Appendix IR1-12-A
Representativeness of WR Dataset

Red Mountain Underground Gold Project
IDM Mining Ltd. Responses to
Canadian Environmental Assessment Information Request #1

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Memo

To:	Max Brownhill, Brownhill Consulting Services Ltd.	**Client:**	IDM Mining Ltd.
From:	Lisa Barazzuol, SRK Kelly Sexsmith, SRK	**Project No:**	1CI019.002
Cc:	Jasmin Flores, Falkirk Resource Consultants Ryan Weymark, IDM Mining	**Date:**	January 16, 2018
Subject:	20180116 Red Mtn – CEAA –Representativeness of WR Dataset – Comment IR1-12		

1 Introduction

This memo provides SRK's responses to CEAA Comment IR1-12 related to representativeness of geochemical samples for the Red Mountain Underground Gold Project Application for an Environmental Assessment Certificate/Environmental Impact Statement (Application/EIS).

The response duplicates the response to BC EAO working group comments 348, 636, 646, and 647. Therefore, it includes additional details on this topic were not specifically requested by CEAA.

2 CEAA Comment IR1-12

Rationale: Section 6.1.2 of the EIS Guidelines sets out the requirement to provide "the geochemical characterization of expected mine material such as waste rock, ore, low grade ore, tailings, overburden and potential construction material in order to predict metal leaching and acid rock drainage". This information is required to inform the assessment of predicted changes to fish and fish habitat.

Figure 3-1 in Appendix 1-B provides the location of waste rock and ore samples. It is unclear from this figure whether the ABA sampling is spatially and geologically comprehensive, and as a result, whether conclusions are substantiated.

Requested Information:

a) Provide a map showing waste rock and ore sample locations overlaid with boundaries of mine workings, rock units, and types of alteration (geologic units, pyrite-pyrrhotite and sphalerite halos).

b) Describe the potential for ML/ARD in work areas where sampling was not conducted, and the assumptions with respect to ML/ARD potential of these areas made in the effects *assessment. Further detail is required on the uncertainty associated with geochemical characterization as well as measures that would be taken to address and manage the uncertainty.*

3 Response

3.1 Overview

The ABA sample set for waste rock and ore is sufficiently representative of all mining zones and rock types for the purposes of waste rock and ore management, and also source term development. This memo provides the supporting technical rationale.

3.2 Geological Model and Visual Representation of Mine Plan, Ore Body and ABA Sample Set

In support of these responses, IDM provided SRK with their 2016 and 2017 exploration assay database which was not available at the time Volume 7, Appendix 1-B of the application was prepared. The exploration drilling program included 147 drillholes in the Marc, AV, JW, 141 ore zones, and also the Lower Portal area (Figure 1). Each drillhole was geologically logged by IDM using their standardized lithology codes (Table 1). Each drillhole was sampled from top to bottom, with continuous sampling above, within and below the resource zones. The mine workings are represented by the areas that were continuously sampled. Sample intervals were typically in the range of 0.5 to 1.5 metres in length. A total of 13,882 samples were analyzed for gold, silver and multi-elemental analysis by 4-acid digestion followed by ICP finish. Assays included total sulphur by ICP. Samples were grouped according to zone, rock type and grade (ore versus waste) for interpretation purposes.

The sample distribution of the 2016 and 2017 exploration samples according to rock type for waste and ore is presented in Table 1. While acknowledging that a drillhole selection targets the ore body and intersects more rock than the underground workings, the distribution of samples provides a reasonable indication of the distribution of major rock units within the deposit. For waste, the most significant unit is the Hillside porphyry (69%) followed by tuff (14%), mudstone (8%) and Goldslide porphyry (7%). All other rock types of waste are minor (<2%). Ore lithologies include Hillside porphyry (67%), tuff (20%), mudstone (10%) and minor amounts of Goldslide porphyry (1%).

Table 1: Geological Distribution of Assay Samples from IDM Exploration Drilling Program and ABA Sample Set.

Geological Unit	Logging Code	Waste			Ore		
		Sample No. by Database		% of	Sample No. by Database		% of
		ABA	Assay	Waste**	ABA	ICP	Ore**
Hillside Porphyry	Hlp, xHlp	35	8669	69%	4	854	67%
Goldslide Porphyry	Gop, xGop	1	862	7%	--	18	1%
Mudstone	MS, MSI, xMS, xMSI	84	995	8%	--	131	10%
Sediments	SL, SS, WK	--	16	0%	--	6	0%
Tuff*	Tf, xTF, TfB, TfW	269	1795	14%	45	249	20%
Fault Zone	FZ	--	189	1%	1	2	0%
Dykes	DK, MDK	--	71	1%	--	5	0%
Pepperites	Pep	--	2	0%	--	0	0%
Veins	PYC, PYV, QV	--	5	0%	--	1	0%
Not specified		11	10	--	3	2	--
Total		400	12614	100%	53	1268	100%

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Notes:

*Including welded and bedded

**As calculated from ICP database

The following information is provided in support of the requests for additional figures and/or information on the geological model, alteration halo and distribution of rock types according to the mine workings.

- Table 3-3 in Volume 7, Appendix 1-B of the Application presents the number of ABA samples according to economic classification and rock type. The distribution of ABA samples according to rock type and economic classification has been reproduced in Table 1.
- Figure 3-1 in Volume 7, Appendix 1-B of the Application presents the spatial distribution of the ABA samples, including the 317 blast round samples that were characterized as part of the underground development of the exiting mine workings (denoted as blue stars in Figure 3-1 as “ABA Blast Round Sample”. Accordingly, the distribution of the ABA Blast Round Samples follows the as-built decline and cross cuts as presented in Figure 2-3.
- Figure 2 (this memo) provides a visual depiction of the geology of the as-built decline as derived from the logging of the ABA Blast Round Samples (Section 4.6 of Volume 7, Appendix 1-B of the Application). Figure 3 presents a geological cross-section within the Marc Zone oriented perpendicular to the as-built decline (also presented in the figure).
- The geological model is not sufficiently refined to calculate volumes of waste rock and ore according to rock type from the proposed mine workings. Table 1 presents the distribution of assay samples from IDM’s drill program according to the geological units for the project and is a considered to be reasonable indication of proportions of the major waste and ore lithologies within the deposit. Additionally, as presented in Section 3.3 of this memo, SRK has evaluated the characteristics of the individual rock units (e.g. by logging code or

brecciated vs. non-brecciated) and determined that there are no relevant differences in the geochemical characteristic of within the units. Therefore, quantification of individual logging codes would not provide further insights into the effects assessment or management plans for this project.

- The geological model is not sufficiently refined to visually present the alteration halo. In the absence of this information, the downhole distribution of sulphur was plotted for drillhole U16-1181, which was identified by IDM geologists as an typical drillhole intersecting the ore body within the Marc Zone (Figure 3). Sulphur levels are highest within and decrease with distance from the ore zones, with sulphur levels ranging from 0.45% to maximum levels of detection (10%) in the waste samples. The ABA database for waste rock includes samples with these sulphur ranges, indicating that variations within the alteration zone are reflected in the current dataset.
- Section 2.1.2 of Volume 7, Appendix 1-B of the Application provides the geological setting for the mine. Mineralization (both gold and sulphides) and carbonate content for the Red Mountain ore body is related to emplacement of the intrusive porphyry bodies and associated alteration of the entire suite of rocks present at the site. Accordingly, geochemical and mineralogical properties with respect to ML/ARD are expected to be relatively uniform between rock types.

