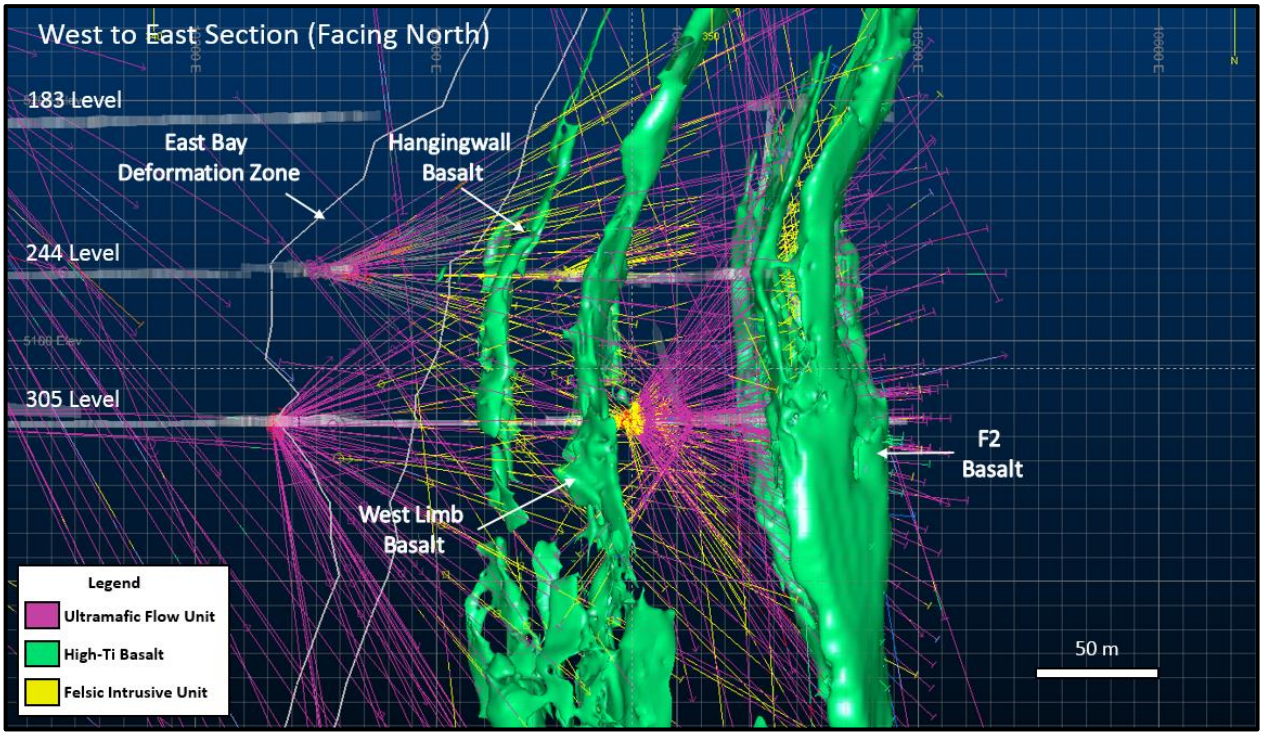

Figure 25-1: F2 Zones – Hangingwall Basalt, West Limb Basalt, F2 Basalt (Looking North)

The 2018 Mineral Resource Estimate has been developed by building on Rubicon's historical exploration activity. The 2018 Mineral Resource Estimate included additional data from the 2017 Exploration Program, which was not available during the determination of the 2016 Mineral Resource Estimate. Both the Structural Interpretation and diamond drilling from the 2017 drilling program were used to update the F2 gold deposit Mineral Resource Estimate. Using the Structural Interpretation as the basis for an updated geological model, the QP's were able to interpolate a greater volume of gold mineralization within the High-Ti Basalt units. This resulted in a material increase in the Mineral Resources throughout the deposit compared to the 2016 Mineral Resource Estimate. The 2018 Mineral Resource model covers a strike length of approximately 1,200 m and depths up to 1,350 m and remains open along strike and at depth. The 2018 Mineral Resource Estimate excludes the crown pillar, depleted resources, and information below the 1,350 m elevation.

