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First name: Kendra
Last name: Zamzow
Organization: Center for Science in Public Participation
Title:
Comments: Please see the attached comments and references. An additional folder of references will follow, containing SRK documents relied on but not directly referenced in the DEIS.

Thank you for the opportunity to comment.

Kendra Zamzow, Ph.D.

This review was conducted by Kendra Zamzow, Ph.D., at the request of Idaho Rivers United (IRU) for the purpose of providing geochemical information and analysis of the Stibnite Gold project. It includes an assessment of data validity and assumptions in geochemical models that affect water quality. Material reviewed all or in part included:

Brodie Consulting, Ltd. 2003. A review of tailings relocation projects and methodology. Prepared for Department of Indian Affairs and Northern Development, Type II mines. 24p.

Brown & Caldwell. 2019. Stibnite Gold Project DEIS Modified Proposed Action. Technical memo, 140p.

Brown & Caldwell. 2020. Stibnite Gold Project Water Quality Management Plan. 162p.

HDR. 2016. Stibnite Gold Project: Groundwater Quality Baseline Study. December 2016. 1,665p.

HDR. 2017. Surface Water Quality Baseline Study. December 2016, revised May 2017. 1,335p.

Hodges, R. 2020. "Midas Gold takes no responsibility for pollution." The Star-News. Op-Ed. Sept 24.

ERM. 2019. Review of surface water and groundwater modeling for the Midas Gold Existing Conditions and Proposed Action. 20p.

Kwong, YTJ, A Kapoor, and J-F Fiset. 2002. Assessment of chemical stability of impounded tailings at Mount Nansen, Yukon Territory. CANMET Mining and Mineral Sciences Laboratory study for the Water Resources Division, Indian and Northern Affairs, Canada, Whitehorse. Project 602345, Report MMSL 02-011CR. 59p.

M3.2019. Stibnite Gold Project Prefeasibility Study Technical Report. 642p.

Maest, A and DK Nordstrom. 2017. A geochemical examination of humidity cell tests. App. Geochem. 81: 109-131.

MEND. 1995. Hydrogeology of Waste Rock Dumps, MEND Associate Project PA-1, July 1995. In SRK 2018c SGP Existing Conditions SWWC

Midas Gold Inc. 2016. Plan of Restoration and Operations.

Newman, CP. 2018. Guidance for geochemical modeling at mine sites. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation.

Prucha, B. 2020. Review of hydrologic impacts of the proposed Stibnite Gold Project, Draft Environmental Impact Statement (DEIS), August 2020.

SRK. 2017a. Stibnite Gold Project Baseline Geochemical Characterization Report. Stibnite Project Midas Gold, Inc. May 2017. 1,890p.

SRK. 2018a. Stibnite Gold Project Proposed Action Site-Wide Water Chemistry modeling report. Prepared for Midas Gold Idaho, Inc. December 2018. 900p.

SRK. 2019a. Stibnite Gold Project Phase 2 Geochemical Characterization update report, 321p.

SRK. 2019b. Stibnite Gold Project Proposed Action Site Wide Water Chemistry (SWWC) Sensitivity Analysis Report, 218p.

Executive summary

Geochemistry and hydrology are the foundational underpinnings of predictions for future surface water and groundwater water quality, which in turn support - or do not support - statements from Midas Gold Idaho Inc (MGII) that the Stibnite Gold project will improve the currently degraded waters of Meadow Creek, East Fork Meadow Creek, and the East Fork of the South Fork of the Salmon River (EFSFSR).

Information to support all Alternatives is not provided in the DEIS, and additional Alternatives that would reduce the mine waste footprint have not been placed in the DEIS. The No Action Alternative that assumes the current degraded condition would be the future condition under a No Action option is also not supported, given the reclamation work that was ongoing until the MGII Stibnite project proposal.

With respect to geochemistry, the focus of this comment letter, there are important data gaps as well as model designs and test results that have not been clearly conveyed in the DEIS to support the predicted water quality for each Alternative. The issues most likely to affect water quality predictions are the lack of - and incomplete - conceptual models and the application of average steady-state humidity cell test (HCT) leachate at average "field scale temperature" to represent model inputs with average precipitation based on historic precipitation. The expected ranges of HCT leachate chemistry, precipitation, and temperature were not captured and will influence water quality. There is also a significant gap in that no predictions considered underground mining. A summary of issues is included below, and are expanded on in the remainder of this comment letter.

Given the data gaps and lack of information supporting Alternatives placed in or not considered in the DEIS, a supplemental EIS should be considered.

Development and application of geochemistry model

Future water quality predictions are highly dependent on HCTs - which have no mechanism to test the validity of their results - and on hydrology. HCT is a laboratory method to examine how material reacts under aggressive weathering conditions. Problems with this approach have been addressed by Maest & Nordstrom 2017 (limits of HCTs) and Prucha 2020 (issues with Stibnite mine hydrologic models). Some issues with model development in the DEIS are:

* Missing entire conceptual models and tables of geochemical model inputs.

* No conceptual model or model inputs table for existing conditions.
* No conceptual model or model inputs table for operations.
* No conceptual model or model inputs table for post-closure under Alternatives 2, 3, or 4.1 The model clearly was revised to provide the predicted water quality graphs and tables, but the inputs are not provided.
* No conceptual model or model inputs table for underground mining.
* PHREEQC geochemical model inputs were missing from the DEIS and references.

* Geochemistry model was based on average "steady-state" HCT leachate chemistry.