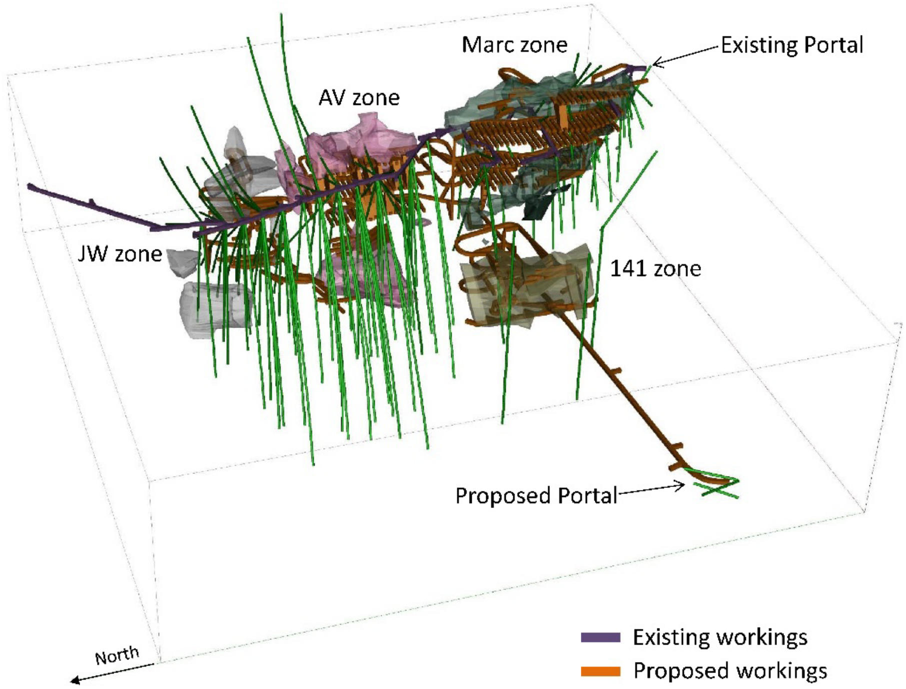

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Figure 1: 2016 and 2017 IDM Exploration Drillholes with Trace Element Data

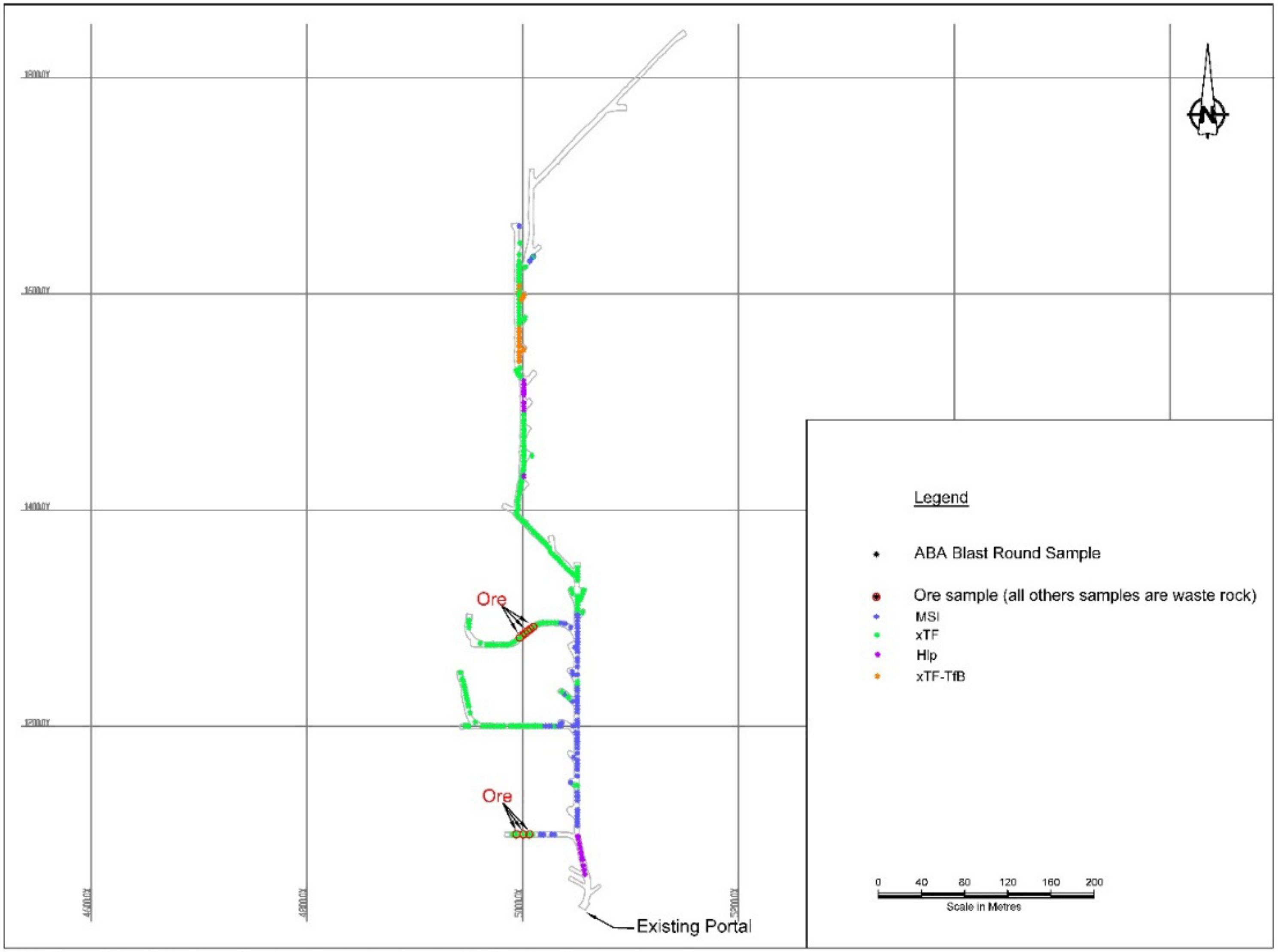

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Figure 2: Geology of the Underground ABA Blast Round Samples