The 2018 Mineral Resource Estimate was evaluated using a geostatistical block modelling approach constrained by mineral and stratigraphic domains interpreted from the drill hole and mapping data. The block model grades were interpolated using ID^3, which Rubicon and its Consultants evaluated as the most representative method. Other grade interpolation methodologies were assessed, including OK and ID^2, and determined that the ID^3 estimates controlled grade smoothing the best and achieved an appropriate grade-tonnage profile relative to the characteristics of the deposit. Density was assigned to the model based on average SG values for each stratigraphic unit.

At the reporting cut-off grade of 3.0 g/t Au, the 2018 Measured and Indicated Mineral Resources' tonnes, grade, and gold ounces increased by 91%, 12% and 113%, respectively, compared to the 2016 Indicated Mineral Resources (Measured Resources were not estimated in 2016). The 2018 Inferred Mineral Resources' tonnes,

grade, and gold ounces increased by 56%, 16%, and 80%, respectively, compared to the 2016 Inferred Resources. The expansion of the Mineral Resources is mainly attributed to, and supported by, a re-interpretation of geological and structural controls on mineralization along with recognizing the potential for larger scale mining, rather than focusing entirely on a narrow-vein mining plan. This resulted in broader mineral domains. Rubicon believes more reasonable controls and estimation parameters have been deployed to produce a representative geological model and 2018 Mineral Resource Estimate.

25.2 Conclusions

The 2018 Mineral Resource Estimate was completed according to CIM best practice guidelines and is reported in accordance with NI 43-101 regulations. The QP believes that the current data presented is an accurate and reasonable representation of the Phoenix Gold Project and concludes that the updated database (2017) is of suitable quality to provide the basis of the conclusions and recommendations reached in this Technical Report.

Golder has taken reasonable steps to make the block model and Resource Estimate as representative of the data as possible but given the nature of the deposit there are still risks related to the accuracy of the estimates related to the following:

- the variable and complex nature of the geology and structural controls on mineralization
- the nuggety nature of the gold mineralization
- the impact of outlier grade data
- inconsistent continuity of mineralization
- limited constraints on mineralization locally in the model, in areas where the High-Ti Basalt is relatively wider

26.0 RECOMMENDATIONS

26.1 Resource Recommendations

The data and observations collected during Rubicon's 2017 Exploration Program provided both a further understanding of the structural controls of the mineralization at the F2 gold deposit and additional geological information that contributed to the 2018 update of Mineral Resources at the Phoenix Gold Project.

Golder believes Rubicon can potentially improve upon the 2018 Mineral Resource Estimate through the implementation of a proposed exploration program (subject to any requisite financing) comprising of the following components:

- Targeted infill and step-out drilling is recommended in the mid-to-upper levels of the deposit to potentially convert Inferred Mineral Resources (generally drilling spacing of 40 m centres or more) to Indicated Mineral Resources. In addition, targeted infill and step-out drilling is recommended in areas identified as Exploration Targets (greater than 80 m centres), which potentially could contain between 500,000 and 800,000 tonnes of sparsely drilled mineralized material grading between 5.0 to 7.0 g/t Au, and has the potential to be upgraded to Mineral Resources. As per 2.3(2)(a) of NI 43-101, the potential quantity and grade of Exploration Targets

is conceptual in nature, that there has been insufficient exploration to define a mineral resource and that it is uncertain if further exploration will result in the target being delineated as a mineral resource.