* Several columns were ended before all analytes reached steady-state rates.
* Relying on HCTs misses inputs from material not tested by HCT such as tailings (legacy and future), weathered waste rock, and weathered ore. It also appears to miss inputs from the second phase of HCTs designed to fill data gaps. Overburden material that went through HCT tests does not appear to be included in models.
* The range and variability of HCT results - including first flush of salts - was not utilized to develop a range of potential water quality inputs for the geochemistry model.2 This should have been part of the uncertainty analysis.
* Large scale tests (field barrel, pilot plots) were not conducted to verify contaminant release rates determined by HCT.

* Models miss some inputs.

* There appears to be an assumption that moving legacy waste rock and tailings will not cause changes to water quality.
* Water treatment plant sludge disposal in pits or the TSF has not been included in models.3
* Model assumes no ammonia or nitrate load to groundwater from blasting.
* Predictions are based on very broad scales.
* Geochemistry model was calibrated to and reported out annual averages for predicted water chemistry when it should have applied monthly, weekly, or even daily averages.
* A single average annual temperature of 2.6C was applied to predictions, rather than using ecologically relevant monthly temperatures.

* Precipitation fluxes into and out of mine waste have not been fully considered.

* Faults intersect all three pits, but models do not consider the potential for faults to convey pit lake water
* Assumption of a 10m zone of interaction between waste rock or tailings liner seepage and groundwater is at odds with the different bedrock and alluvial material underlying facilities, and affects whether pore water leaves as toe seepage or recharges groundwater.
* Assumption that there will be no infiltration into waste rock or tailings facility covers is flawed.

Site characterization

The area is complex, with oxide, sulfide, silicate, and carbonate materials and includes legacy waste rock in several locations, legacy tailings in the Meadow Creek valley, some old pits, at least one pit lake that a stream runs through, and numerous old mine tunnels. The terrain is generally steep narrow valleys with high avalanche and landslide risk, with streams feeding towards the South Fork of the Salmon River.

Maps of legacy waste and potential future mine waste storage areas are provided. However, there are data gaps that could influence the accuracy of the conceptual models. Conceptual models are based on site characterization information and are themselves the basis for hydro-geochemical modeling.4

* There is no discussion of the cleanup work that has occurred recently or the effect on contaminant sources to

water quality and any resulting water quality changes due to cleanup.
* There is no information on whether the numerous underground tunnels have collapsed, or of water quality within tunnels, or how water quality may have evolved over time.
* It does not appear that there is information on whether faults convey or block water movement.5

This is recognized as a source of uncertainty in the DEIS.6

* The Fiddle WRF and West End WRF areas had only minimal drilling to characterize the area.7

Sampling adequacy

An extensive drilling program has occurred, and many samples are drawn from these cores.

* A map of all sample locations, relative to faults and historic and future mine facilities, is needed to determine if sampling was spatially adequate.
* No samples were collected from exploration tunnels and faults.8 If tunnels and/or faults convey water, the geochemical make-up, including extent of weathering on tunnel walls, may inform the geochemical model and future water quality.
* No ore-grade samples were collected from the West End pit.
* No surface samples were collected from the Bradley waste rock dumps, although samples collected by auger showed signs of oxidation.

Adequacy of tests

* Numerous tests were conducted on material to determine neutralizing potential (NP) and acid potential (AP), but the actual application of NP and AP to material from the spent ore disposal area (SODA), surface sample, and fresh core material is very confusing. It is not clear which of the several methods applied was utilized (modified Sobek, Nevada Sobek, multi-element analysis, etc.). It was not clear how a neutralization potential ratio (NPR) cut-off of 1.5 for classifying material as potentially acid generating (PAG) was determined.
* Testing was not uniform across different materials.

* Field barrel or larger field tests were not run on any lithology or waste type.
* Only a single sample of ore-grade material was submitted for HCT tests.
* No HCT tests conducted on Stibnite stock; this may make up 14% of the West End WRF.
* No HCT tests were conducted on legacy waste rock or tailings
* No MWMP leach test was conducted on legacy waste rock.
* No mineralogy was conducted on legacy tailings.
* Oxide tailings did not go through any geochemical testing.
* Only a single sample of mixed POX and flotation tailings was tested by SPLP.
* Very few tailings went through ABA tests.
* Although 30 tailings samples were composite from 13 of the 42 drill holes in the SODA facility, only four samples were submitted for ABA or MWMP tests. All 30 went through multi-element testing.
* Submerged column tests were not done to inform pit lake water quality when backfill is submerged, or future underground workings water quality if tunnels are flooded at closure.

* The laboratory reporting limit for mercury was so high (100 ng/L) that it constrains the ability to determine current and future mercury sources.

Assumptions and Missing/Incomplete information

* No waste rock management plan (WRMP). The DEIS relies on assumptions made with respect to the WRMP.

The final location of waste rock from different pits is necessary to inform the geochemical model.
* There is an assumption that water leaching from WRFs and through TSF liner will enter groundwater and from there will enter pit lakes. This does not consider the potential for leachate to enter fault systems or groundwater that becomes seeps, particularly in the alluvium of the Meadow Creek valley.
* It is not clear if the block model distinguishes quartz-monzonite (or other lithologies) with sulfide veins from those with calcite veins - whether it places both types of material together to develop averages for the block model. Bailey tunnel surface samples also had sulfide veins and calcite veins, and this may occur with YP gouge samples.9
* The assumption that only 4% of waste rock material would be available for weathering and contaminant leaching, while explained, seems unreasonably low. This should be backed up by information from operating mines that are also research projects determining water and oxygen flow through waste rock mass.