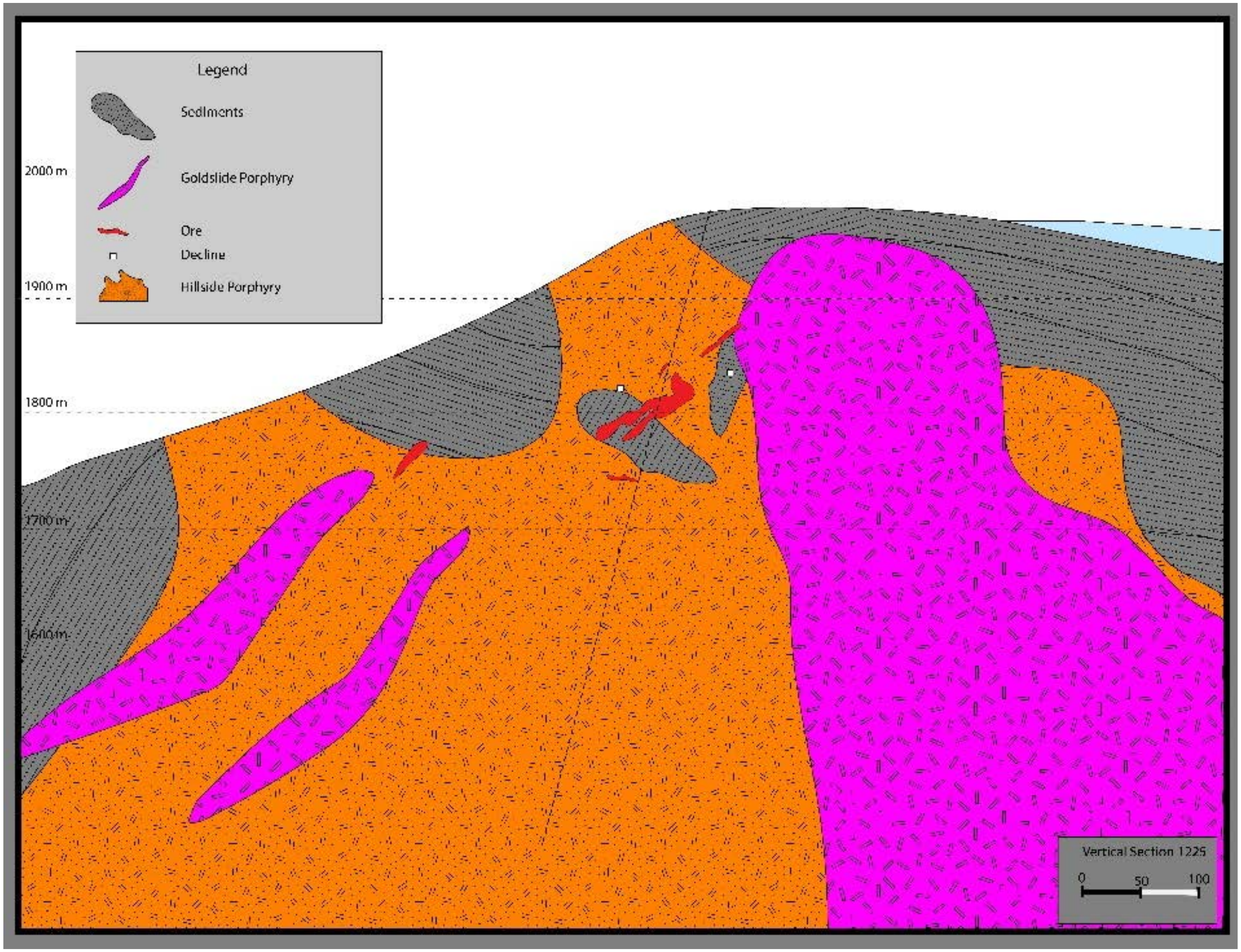

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Figure 3: Geological Cross Section, Marc Zone (Section 1225)

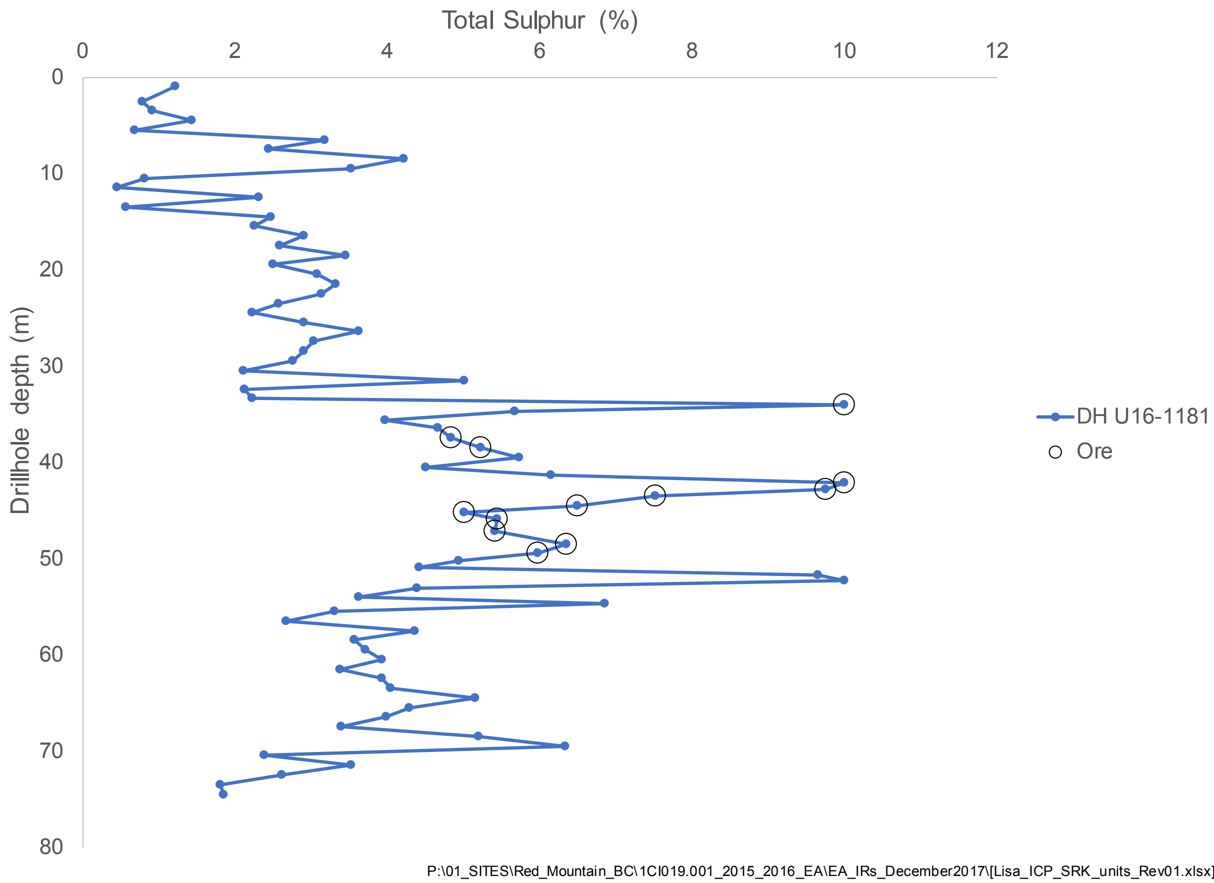

Figure 4: Downhole Sulphur Distribution for Marc Zone Drillhole U16-1181

3.3 Assessment of ARD Potential

3.3.1 Sulphur

To assess the representativeness of the ABA database, SRK compared total sulphur from the 2016 – 2017 exploration database (denoted as "ICP" in the Figures) with the ABA sample set presented in Volume 7, Appendix 1-B of the Application (denoted as "ABA" in the Figures).

Comparison of Sulphur Content by Zones

Figure 4 presents the statistical distribution of sulphur content for waste rock and ore according to the ABA and exploration samples sets and also by Zone (Marc, AV, JW and 141). Of note is that maximum sulphur levels are higher for the ABA samples (>10%) compared to the exploration samples (10%). This is due to a maximum detection limit of 10% for the analytical method used for exploration. For waste rock, P25 to P75 sulphur concentrations range from approximately 2 to 6% for all waste rock samples in the ABA and exploration sample sets. Similar ranges are present in the Marc, JW and AV zones. Sulphur levels for the 141 Zone and Lower Portal area are lower, ranging from 2 to 3.9% and 0.95 to 2.3%, respectively. Therefore, the ABA dataset sufficiently represents sulphur content from all mining zones except the 141 Zone and Lower Portal area which have lower but still appreciable sulphur contents.