- Extend the exploration drift up to 200 m southward on the 610 m level (parallel to the F2 gold deposit) to provide additional drilling platforms that allow proper up-dip and down-dip infill drilling and step-out drilling of the mineralized zones in the southern portion of the deposit.
- Complete a model reconciliation based on the production of 25,000 to 30,000 t from a bulk sample, following Rubicon's test trial mining program that is currently underway. The model reconciliation exercise could further validate the 2018 Mineral Resource Estimate and improve confidence in the established modelling and estimation processes. The test mining will allow for the collection of important data including stope parameter performance, input costs, and mill operating parameters, which could be implemented in a potential feasibility study of the Project in the future.
- Conduct exploration drilling of the F2 gold deposit, which remains open at depth and along strike. Historical drilling intersected high-grade intercepts to a depth of 1,600 m below surface, well below the bottom of the 2018 Mineral Resource Estimate at 1,350 m elevation. The mineralization at depth has not been cut-off to date.
- Evaluate the historical data from the McFinley Deposit and Close Proximity Exploration Targets. Rubicon could evaluate data from the historic McFinley Deposit, located near existing underground development at the Project, using modern standards and parameters that are in accordance to CIM best practise guidelines. This exercise could potentially expand any future Mineral Resource Estimate. Rubicon is also evaluating historical drill data from its Close Proximity Exploration Targets (Peninsula, CARZ, and Island Zones) located within two km northeast of the Project, which could possibly be included in any future updated Mineral Resource Estimate.

In January 2018, Rubicon announced an overall budget (exploration and corporate expenditures) of between $CAD15-18 million. Rubicon has since raised gross proceeds of approximately $CAD10.9 million in flow-through financing, which will be used towards Canadian Exploration Expenses in 2018. The Rubicon's expanded 2018 Exploration Program is comprised of the following activities:

- 14,000 m of infill diamond drilling between the 305 and 854 m levels (including 4,000 m of closely spaced definition drilling).
- 10,000 m of infill and exploration diamond drilling on the 610 m level, from the new 200-metre exploration drift.
- Test mining and bulk sampling of between 25,000 to 30,000 tonnes of mineralized material, utilizing pre-existing underground infrastructure and development, which Rubicon plans to process through its mill infrastructure at site.

The estimated cost of the recommended work program is presented in Table 26-1.

Table 26-1: Cost Estimates for Recommended Work Programs*

Task	Units	Quantity	Unit Cost* (C$)	Total (C$)
Exploration Drilling				
2018 budgeted drilling				
Infill drilling (between 305 m to 854 m Levels)	metres	14,000	$70	$980,000
Sampling and assay analyses	samples	5,000		$120,000
Infill drilling 610m level exploration drift	metres	10,000	$70	$700,000
Sampling and assay analyses	samples	3,700		$90,000
Subtotal				**$1,890,000**
Underground Development				
Development drifting (on 610 Level)	metres	280	$4,285	$1,200,000
Subtotal				**$1,200,000**
Test Mining and Bulk Sample Processing				
Underground test mining				$9,000,000
Bulk Sample Processing	tonnes	25-30K		$3,000,000
Subtotal				**$12,000,000**
Technical and Other Studies				
43-101 Technical Report				$300,000
Potential Feasibility Study Work in 2018				$300,000
Regional Exploration work				$1,200,000
Subtotal				**$1,800,000**
Contingency (10%)				$1,689,000
Total				**$18,579,000**

*All-inclusive costs

26.2 Operations Recommendations

Other engineering, processing, and environmental work must be carried out to meet all of the regulatory obligations required to develop the Rubicon Gold Project. Some of these activities include environmental monitoring work related to the environmental management system, and the maintenance of the surface and underground infrastructure. Portions of the underground and surface infrastructure have been upgraded in 2017 and early 2018 to support the planned diamond drilling, test mining and bulk sample processing. These upgrades include:

Surface Support Infrastructure

- Completion of hoist upgrades relative to safety, fire prevention and operation.
- Expansion of the effluent treatment plant to enable the removal of metals from the tailings management facility water.

- Commissioning of backup generators to provide essential services to the underground during power outages.

Underground Infrastructure

- Installation of a second rock breaker underground to finalize a separate waste handling system at shaft.
- Rehabilitate the 366 m level loading pocket, the 488 m level spill pocket, and the 685 m level loading pocket.
- Extend power distribution system to the 610 m and 685 m Levels.
- Development and commissioning of water handing system on 685 m level.