Introduction

Midas Gold Idaho, Inc proposes a series of three open pits to mine for gold in and around the Payette National Forest and near the South Fork of the Salmon River in Idaho. Products would be antimony (Sb) concentrate and gold and silver dor[eacute]. Mining would start at the Yellow Pine (YP) pit near the South Fork of the Salmon River, then move to the Hangar Flats (HF) pit, and finish at the West End (WE) pit, also near the South Fork of the Salmon River. Mention is also made of the Midnight Pit, which is within the West End pit.

The operations would occur in an area of extensive historical mining that included open pits, underground mines, and heap leach pads from intermittent mining between 1919 and 1998.10 The YP and WE areas were previously mined; the HF area has been utilized to store mine waste but has not been mined. One set of underground workings runs from the HF area to the YP pit (Fig. 1).

Historical mine waste, including tailings, leached ore, waste rock, and a pit lake remain in the area (Fig. 1). Remediation efforts were ongoing until the recent MGII proposal.11

Several streams in the area are listed as impaired water bodies for elevated arsenic, including the EFSFSR, Fern Creek, Fiddle Creek, Rabbit Creek, Meadow Creek, Garnet Creek, Midnight Creek, Hennessy Creek, and Sugar Creek.12 All these water bodies are designated for salmon spawning, and most for drinking water use.

SEE LETTER SUBMISSION: Figure 1: Mine area relative to historic tunnels. (Upper image) Historically mined areas; purple lines are underground workings. Source: DEIS Fig. 3.7-2 (Lower image) Cross-section showing tunnels. Source: Midas 2016 Plan of Restoration and Operations (PRO), Appendix D.

MGII claims they will restore salmon for the first time since the 1930's by removing and/or re-processing old mine waste.

Past activities primarily mined and leached oxide-based gold ore through heap leaching, transitioning to more sulfide-based material and flotation operations that produced tailings in later years.13

Future activities would mine primarily sulfide material, with some oxides. Future waste rock will reflect this range of composition. Future milling would process oxide and sulfide material through chemical means (flotation) and sulfide products of gold-silver flotations would pass through pressure oxidation (POX, autoclave) followed by cyanide leaching.14 Future tailings and tailings pore water will reflect this. Runoff and leachate from some waste rock facilities (WRF) and the tailings storage facility (TSF) will be directed to pits, where pit lakes will form after mining is completed, or to creeks. Pit wall material will influence pit lake water quality. Pit lakes are intended to be flow-through, spilling over into creeks. One WRF will have run-off discharge directly into a creek.

Sample collection

Samples collected for testing included legacy and fresh material.

* Legacy ore: Surface samples of weathered ore-grade material
* Legacy heap leach: Spent ore samples, collected by drilling at SODA
* Legacy waste rock: Waste rock samples collected by drilling at the Bradley waste rock dump
* Legacy waste rock: Surface samples of waste-rock grade material from YP and WE pit areas, with two samples from near an adit in the HF area
* Legacy tailings: Tailings samples collected by drilling beneath spent ore at SODA
* Fresh ore: Fresh ore-grade material from different lithologies
* Fresh waste rock: Fresh material from different lithologies with low mineral content
* Fresh tailings: Simulated tailings composited to represent different sets of mine years

Contaminants and sources

The contaminants of concern are primarily arsenic (As), antimony (Sb), and mercury (Hg) which are present in the ore as the sulfide minerals arsenopyrite and stibnite, and present in waste rock. Additional contaminants such as aluminum (Al), iron (Fe), and manganese (Mn) currently exceed water quality criteria occasionally or are expected to due to new mining.15

Surface water and groundwater

Surface water un-impacted by legacy mining meets water quality criteria (WQC) except for occasional exceedances of Al.16 However downstream surface waters impacted by legacy mining are elevated in As and Sb, and sometimes in Al, Fe, Mn or Hg. 17 Other metals and metalloids may show as occasional contaminants.

Groundwater un-impacted by legacy mining is generally good and is not a source of contamination. Bedrock groundwater unimpacted by mining activities does not exceed any WQC regularly, with the exception of As. Alluvial groundwater was elevated in Al, As, Fe, and Mn in one to three samples of 15.18 This is based on a single monitoring well at different depths, MWH-A01/B01 (Fig. 2).

SEE LETTER SUBMISSION: Figure 2: Location of background groundwater wells. MWH-A01 is screened in alluvial groundwater, MWH-B01 is screened in bedrock groundwater. The well is located in Meadow Creek Valley upgradient from legacy mine waste. Green lines represent fault lines. Geo-location of well and fault lines relative to land features contributed by B. Prucha.

Groundwater impacted by legacy mining is in a degraded condition and does contribute contaminants. This is due to legacy tailings, waste rock, heap leach pads, and pits.

In the SODA area, alluvial groundwater was elevated in total and dissolved Fe and Mn in every sample. For the same area, bedrock was elevated in total (but not the dissolved form) for Al, Fe, and Mn.19 Lower down the Meadow Creek valley, total and dissolved As, Fe, and Mn exceeded in nearly every alluvial groundwater sample while As alone exceeded in every bedrock groundwater sample.20 Sb and As are also issues in groundwater in the West End area.21

Legacy waste in the Meadow Creek Valley contaminates the entire EFSFSR valley. It is the removal of the overlying waste that Midas is relying on to improve water quality from current degraded conditions.

Legacy tailings

There are 3 Mt of legacy tailings on the site, buried under 6 Mt of spent ore in 1982-1994 at the SODA facility.22

This currently degrades surface water and groundwater.