For ore, median sulphur levels for the ABA sample set (5.0%) are lower than the Marc (7.6%), JW (8.3%), and AV (6.6%) Zones and slightly higher than the 141 Zone (4.1%). The lower sulphur content for the ore ABA samples does not affect the outcomes of the project in terms of ore management or source terms, as discussed later in this memo because ore is still classified as PAG in both datasets, and ore will have a much shorter residence time in stockpiles prior to processing.

Comparison of Sulphur Content by Waste Lithologies

Figure 5 presents the statistical distribution according to the significant waste lithologies presented in Table 1. Sulphur levels are relatively uniform for all rock types as indicated by the range of P25 to P75 values (2.5 to 6%).

Table 1 denotes the logging codes that are represented in the ABA database in Volume 7, Appendix 1-B of the Application. The geological coding of the ABA database included codes that were used by previous owners of the properties. In consultation with IDM, SRK updated all the geological codes to those in Table 1 based on the geological descriptions and/or previous logging codes. Of note is that the ABA database includes samples of all the major waste lithologies but not all geological logging codes. For example, Goldslide porphyry is in the database, but samples with the logging code xGOP are not in the ABA database. Other missing logging codes in the ABA database include mudstone (MS, xMS, xMSI) and tuff (Tf, TfW). The absence of these codes in the database could be due to the limited information available when updating the codes, for example, the description did not note that the rock was brecciated. Nonetheless, Figure 6 and Figure 7 present the sulphur content according to logging code for the geological units Goldslide porphyry, mudstone and tuff. Consistent with Figure 4 and Figure 5, P25 to P75 sulphur levels are uniform ranging from approximately 2 to 6% for all logging codes except for welded tuff (TfW) – a very minor subunit, which has lower levels (P25 to P75 ranging from 1.8 to 3.0%). This supports our conclusion that sulphur content is not related to rock type, but rather to mineralization that has overprinted rock type.

Figure 4 to Figure 7 demonstrate that sulphur content is uniformly high regardless of mining zone, geological unit or geological logging code. Furthermore, as shown in Volume 7, Appendix 1-B of the Application, the high sulphur content in waste rock and ore govern the ARD potential for the waste rock and ore whereby all samples were classifed as PAG by TIC/AP and the majority by NP/AP. Accordingly, all waste rock and ore will operationally be classified as PAG, (as stated in Section 6 of Volume 7, Appendix 1-B of the Application). On this basis, it is also SRK's opinion that the ABA database sufficiently represents all rock units, including Goldslide Porphyry, for which there is only one sample.

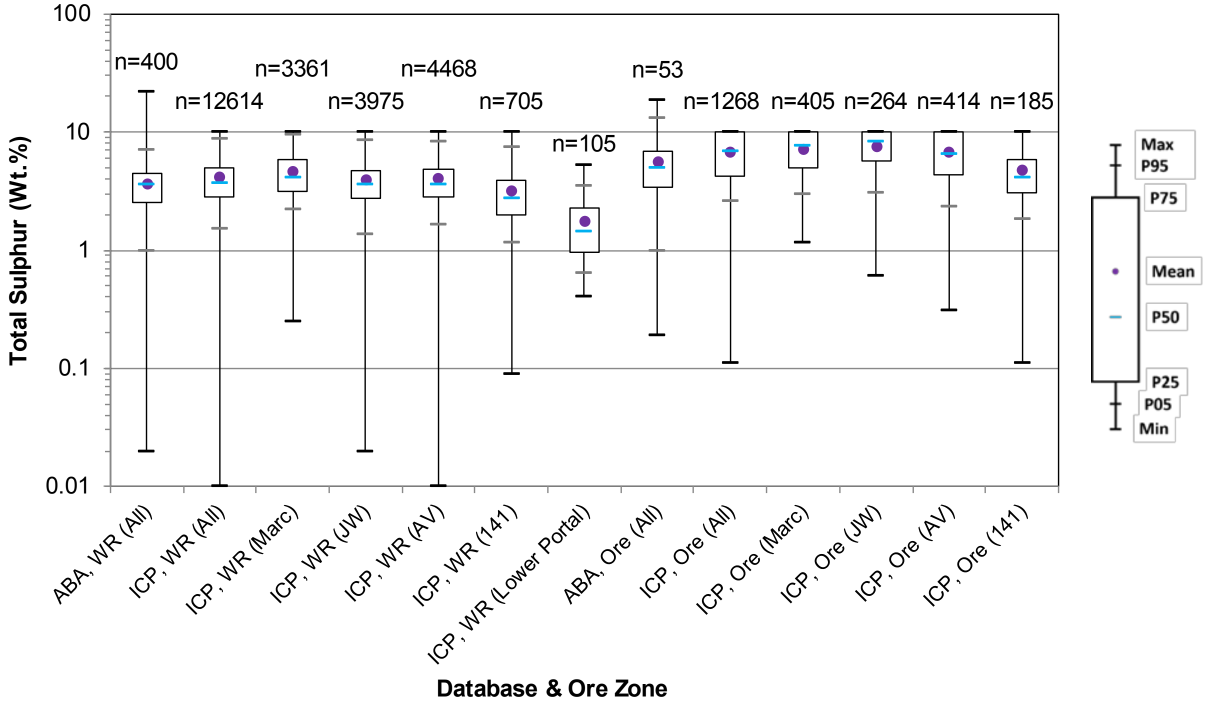

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Figure 5: Sulphur Distribution in Waste Rock and Ore by Mining Zone (Marc, JW, AV, 141 and Lower Portal)