Mill

- Reinstall liners in the ball and SAG mills.
- Currently checking, repairing and upgrading each area in mill in readiness for commissioning.
- Installation and commissioning of the mill fire suppression system (in progress).

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DATE AND SIGNATURE PAGE

This technical report on the Phoenix Gold Project is submitted to Rubicon Minerals Corp. and is effective as of June 13, 2018.

Original signed and sealed by:

Brian Thomas, P.Geo.
Golder Associates Ltd.

June 13, 2018

Original signed and sealed by:

John Frostiak, P.Eng.
Independent Consultant

June 13, 2018

Original signed and sealed by:

Tim Maunula, P.Geo.
T. Maunula & Associates Consulting Inc.

June 13, 2018

Original signed and sealed by:

Michael Willett, P.Eng.
Rubicon Minerals Corporation

June 13, 2018

APPENDIX A

Certificates of Qualified Persons

CERTIFICATE OF QUALIFIED PERSON

I, Michael Willett, state that:

(a) I am the Director of Projects of Rubicon Minerals Corporation, 121 King Street West, Suite 830, Toronto, Ontario, Canada, M5H 3T9.

(b) This certificate applies to the technical report titled "**National Instrument 43-101 Technical Report for the Rubicon Phoenix Gold Projec**t" with an effective date of: June 13, 2018 (the "Technical Report").

(c) I am a "qualified person" for the purposes of National Instrument 43-101 (the "Instrument"). My qualifications as a qualified person are as follows: I am a graduate of Queen's University (Kingston, Ontario) with a Bachelor of Science (Mining Engineering) in 1981. I am a professional mining engineer and am registered in the Province of Ontario with the Professional Engineer Ontario as a P.Eng. (Licence number 100511340). I have worked as a Mining Engineer for a total of 37 years since my graduation.

(d) I have been at the Phoenix project site since January 2017. I am currently located there.

(e) I am responsible for Items 1.5.1, 15, 16, 18, 19, 20, 21, 22, 24.1, 24.3, 24.4, 26.2, 27 of the Technical Report.

(f) I am not independent of the issuer as described in section 1.5 of the Instrument.

(f) I have been directly involved with the Phoenix project since January 2017.

(g) I have read the Instrument. The parts of the Technical Report for which I am responsible has been prepared in compliance with this Instrument; and

(h) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of Technical Report for which I am responsible, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Balmertown, Ontario this 13th day of June, 2018

"Original Document Signed and Sealed"

_____

Michael Willett, P. Eng.
Director of Projects, Rubicon Minerals Corporation

CERTIFICATE OF QUALIFIED PERSON

I, John William Frostiak, P.Eng., state that:

(a) I am an independent Professional Engineer resident at: 56 McManus St., Balmertown, Ontario, Canada, POV1CO.

(b) This certificate applies to the technical report titled **"National Instrument 43-101Technical Report for the Rubicon Phoenix Gold Project"**, with an effective date of June 13, 2018 (the "Technical Report").

(c) I am a "qualified person" for the purposes of National Instrument 43-101 (the "Instrument"). My qualifications as a qualified person are as follows: I am a graduate of Queen's University (Kingston, Ontario) with a Bachelor of Science in Mining Engineering (Mineral Processing) in 1973. I am a member of the Professional engineers of Ontario (PEO No. 15150014), the Ontario Society of Professional Engineers (OSPE No. 11389251), the Society for Mining, Metallurgy & Exploration (SME Member ID 4019986), and a life member of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM No. 92165). I have worked as an engineer for a total of forty (40) years since graduating from university. During that time, I gained operational, management and project and study management experience in Canada, the USA, Australia, Chile, Peru, Tanzania and South Africa.

(d) I have been to the Phoenix project site and visited the mill and tailing management facility (TMF) on numerous occasions. My last visit to the mill specifically was on May 1, 2018.

(e) I am responsible for items 1.5.2, 13, 17, 24.2.

(f) I am independent of the issuer as described in section 1.5 of the instrument.