Future POX and flotation tails will be mixed together in a new TSF; three of four alternatives have the new (lined) TSF at the SODA site after removal of legacy spent ore and re-processing of legacy tailings. The DEIS describes different TSF liner systems for Alternatives 1, 2, and 4.23

Alternative 1. A 60-mil LDPE liner with a geosynthetic clay liner on top, 12-inches of bedding, and an HDPE perforated pipe as an underdrain wrapped in geotextile.

Alternative 2. Primary and secondary 60-mil HDPE liners with added leakage collection layer, as well as the 12-inches of bedding and underdrain as for Alternative 1.

Alternative 4. Primary and secondary 80-mil HDPE liners with leak detection and ability to remove process water when specific head heights are reached to limit leakage. Would meet Idaho regulations for facilities utilizing cyanide.

These liners differences are not shown on images or in conceptual models. Alternative 3 would leave the unlined SODA material in place and place a new facility in a different valley, using the liner system of Alternative 1 but improved to meet Idaho regulations.

Future tailings for Alternative 1 are expected to leach elevated concentrations of As, Sb, and cyanide.24 This is based on an SPLP test of a single tailings mix sample. It may leach other contaminants, but the laboratory reporting limit was above the WQC for Hg, cadmium (Cd), copper (Cu), selenium (Se), silver (Ag), and thallium (Tl). POX tailings alone leach high concentrations of Cu, Fe, and sulfate in addition to As, Sb, and cyanide.

The degree to which different Alternative designs change TSF leachate water quality is not provided.

Legacy waste rock

Legacy waste rock dots the landscape (Fig. 3). Although there are some exceptions, in general waste rock remains at neutral pH while ore-grade material collected from the surface is acidic.25

Bradley WRF piles (near the YP pit) have oxidized for several decades and could be an analog for future WRFs. Material has lower neutralizing potential than fresh material or spent oxide ore:26 "which reflects the removal/consumption of neutralizing minerals by weathering and oxidation of sulfides"

However, acid had not developed. Whether this material leached contaminants was not tested, missing an opportunity to ground-truth laboratory tests of fresh waste rock.27

Surface samples of legacy waste rock material from WE pit area did not leach contaminants, other than some slightly elevated As, but waste rock material from the YP pit is a source of high concentrations of several metals, including Al, Fe, Mn, As, Sb, Cu, and/or Hg and one sample additionally had elevated cobalt and nickel.28

Surface samples of legacy ore frowere generally acidic and leached similar metals.29

Two surface samples of waste rock picked up by an adit in the HF area were acidic; however only one was submitted for leachate tests. It leached Al, Mn, As, and Sb above WQC.30

The main lithologies that will make up future waste rock (alaskite, quartz-monzonite (QM), quartz-monzonite-alaskite (QMA), carbonate) and some overburden material (granite, breccia, gouge) all are expected to leach As and Sb above WQC, but do not leach other analytes.31 Based on MWMP leach tests and HCTs, the WRFs will leach these and Al, with occasional exceedances of Mn, Se, and sulfate. Other constituents may leach but due to high laboratory detection or reporting limits were not detected: Cu, Hg, Tl.32

SEE LETTER SUBMISSION: Figure 3: Legacy waste rock facilities. Source SPK 2018c, Appendix A

Mercury

Currently, mercury is found in streams, seeps, and adit seep discharges above surface WQC.33 It was not detected in groundwater monitoring wells, in either alluvial or bedrock groundwater, above groundwater WQC. However, the groundwater WQC is 2,000 ng/L, while surface water WQC is 12 ng/L.34 All groundwater had total Hg over surface WQC, and wells MWH-A04 and MWH-A05, alluvial wells near heap leach pads in the Meadow Creek valley had dissolved Hg over surface WQC (Fig. 4). Potentially Hg was liberated when cyanide was applied to heap leaches.

SEE LETTER SUBMISSION: Figure 4. Location of alluvial wells with elevated dissolved Hg at old heap leaches Looking up Meadow Creek Valley; MWH-A01 is located above SODA (outside of image]. Green lines represent fault lines. Both wells are in the location of the future HF pit. Geo-location of well and fault lines relative to land features contributed by B. Prucha.

Mercury concentrations are expected to increase in surface water after mining operations. Future sources of Hg are likely to be at pit backfills, WE pit walls, tailings and tailings consolidation water,35 which includes tailings process water.36 WRF toe seepage is expected to be elevated in Hg during operations at Fiddle (mining years 2-8), West End (mining years 1-7) and Hangar Flats (mining years 2, 4, and 10).37 The model predicts no contaminants from WRF seepage post-closure due to cover placement; this is an unjustified assumption.

Geochemical characterization of existing conditions

The site has had extensive drilling and sampling, with ore and waste samples submitted to numerous mineralogical and geochemical tests. A water quality predictions model was developed and tested against existing conditions to see if it accurately predicted surface water chemistry.

Were samples adequate and representative?

Sampling has included collection of weathered ore and waste rock material on the surface (n=25), the SODA facility (n=241), and over 700 samples from exploration drilling cores.

Spatial coverage

Whether samples have adequately covered the area spatially cannot be determined. There do appear to be gaps in coverage.

[bull] A map of all sample locations, including those from fresh core drilling, relative to faults and historic and future mine facilities, is needed to determine if sampling was spatially adequate. Phase 2 sampling was designed to address data gaps in spatial and lithological representation. Phase 2 actually conducted tests on existing samples, expanding lithological representation without expanding the spatial representation.