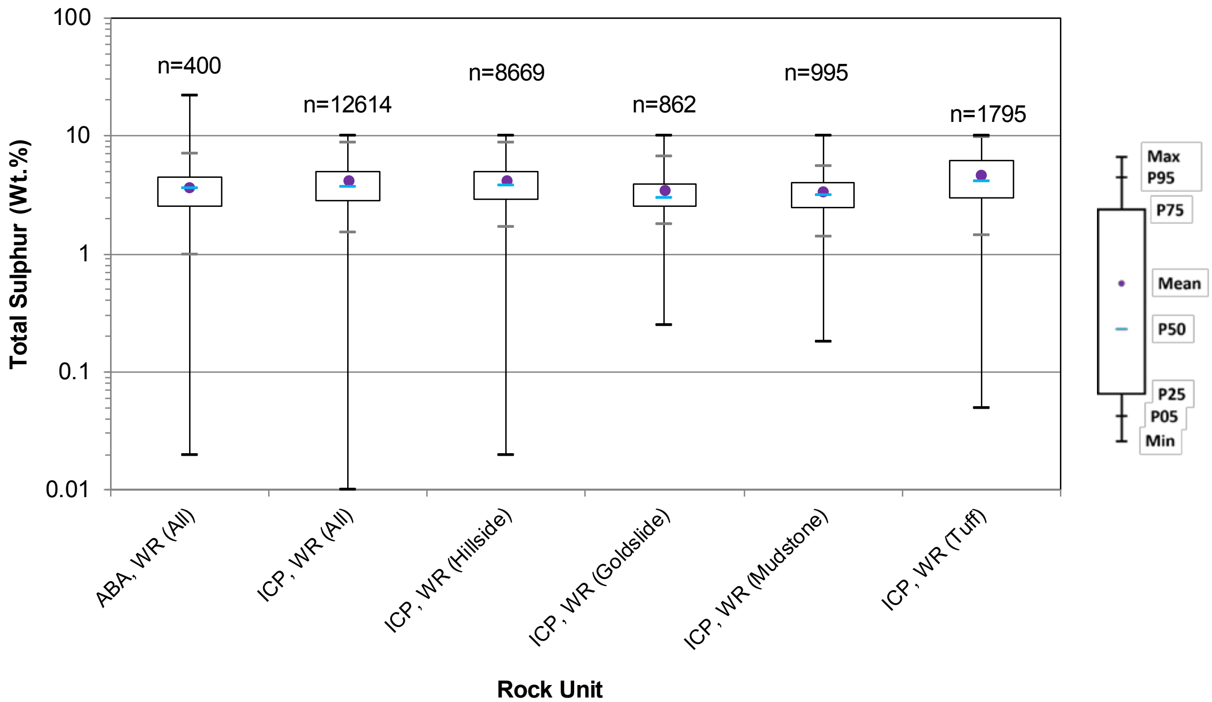

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Figure 6: Sulphur Distribution for Dominant Waste Lithologies

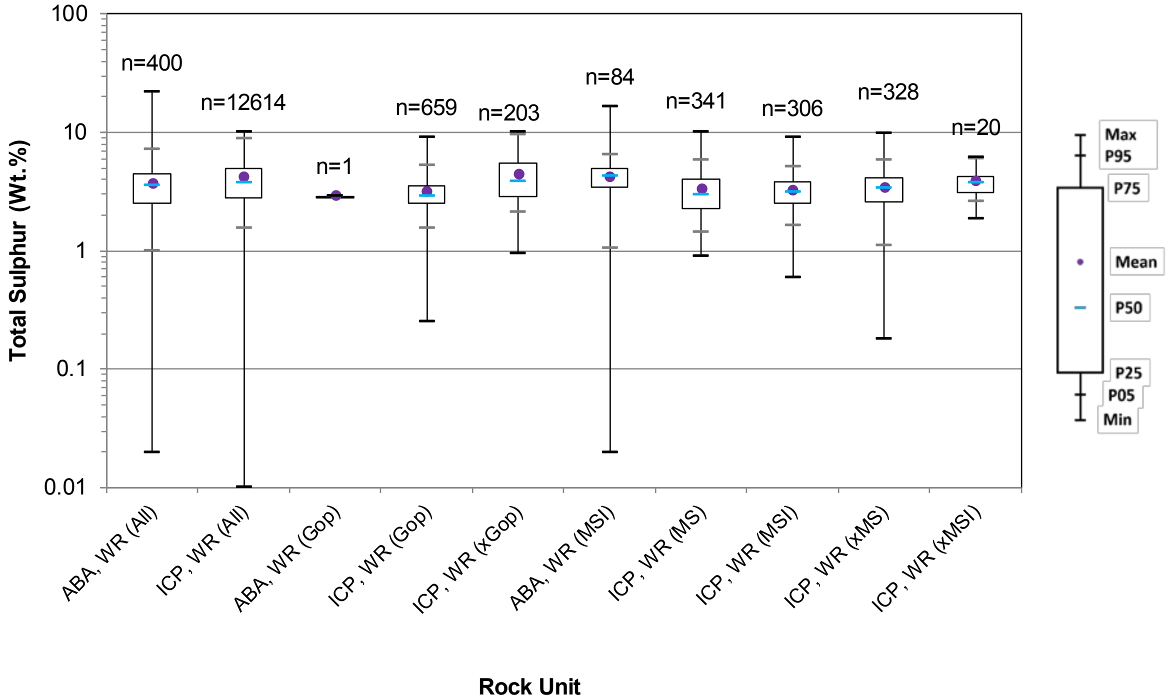

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Figure 7: Sulphur Distribution by Logging Code for Goldslide and Mudstone Units, Waste Rock

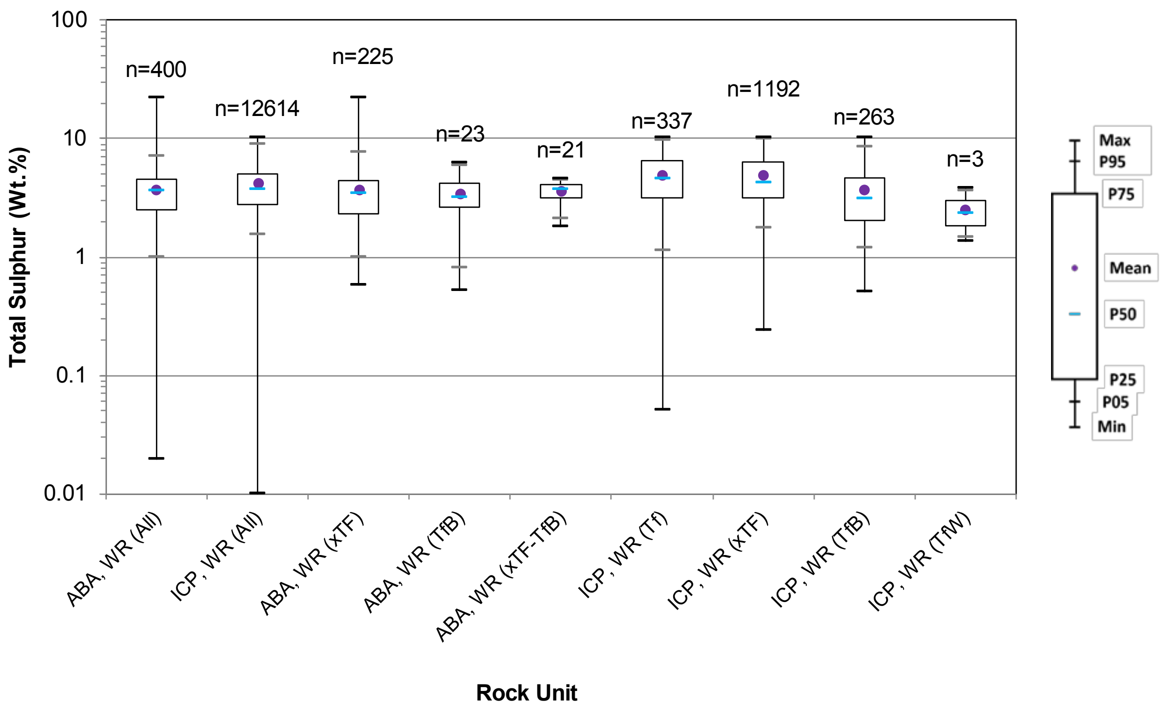

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Figure 8: Sulphur Distribution by Logging Code for Tuff, Waste Rock

3.3.2 NP

For waste rock, ore and tailings there is relationship between calcium content and NP in the ABA dataset. For waste rock and ore, calcium levels approximate NP levels (Figure 8) except for samples analyzed in 1994 (Figure 9). For the 1994 samples, the data suggests there was a different digestion method or a problem with the digestion of the samples resulting in uniformly lower calcium levels compared to other years. For tailings, Modified NP and Ca concentrations are at near parity (Table 2). The relationship between NP and calcium in these two datasets provides a sufficient basis to use calcium assays from the ICP database as a proxy for NP for the purposes of qualitatively assessing NP between deposit zones and waste lithologies.