(f) My prior involvement with the property that is the subject of the Technical Report is as follows: In October 2015, I was retained by Rubicon Minerals Corporation to assist in the preparation of the report entitled "Technical Report for the Phoenix Gold Project, Red Lake, Ontario" dated February 25, 2016.

(g) I have read the instrument. The parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument; and

(h) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of Technical Report for which I am responsible, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Balmertown, Ontario this 13th of June, 2018

"Original Document Signed and Sealed"

John William Frostiak P.Eng.,(PEO No. 15150014)
Mining Engineer (mineral processing) Independent Consultant

CERTIFICATE OF QUALIFIED PERSON BRIAN THOMAS

I, Brian Thomas P.Geo., state that:

(a) I am a Geologist at :
Golder Associates Limited
33 Mackenzie Street, Suite 100
Sudbury, Ontario, P3C 4Y1

(b) This certificate applies to the technical report titled "**National Instrument 43-101Technical Report for the Rubicon Phoenix Gold Project"** with an effective date of: June 13, 2018 (the "Technical Report").

(c) I am a "qualified person" for the purposes of National Instrument 43-101 (the "Instrument"). My qualifications as a qualified person are as follows. I am a graduate of Laurentian University with a B.Sc. in Geology from 1994, am a member in good standing of the Association of Professional Geoscientists of Ontario (#1366) and a member in good standing of the Engineers and Geoscientists of British Columbia (#38094). My relevant experience after graduation includes over 24 years of experience in mine geology and mineral resource evaluation of mineral projects nationally and internationally in a variety of commodities including 9 years of industry work experience, in gold deposits, with Placer Dome Ltd.

(d) My most recent personal inspection of the property described in the Technical Report occurred between June 5 and 9, 2017.

(e) I am responsible for Items 1.1, 1.4.4, 1.6, 1.7, 2, 3, 12, 14, 23, 25, and 26.1 of the Technical Report.

(f) I am independent of the issuer as described in section 1.5 of the Instrument.

(g) I have not had any prior involvement with the Phoenix project;

(h) I have read National Instrument 43-101. The parts of the Technical Report for which I am responsible has been prepared in compliance with this Instrument; and

(i) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the part of Technical Report for which I am responsible, contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Sudbury, Ontario this 13th of June, 2018.

"Original Document Signed and Sealed"

_____

Brian Thomas, P. Geo.
Senior Resource Geologist
Golder Associates Ltd.

CERTIFICATE OF QUALIFIED PERSON

I, Tim Maunula, state that:

(a) I am a Principal Geologist of T. Maunula & Associates Consulting Inc., 15 Valencia Drive, Chatham, Ontario, Canada, N7L 0A9.

(b) This certificate applies to the technical report titled **"National Instrument 43-101Technical Report for the Rubicon Phoenix Gold Project"**, with an effective date of June 13, 2018 (the "Technical Report").

(c) I am a "qualified person" for the purposes of National Instrument 43-101 (the "Instrument"). My qualifications as a qualified person are as follows: I am a graduate of Lakehead University with an H.B.Sc. degree in Geology in 1979. I am a member of the Association of Professional Geoscientists of Ontario (Registration Number 1115). I have worked as a Geologist for a total of 37 years since my graduation.

(d) I have been to the Phoenix project site on numerous occasions. My last visit to the Phoenix project site specifically was on June 5 to 9, 2017.

(e) I am responsible for Items 1.2, 1.3, 1.4.1 to 1.4.3, 4, 5, 6, 7, 8, 9 10 and 11 of the Technical Report.

(f) I am independent of the issuer as described in section 1.5 of the Instrument.

(f) I have not had any prior involvement with the Phoenix project.

(g) I have read the Instrument. The parts of the Technical Report for which I am responsible have been prepared in compliance with this Instrument; and

(h) At the effective date of the Technical Report, to the best of my knowledge, information, and belief, the parts of Technical Report for which I am responsible, contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Chatham, Ontario this 13th of June, 2018

"Original Document Signed and Sealed"

Tim Maunula, P.Geo.

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