[bull] There are no samples from faults or tunnels. There is no information on whether faults convey or block water. There is no information on the extent to which tunnels are collapsed or open or of the water quality in tunnels. No monitoring wells appear to have been drilled in the areas of old tunnels, although some surface water samples were collected near adits.

[bull] There are no samples from roads, but samples available from initial data collection, with the same lithologies as roads, were targeted in Phase 2 sampling (no new samples collected).

[bull] A figure of the depths of sample collection in pits is available.38 The West End pit and YP pit appear to have adequate sampling at depths of the currently known ore body. However, the figures do not indicate if the full resource body is shown.39

Lithological coverage

Initial sampling did not adequately capture some lithologies; an attempt to rectify this was made in Phase 2 sampling by adding granite, breccia, and gouge - previously not represented in HCTs.40 However, there remain data gaps and lack of clarity on sample representation. In addition to the data gaps listed below, it is apparent that QM may contain either sulfide or calcite veins, which has a distinct influence on paste pH and neutralizing potential.41 For this reason, tables such as Table 2 in SRK 2018b and Table 4-3 in SRK 2017b are important in showing which samples have high, low, or average sulfide. However, this information is scattered, difficult to find, and limited to samples that went through HCT testing. This kind of information should be pulled into a Geochemistry appendix.

* There is a lack of clarity regarding which QM samples had sulfide veins and which had calcite veins. This information would have been collected during exploratory drilling, but it's not clear if this has been included in the block model. Text in SRK 2018a suggests multi-element analysis weighted by lithological unit was the basis for the block model.42 Are sulfide and calcite veins segregated to specific areas of the old pit and proposed pits? If the block model is based on the P50 concentrations of % sulfide, NPR, net neutralization potential (NNP), or net acid generating (NAG) are they blurring areas that will be more distinctly influenced by sulfide or calcite veins?
* Stibnite stock has not been tested using HCTs. This may make up 14% of the West End WRF.43
* HCT testing was conducted on diorite and rhyolite, which will be part of overburden, but results were not used in the geochemical model.44 These lithologies may make up less than 1% of WRFs and pit walls,45 but this remains to be determined when a WRMP is provided. Diorite leached Sb elevated above WQC throughout the HCT test and rhyolite leached elevated Sb for the first 50 weeks of testing.46
* No samples appear to have been collected from tunnels or areas under consideration for underground mining for HCT or any other geochemical testing, with the exception of two surface samples from Bailey Tunnel and one collected near an adit in the HF area.

Historic material

Historic material was collected from augered drill samples and surface grab samples. Surface samples were collected from ore and waste rock material that had been oxidizing for decades (Table 1). Sample locations are at the YP and WE pits, from an adit in the HF area and from waste piles generated during construction of the Bailey Tunnel.47 Augered samples were collected at the Bradley dumps and core samples from the SODA area. They represent how future mine material may geochemically evolve. The degree to which acidity and metal leaching developed were related to the presence of pyrite and degree of oxidation (Table 1). If the original lithology of the material is available, they would provide ground-truthing for the HCT leachate.

* Of the 25 surface samples, four were collected near tunnels. Results suggest tunnel material should be better characterized.48

* At a portal near HF ore-grade QM with fine-grained pyrite was collected: paste pH testing determined an unoxidized sample had pH 2.8, while a mixed oxidation sample had pH 5.8.
* Samples from Bailey tunnel waste-rock grade QM: a partly oxidized sample with fine-grained pyrite had pH 4.7, while an oxidized sample with calcite had pH 7.0.

* No ore-grade surface samples were collected from the West End pit.
* No surface samples were collected from the Bradley dumps; augered "core" samples were collected and showed signs of oxidation.
* There appear to be some discrepancies between SRK 2017a Table 3-2 and Table 3-6 regarding what lithologies were collected from each area.
* What is the fate of the material from the old Homestake pit? The one sample was extremely acidic (pH 2.8).

SEE LETTER SUBMISSION: Table 1: Surface samples., QU=quartz monzonite, the primary ore lithology. Adapted from: SRK 2017a Table 3-6.

* Given the variable reactions from within a single lithological unity - based partly on ore grade and extent of oxidation - more surface samples should have been collected for most lithologies.

* Of the 25 surface samples collected (Fig. 5, Table 1), 12 were from a single lithology (QM). The remainder were two samples each of breccia and calc-silicate, and one each of carbonate, quartzite, schist, alaskite, granite, and gouge. 49
* QMA- expected to make up 50-60% of HF and YP pit walls or waste rock - was not collected.
* Stibnite Stock, expected to make up 10-14% of HF pit wall or waste rock, was not collected.

* At the SODA facility, 241 samples were collected from 42 drill holes, but only two surface grab samples were collected, both at the edge of an old heap leach pad. More samples may be needed to adequately characterize surface material. This material will be moved, so understanding the outer layer as well as the inner layer will be useful in predicting potential impacts related to moving the material. For example, whether secondary salts have formed over an area of the facility.

Were the appropriate tests performed?50

* No MWMP leach test was conducted on legacy waste rock (Table 2).
* No mineralogy was conducted on legacy tailings.

SEE LETTER SUBISSION: Figure 5. Surface samples. Yellow squares highlight where groups of samples were collected, numbers refer to the number of samples collected at each site. Source: SRK 2017 Baseline Geochem Fig. 3-4.

No HCT tests were conducted on legacy waste rock or tailings

* Although 30 tailings samples were composite from 13 of the 42 drill holes in the SODA facility, only four samples were submitted for ABA or MWMP tests. All 30 went through multi-element testing.