Based on range defined by the P25 to P75 levels, calcium is relatively uniform between mining zones and the major waste lithologies. This supports our conclusion that NP is not related to zone or rock type, but rather to mineralization that has overprinted rock type. Accordingly, the ABA dataset sufficiently represents NP for all mining zones and rock types.

Table 2: Assessment of Buffering by TIC, Modified NP and Calcium (Aqua Regia) Methods, Tailings

Zone	Sample ID	TIC	Modified NP	Ca*
		kg$CaCO_3$/t		
Marc	HCT T1, Master Detox Filter Cake (40 µm)	10	15	18
	HCT T2, Marc Master Comp, 25 µm K80 Grind	9.2	13	17
AV	AV Master Detox Filter Cake (40 µm)	21	22	25
JW	JW Master Detox Filter Cake (40 µm)	23	27	30

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Notes:

*aqua regia

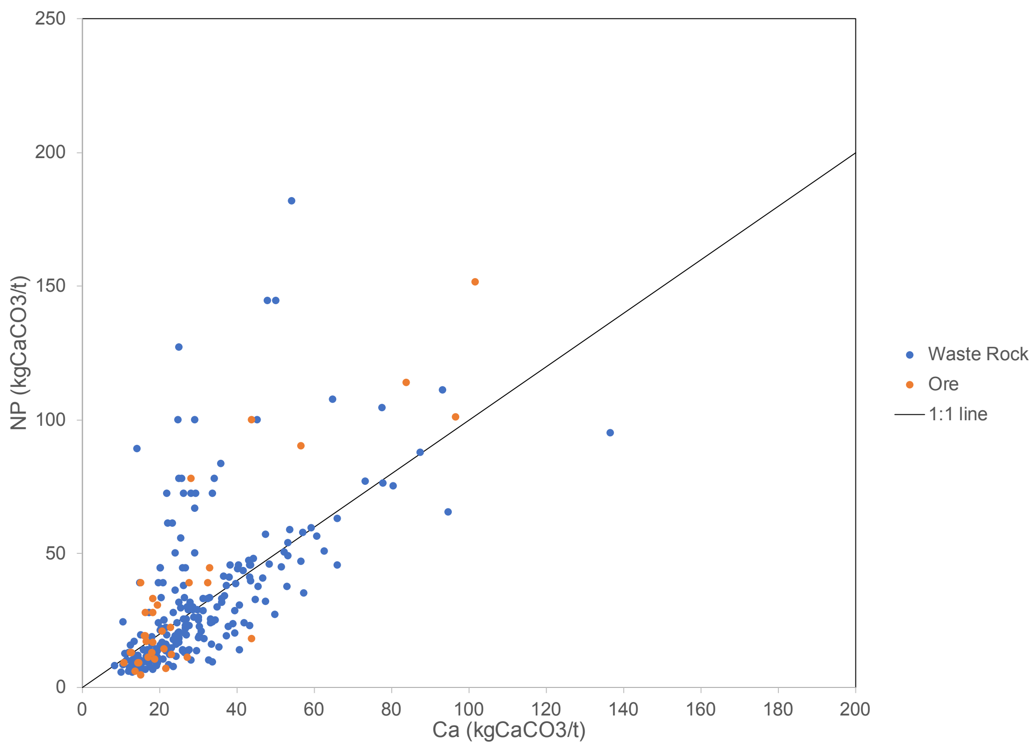

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Figure 9: Relationship between NP and Calcium, ABA Database (Excluding 1994 Samples)

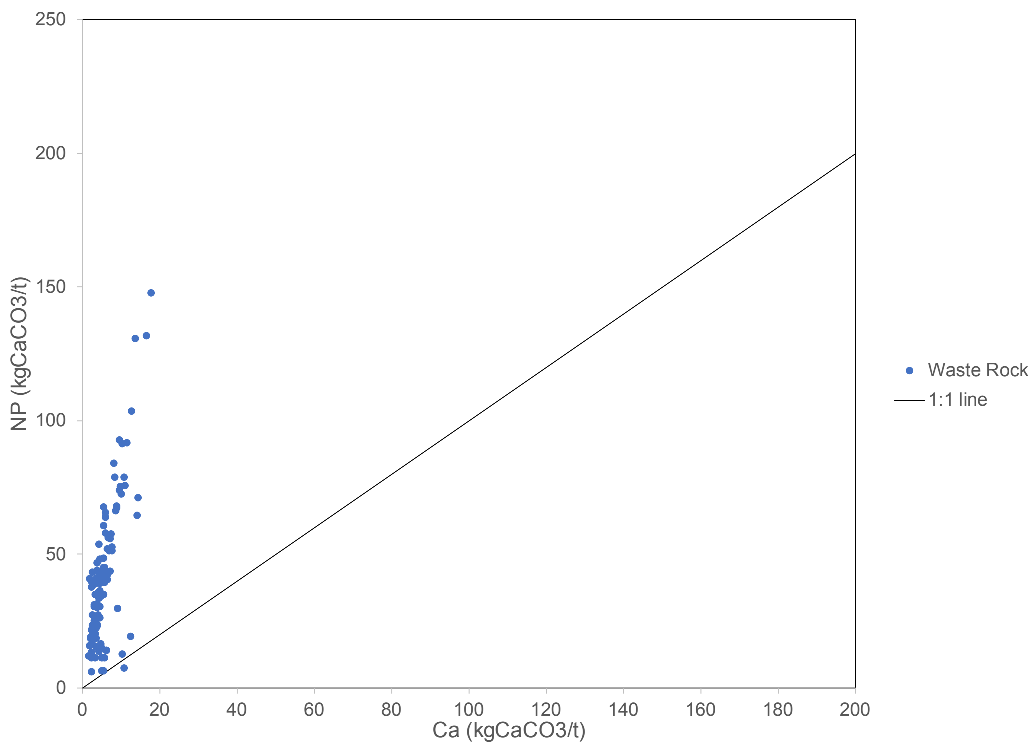

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Figure 10: Relationship between NP and Calcium, ABA Database (1994 Samples Only)