SEE LETTER SUBMISSION: Table 2. Testing conducted on historic material to characterize existing conditions. The thirty tailings samples were composited from 13 drill holes in the SODA. Section 3.5 of SRK 2017 notes that 30 tailings samples went through multi-element testing and four went through ABA, NAG, and MWMP tests; however, Section 4.2.3.3 of the same report says seven samples were submitted for all of these tests. ABA = acid base accounting, NAG = net acid generation, MWMP = meteoric water mobility procedure, HCT = humidity cell test. Source: SRK 2017a Sections 3.3 to 3.5.

Was the conceptual model appropriate?

No conceptual model was provided for existing conditions, with the exception of a TSF model.51 A model would show the reader the assumed contaminant inputs affecting current water quality, and could be useful in assessing why the predictive water quality model was only partially successful in re-creating current conditions.

This could be added to Chapter 3, Affected Environment. Like conceptual models for future conditions, it would show key sources of hydrologic and geochemical inputs to the watershed.

Were geochemical model assumptions reasonable?

Moving legacy material

There appears to be an assumption that moving legacy waste rock and tailings will not introduce changes to water quality. However, disturbing material -particularly fine-grained material like tailings -could provoke release of contaminants. In a study of legacy tailings at an abandoned gold mine in the Yukon, it was determined through short-term leach tests and submerged column tests that moving arsenic-contaminated tailings posed a risk of causing contamination:

[hellip].column testing demonstrates that thiocyanate, ammonia, As, and possibly Sb may be mobilized in tailings porewater and the water cover at concentrations of concern. If the tailings were to be relocated[hellip].moving the tailings in a relatively dry form would likely have a less significant impact on the resultant water cover quality than transferring the tailings as a slurry. Sequential batch leach testing [hellip].also indicates As and Sb are the only trace elements susceptible to significant leaching with intense perturbation of the tailings.52

Additional studies have shown that moving tailings can result in unexpected upsets.

There also appears to be little thought to the actual procedure of processing tailings or where legacy tailings will be placed. At the Giant Mine in the Yukon, approximately 2.3 million tonnes of tailings were removed and process - similar to what is envisioned at Stibnite. The work took two years at a processing rate of 200,000 tonnes per month. Pilot scale work was conducted well before actual processing, using a hydraulic pump to cut the face of the tailings and form a slurry and encountered problems with pumps, difficulty in working with frozen tailings, and problems related to a high-water table53 - all potential issues for re-processing legacy tailings from the SODA. This is a project in and of itself, yet, like an underground mining project, receives only a brief mention in the DEIS.

Tailings would appear to need to be staged somewhere in order to make room to lay the liner for the new tailings facility. Wherever this staged area is should be considered in determining hydro-geochemical model inputs. The only Alternative that reasonably provides for a location for both legacy and new tailings is Alternative 3.

Geochemical modeling to represent future conditions

Were samples adequate and representative?

Over 700 samples were collected, primarily around or in the proposed pit areas. In general, the samples should be sufficient to provide material for assessing future conditions. There are some exceptions.

* If underground mining is to occur, we have no information on whether the samples collected are sufficient to characterize tunnels. It appears that 2 surface grab samples were collected at the Bailey tunnel area and one at the Homestake area, but no samples from cores.54
* Some lithologies that make up more than 5% of potential waste rock or pit walls did not appear to have many samples.

* Alluvium
* Stibnite Stock
* Carbonate (marble)

Was geochemical testing adequate?

Tests for acid generation potential

The potential for acid drainage to develop is considered low in part because none has developed to date. However, the focus of new mining will be much more extensively in the sulfide zone than past mining.

The Stibnite area hosts primarily silicate, sulfide, and oxide material. Sulfides produce acid while silicates and oxides provide no neutralizing capacity. Carbonates - which neutralize acid - are only present in the West End area. This presents a potential risk that certain sulfide minerals will promote acid drainage. Testing has been done to determine acid generation potential including:55

* Multi-element tests. The potential to use % sulfur to estimate AP and calcium plus magnesium (Ca + Mg) to estimate NP. This could overestimate NP.
* Total inorganic carbon to represent NP. This could overestimate NP.
* Modified Sobek ABA. This could overestimate NP for samples with low NP content.
* Nevada modified Sobek ABA.
* Siderite correction method of ABA- considers that $FeCO_3$ does not contribute neutralization.
* Net Acid Generating (NAG) test.
* Mineralogy to determine the structure of minerals containing material that could produce or neutralize acid.

For the geochemical modeling, the determination of what is considered PAG lithological material in waste rock and pit walls appears to have been determined by the ratio of NP to AP (NPR) where NP is from the Nevada Sobek method and AP is from percent sulfides, with sulfides presumably determined from multi-element tests.56 However, the discussion is confusing, split between different documents, and it is not clear whether different methods were applied to different materials to determine an NPR.

Testing for acid potential has been conducted on legacy mine waste material, surface samples of weathered ore and waste material, and fresh core material. These are summarized below.

Legacy material to inform the future

The past may inform the future. Although 130 samples of spent ore went through ABA testing, fewer samples of Bradley waste rock (n=24) and very few Bradley tailings (n=4) went through ABA testing (Table 2). Therefore, testing was heavily weighted to the SODA material derived from the West End oxide deposit and expected to not generate acid - yet this was the only legacy waste to be tested with HCTs.

Bradley waste rock has variable composition with lower NP and lower paste pH than fresh core material, likely due to oxidation and weathering.57 This is material that was brought out of the YP pit between 1947 and 1951, and tells us what material mined out of YP in 2021 might look like in 50 years. It also provides prime material to subject to HCT aggressive weathering to provide a look further into the future, to determine whether the rate of consumption of neutralizing material will be faster than the rate of acid- producing material. Yet this was not done.

A set of 25 surface samples were tested through paste pH, ABA, multi-element, and mineralogy tests.58 Importantly, at the Yellow Pine pit: rock exposed in the lower portion of the pit consisted of an abundance of sulfide minerals (pyrite and stibnite) and limited acid buffering minerals (e.g., calcite). Further evidence of acidic conditions was provided by iron oxide staining as well as secondary mineral precipitation on some of the pit surfaces.59

Like legacy material from waste rock dumps, grab samples of legacy waste rock and ore material on the surface had lower NP than fresh material. Historic ore-grade surface grab sample material was acidic - with three exceptions -- regardless of whether it was unoxidized, oxidized, or in a mixed oxidation state, while historic waste-rock grade material - with two exceptions - was uniformly neutral pH regardless of oxidation state (Table 1). SRK states that ore-grade weathered material has a greater potential for acid generation because of the "porous and disseminated arsenopyrite" that is more available for reaction.60

This material will remain on site as part of pit walls. The models assume only small surface areas of PAG will remain on pit walls, but large surface areas of intrusive QM will remain, making up 10% - 42% of the final pit wall above pit lake level.61 Given that nearly all ore-grade surface samples went acidic over time, it should not be assumed that pit walls will not similarly develop acid over time. Only two surface samples were waste-grade QM; both were fully oxidized and neutral pH.62 What pH and leachate occurred during the process of oxidation? A better understanding of the evolution of pit wall material is needed, particularly to develop the model of the HF pit lake.

* Mineralogy and ABA tests alone are not sufficient to determine if legacy material will go acid; the relative rates of mineral consumption need to be known. In particular, legacy waste rock should have gone through HCTs.
* Host material that is porous and reacting seems to contradict the narrative that sulfides are "encapsulated" and unavailable for acid-generating reactions.

Fresh core samples

By far the most samples tested were from freshly cored rock. The majority, but not all, of fresh core material was non-acid generating.

NAG tests. In NAG testing of 155 HF and YP samples, 22% showed some potential for acid generation. The lithologies with the highest potential were alaskite and QMA in both ore and waste rock grade material.63 Of these, five waste-rock and one ore sample went on to go through HCT testing.

HCT tests. No samples showed an acid pH in HCT testing; however, secondary salts likely did form in HCT tests in the earlier weeks with consequent higher release of As, Sb, Al, Mn, Se, and sulfate; it should not be assumed that secondary salts don't form in the fresh core samples.

Paste pH tests. The paste pH of materials chosen for HCT changed very little before and after HCT leaching, and after leaching all had pH over 8.0. NAG pH was slightly lower - one HF QM sample (HC- 3 column) had pH near 2.6; all others were above pH 6.7. Some samples also went through post-HCT element analysis to determine how much sulfur and total inorganic carbon (as surrogates of acid- producing and acid-neutralizing material) remained relative to the original sample.

Mineralogy. Mineralogy is presented to explain in part the reason for the neutral pH. Gold is primarily associated with pyrite and arsenopyrite, which are encapsulated within quartz and muscovite. This weathers more slowly. Material that goes through accelerated weathering - like HCTs - or is chemically treated to assess available acid and neutralizing materials -like the NAG test - generally had a neutral pH, with the exception of about half of the weathered surface samples collected. The mine relies on this encapsulation, rather than carbonates, as a mechanism to maintain neutral pH.

Ore-grade material will have native chemistry changed as it is subjected to processing and becomes tailings, particularly if it is passed through an autoclave which removes virtually all sulfides. Acid generation is not expected at the tailings facility.

* Testing was adequate, with these exceptions:

* Tailings mixes should have gone through further testing (see next section).
* Legacy waste material should have gone through HCT or other kinetic testing.

* Overall, tests of fresh material and historic waste rock indicated that acid pH will not develop on the site. However, historic ore material did go acid, indicating acid could develop on pit walls exposed above pit lakes or at WRFs if landslides or other events expose underlying waste rock. In particular, secondary salts could cause seasonal and repeated release of higher concentrations of contaminants and lower pH.
* Although testing was generally adequate, the interpretation and explanations were not straightforward.

Tailings tests were not adequate

* There has been a stated intent to test simulated tailings or tailings mixes in HCTs, but this has not been done yet. This test needs to be conducted.64
* Oxide tailings did not go through any geochemical testing.65
* Very few tailings went through ABA tests (Fig. 6).
* Although six POX tailings samples went through SPLP, only a single sample of mixed POX and flotation tailings was tested by SPLP
* Tailings leachate chemistry testing could be improved. Only SPLP tests were done due to a lack of material - why couldn't more material be made available?

The MWMP has a liquid to solid ratio of 1:1 and is more representative of arid or semi-arid areas like the Stibnite site.

The tailings samples were submitted for SPLP leach testing, rather than MWMP, due to the limited quantity of tailings material available for testing and the finer grain size. Some of the disadvantages of the SPLP test are the high liquid to solid ratio (3:1) that may result in an underestimate of leachability and grain size reduction may increase reactivity. The MWMP and HCT leachate chemistry for the tailings and development rock is therefore not directly comparable. The SPLP results only provide a qualitative evaluation of constituents that could occur at concentrations above the water quality criteria and are not considered to be conclusive or to represent actual predictions of water quality.66

* Tailings were assembled as mixes to represent different years of production. They may not be representative.