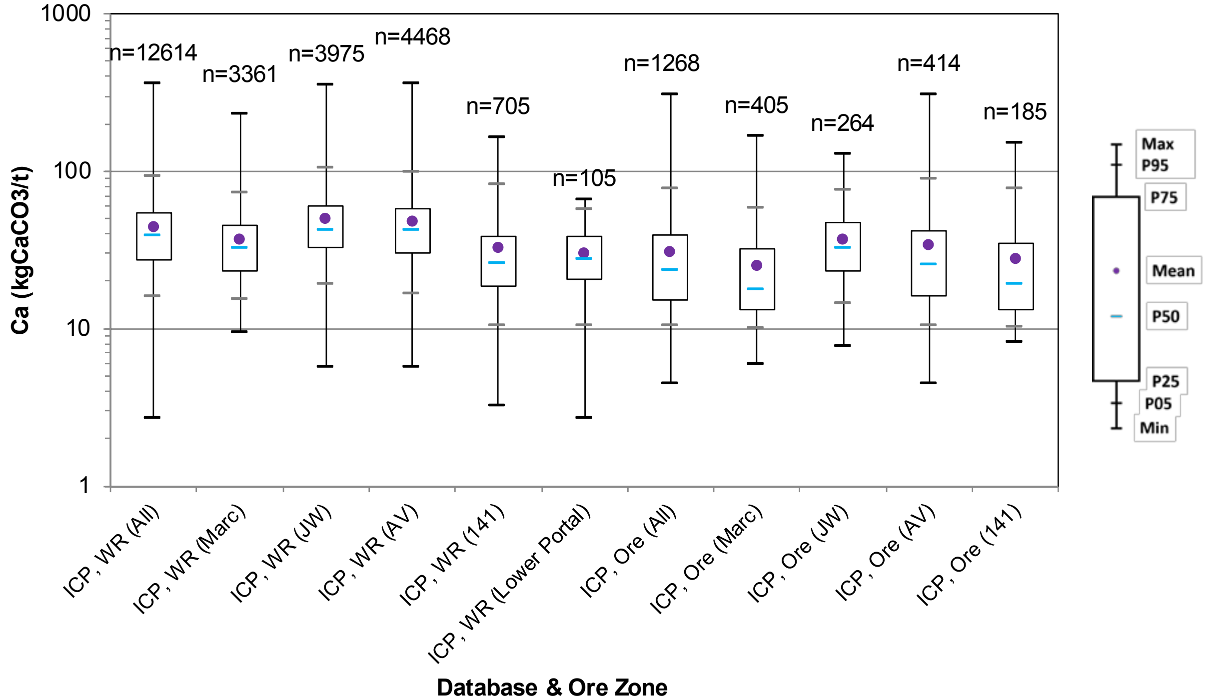

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Figure 11: Calcium Distribution in Waste Rock and Ore by Mining Zone (Marc, JW, AV, 141 and Lower Portal)

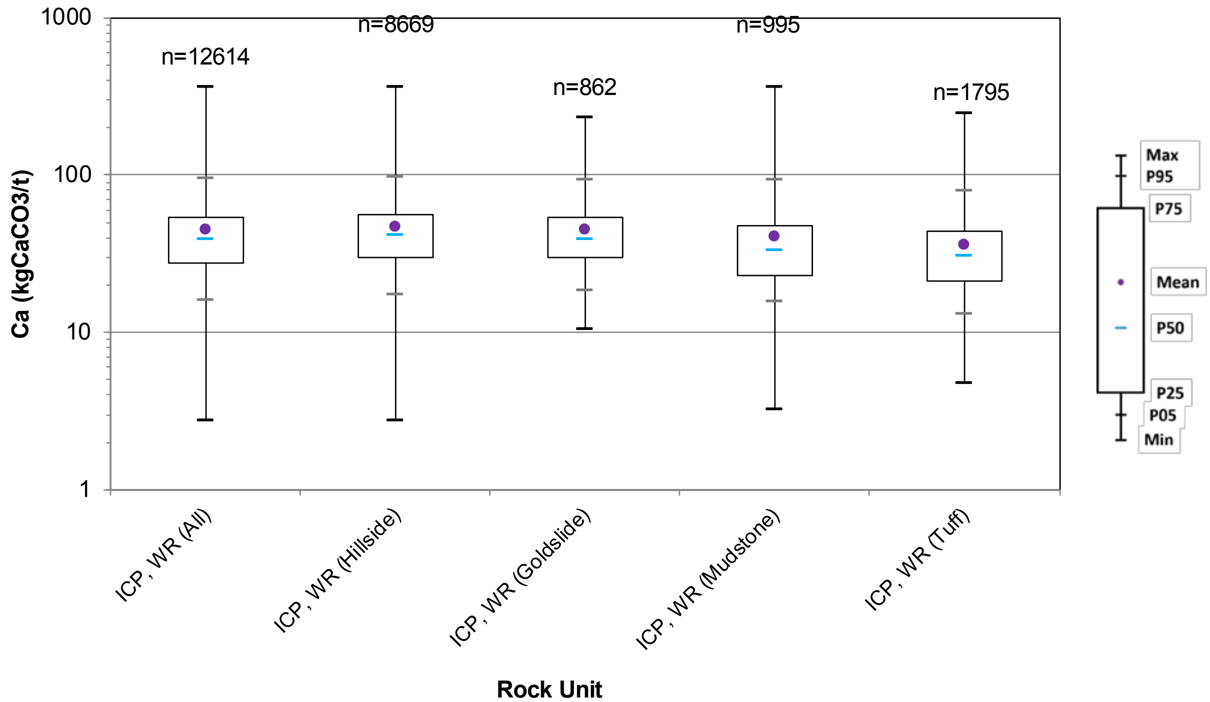

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Figure 12: Calcium Distribution in Waste Rock and Ore by Major Waste Lithologies

3.3.3 Conclusion

As stated in Section 6 of Volume 7, Appendix 1-B of the Application, all waste rock will be operationally managed as PAG. Regardless, a review of the ICP database in the context of acid potential and NP provides additional demonstration that the geochemical characteristics between mining zones and major waste lithologies are relatively uniform. Therefore, the existing ABA database presented in Volume 7, Appendix 1-B of the Application sufficiently represents the ARD potential of the Marc, AV, JW and 141 zones and all major waste lithologies. Additionally, given that there are no relevant differences in the geochemical characteristic of the different units, quantification of individual units would not provide further insights into the effects assessment or management plans for this project.

3.4 Assessment of Metal Leaching Potential

Trace Element Content

Table 3 presents a statistical analysis for selected trace elements from the IDM exploration database (As, Sb, Cd, Co, Cu, Ni, Se, Zn) for waste rock samples and presented by zone. These parameters were selected for discussion as they were identified as parameters of potential concern by ML/ARD monitoring, the water and load balance results and/or identified in a geochemical information request.

Median concentrations for all parameters are the same order of magnitude, except for nickel. Nickel concentrations are relatively uniform for the Marc, AV and JW zones but three times higher for the 141 Zone. The higher nickel content in the 141 Zone and the representativeness of the existing waste rock sample set is discussed later in this Section.

Table 3: Selected Trace Element Data for Waste Rock by Deposit and Zone, 2016 to 2017 ICP Exploration Database

Statistic	As (ppm)					Sb (ppm)					Cd (ppm)					Co (ppm)				
	All	Marc	JW	AV	141	All	Marc	JW	AV	141	All	Marc	JW	AV	141	All	Marc	JW	AV	141
P000	0.4	0.4	0.5	0.6	1	0.16	0.85	0.57	0.16	0.85	0.01	0.01	0.03	0.02	0.02	0.9	1.9	2.8	0.9	2.4
P005	3.8	4.4	5.7	3	3.4	1.9	2.1	1.9	1.9	2	0.15	0.13	0.17	0.17	0.12	8.1	8.7	9.5	8	5.3
P025	14	17	18	9.1	12	3.3	3.8	3.3	3	3.2	0.41	0.35	0.48	0.41	0.4	12	13	13	12	8.6
P050	41	53	49	27	35	4.7	5.8	4.7	4.1	4.7	0.77	0.63	1	0.73	0.62	16	16	17	16	12
P075	140	220	130	110	100	7.2	9.1	7.1	5.9	6.8	1.7	1.3	2.5	1.5	1.1	20	20	20	20	15
P095	610	730	500	570	350	16	25	15	11	13	25	23	44	11	3.7	30	27	32	30	23
P100	10000	8100	7400	10000	1700	1400	510	1400	1000	70	660	300	660	620	120	650	130	180	650	76
count	12614	3361	3975	4468	705	12614	3361	3975	4468	705	12614	3361	3975	4468	705	12614	3361	3975	4468	705

Statistic	Cu (ppm)					Ni (ppm)					Se (ppm)					Zn (ppm)				
	All	Marc	JW	AV	141	All	Marc	JW	AV	141	All	Marc	JW	AV	141	All	Marc	JW	AV	141
P000	1	4	3	1	4	0.2	0.5	0.2	0.2	4.6	1	1	1	1	1	4	6	4	5	9
P005	27	18	30	37	44	3.4	3.1	3.3	3.7	8.5	2	2	1	2	3	25	19	33	26	22
P025	86	76	79	99	88	8.6	9.7	7.8	8.5	15	4	4	3	4	6	48	40	59	46	45
P050	140	130	120	150	140	13	13	12	12	38	5	6	4	6	9	76	63	100	71	66
P075	210	190	180	230	240	25	23	18	24	62	9	9	7	9	13	160	130	240	130	110
P095	380	330	330	410	530	84	100	72	69	120	16	16	13	17	25	2400	2100	4500	950	300
P100	6800	2500	6800	5900	4200	340	160	190	340	320	320	160	320	120	64	66000	35000	66000	59000	10000
count	12613	3361	3975	4467	705	12614	3361	3975	4468	705	12580	3357	3947	4466	705	12614	3361	3975	4468	705

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Humidity Cell Test Samples and Leaching Rates

Cd, Co, Cu, Ni and Zn

Tables 4-9 and 4-10 of Volume 7, Appendix 1-B of the Application present the ABA and selected trace element data (Cd, Co, Cu, Ni, and Zn) for the humidity cell tests (HCT), including the percent rank as compared to the waste rock and ore ABA sample sets. As presented in Table 4-9 of Volume 7, Appendix 1-B of the Application, waste rock HCTs contain P24 to P97 sulphur levels and ore HCT contain P57 to P100 sulphur levels as compared to the ABA sample set. For Cd, Co, Cu, Ni, and Zn, the HCT samples contain at least median levels. Given the relative uniformity of these trace elements throughout the deposit, the HCT samples are considered sufficiently representative of waste rock for the project.

Because nickel levels are higher in waste rock from the 141 Zone, nickel content for the HCT sample set was assesssed against the exploration samples from the 141 Zone. For the waste rock HCT samples, the nickel content represents P01 to P92 levels of nickel in waste rock from the 141 Zone whereas the ore HCT represents P15 to P92 levels of nickel in ore (Table 4). Therefore, the HCT sample set sufficiently represents nickel in waste rock from the 141 Zone.

Table 4: Comparison of HCT Nickel Content to Ni Content in 141 Zone Exploration Database

Economic Classification	Rock Code	Sample ID	Ni	
			Concentration ppm	% Rank* 141
Waste	Hlp	Porphyry FHp	6	1%
	TfB	ABA-024	75	84%
	TfB	Black Tuff	100	92%
	xTF	ABA-031	11	18%
	Mixed	ABA A.V.1	12	21%
	Mixed	ABA A.V.2	28	40%
Ore	TfB	Crystal Tuff	31	58%
	TfB	Ore Avg Pyritic	13	19%
	TfB	Ore Avg ZnS2	25	49%
	TfB	ABA J.W.5	77	92%
	xTF	ABA-010	12	15%
	Mixed	ABA A.V.4	45	73%

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Notes:

*% Rank for waste rock HCTs based on all 141 Zone waste rock samples. Ore samples were compared to ore.

As, Sb and Se

The percent rank of arsenic and selenium for the waste rock and ore HCT samples according to economic classification are presented in Table 5 as these values were not presented in

Table 4-10 of Volume 7, Appendix 1-B of the Application. Arsenic levels are compared to the ABA database. Selenium was not analyzed for the samples in the overall static database. Selenium concentrations in the HCT samples were therefore compared to the IDM exploration database. Levels of arsenic and selenium in the HCTs represent median and up to P70 and P91 levels , respectively for the waste rock samples. The HCT samples are considered sufficiently representative of waste rock for the project.

The HCT samples were not analyzed for solid-phase antimony, however the analysis of the HCT leachates included antimony. Antimony concentrations are broadly correlated with sulphur and other trace elements associated with the mineralization. Therefore, by association, it is reasonable to assume that it is adequately represented in the HCT dataset.

Table 5: Arsenic and Selenium Percent Rank, Waste Rock and Ore HCTs

Economic Classification	Rock Type	Sample ID	As			Se		
			ppm	% Rank*	Count	ppm	% Rank**	Count
Waste Rock	Hlp	Porphyry FHp	5	13	368	4	25	12580
	TfB	ABA-024	350	70	368	9	74	12580
	TfB	Black Tuff	90	32	368	7	61	12580
	xTF	ABA-031	250	57	368	14	91	12580
	Mixed	ABA A.V.1	210	52	368	5.2	51	12580
	Mixed	ABA A.V.2	320	67	368	4.9	38	12580
Ore	TfB	Crystal Tuff	20	6.3	51	9	24	1266
	TfB	Ore Avg Pyritic	80	21	51	34	88	1266
	TfB	Ore Avg ZnS2	10	4.2	51	9	24	1266
	TfB	ABA J.W.5	160	36	51	13	52	1266
	xTF	ABA-010	240	48	51	7	12	1266
	Mixed	ABA A.V.4	790	90	51	4	84	1266

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Notes:

*Compared to all samples in the ABA database and according to economic classification.

**Compared to all samples in the IDM exploration database and according to economic classifcation.

3.5 Assessment of HCT Inputs to Waste Rock Source Terms

The relevance of the representivity of HCT data relates to source term development and the site wide water and load balance (for which source terms were an input). Mine facilities containing waste rock include the stockpile and the underground mine, the latter which contains waste rock backfill. There will also be a small live ore stockpile.

HCT data was not used to derive the waste rock and ore stockpile source terms. These source terms were based on site monitoring data of the cribs and the legacy waste rock and ore stockpiles. Using site data is a more relaliable method of source term development, as discussed in responses to EMPR comment 679, and SEA (for NLG) comments 344 and 349.

The HCT data were used as inputs for waste rock to derive the underground mine source terms. Section 2.3.1 and Table 2-6 of the Appendix D of Volume 8, Appendix 14-C outline the method for deriving the inputs for neutral pH and acidic waste rock leachate. In brief, for neutral pH drainage, the base, intermediate and upper case scenarios were derived from the stable rates for neutral pH leachates from eight HCTs of waste rock and ore. For example, base case leaching rates were selected based on the median rates for each parameter based on the eight waste rock and ore samples. Given that the HCT samples are representative of trace element content for all zones of the deposit, the HCT rates used as inputs to the source terms are representative. Moreover, SRK considers this method for deriving the HCT inputs for waste rock as conservative as it addresses variability in sulphide and trace element content between samples and likely resulted in conservatively higher leaching rates, in part due to the inclusion of ore samples. The acidic leaching rates were based on the one waste rock humidity cell that developed acidic conditions during operation. This test had the lowest pH results observed in the HCT dataset, and for pH sensitive parameters, the concentrations were generally comparable to results from acidic ore samples (Volume 7, Appendix 1-B).

4 Closing

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