* No mixes contained legacy tailings. Do legacy tailings make up part of the composite mixes representing early processing years, since they will be re-processed? It did not appear so.
* The tailings mix for years 1-7 of the proposed operation is assumed to make up 25% of total tailings,67 but will likely make up close to two-thirds.68 This could affect he leachate concentration included in models, because of the higher amount of source material, particularly for predictions of water quality during operations.

SEE LETTER SUBMISSION: Figure 6. Tailings tested for acid and neutralization potential. Source: SRK 2017a, Table 3-61

HCT tests may have ended too soon

* HCT tests were ended before the concentration of key constituents like arsenic had stabilized. This was justified in that concentrations were decreasing. However, tests should be conducted until stable chemistry is achieved.69 This is particularly important for column HCT 14, which is the sole source representing PAG material.70 In addition, high percentages of both potentially acid-generating and neutralizing materials remained at the end of the tests.71

HCT did not capture all material types

* Only a single sample of ore-grade material went through HCTs (Fig. 7). The ore-grade sample was chosen from non-acid generating material, when most ore-grade material falls in the potentially acid generating area. Including them in HCTs would provide information on the rates at which analytes may leach from this material, which will be present on pit walls, tunnels if underground mining occurs, and potentially in waste rock an tailings.

SEE LETTER SUBMISSION: Figure 7. Waste rock and ore acid and neutralization potential. Green dots show waste rock material chosen for HCTS; the black dot is an ore sample chosen. No surface samples were chosen. Source: SRK 2017 baseline Fig. 3-8

* No HCTs were conducted on legacy waste rock.72
* A single HCT was used to represent PAG waste rock material. Depending on the NPR cut-off and the pit, PAG could represent 10-22% of waste rock or pit wall material.

Field barrel testing was not done

* The addition of field barrel tests would have been one way to verify the contaminant rates of release determined in HCTs and scaled from laboratory to field conditions - they would be actual field conditions. They would, for example, provide a more accurate picture of the seasonal changes in contaminant release than the model's application of a constant temperature of 2.6C.
* Field barrels would provide real-time information on the reaction of waste to wetting-drying cycles and the development - and release - of secondary salts, which can have high concentrations of contaminants, especially in early snowmelt and after summer thunderstorms. This would serve as a comparison to a monthly or seasonal time-step model.

Submerged column tests were not done

* There have been no saturated column tests to determine contaminant release from submerged waste rock in backfilled pits or tailings submerged by pore-water. This should be done with different lithologies, including samples representing PAG material.

Testing with inappropriate levels of detection

Some laboratory testing applied limits of detection or reporting limits that were higher than WQC, so that the test was unable to determine if leachate or process water had concentrations of analytes that would exceed surface water WQC. This occurred for:

* Process water for concentrations of Al, Co, Mo, Ni, Ag, and Zn
* Tailings SPLP test for Hg, Se
* MWMP tests for Cu, Hg, Tl
* HCTs for analysis of Hg, Tl

The geochemical model therefore must be running with incomplete information on Hg sources. For the MWMP test and for most of the weeks of HCT testing, the laboratory reporting limit for analysis of Hg in column leachate was very high - 100 ng/L when the surface water WQC is 12 ng/L. This means that there is no information on Hg release from legacy waste (except SODA) or tailings at all unless it was over 100 ng/L, since this material was not subject to HCTs. Even at the high reporting limit, Hg in concentrations greater than 100 ng/L was documented in MWMP leachate.73

Were conceptual models for operations adequate?

Conceptual models - although not provided in the DEIS - were developed for the TSF, WRFs, and the YP pit backfill. These provided the general concept of inputs and outputs that would affect predicted water quality from each mine waste facility. These in turn fed into a pit lake model and predictive water quality models based on the geochemical model developed and tested against existing conditions.

However, images of and details for model inputs were only provided for Alternative 1.74

* No conceptual model is provided for mining operations.

Assumptions related to infiltration

The model assumes that half the precipitation that infiltrates into the Fiddle and WE WRFs will become toe seepage and half will recharge groundwater - despite both WRFs being located on bedrock with little alluvial material. Similarly, the HF WRF is located on alluvium, and all infiltration is expected to recharge groundwater with none reporting as toe seepage.75 This has potential to affect the water quality entering the RIBs.

* The amount of infiltration reporting to toe seepage versus groundwater should be allowed to vary as part of an uncertainty analysis.

Proposed construction material will leach arsenic and antimony

The mine plan relies on moving spent ore from the SODA facility for use in general construction around the mine site and for building the TSF embankment. However, all spent ore tested in HCTs leached arsenic and antimony.

Arsenic leaching is a potential concern for almost all development rock, owing to widespread elevated concentrations in the rock and leachability indicated by testwork.76

As part of the TSF embankment, it will be placed next to fresh waste rock and leachate will flow into the Hangar Flats pit lake and is essentially an extension of the HF WRF. However, it should not be used in constructing roads or pads. It does not appear that there is any substantial source of construction rock on site that would not leach arsenic.

Similarly, the model for the Fiddle WRF assumes an underlying drain layer made of NAG material with low potential to leach contaminants.77

* The volume and source of construction material required from off-site should be included, as well as the cost of obtaining the material.

Water treatment plant sludge

A water treatment plant is proposed only for Alternative 2 - although it could be added to any of the Alternatives. No detailed conceptual model figures were developed for Alternative 2 - now the preferred alternative - nor were tables of model inputs provided. In Alternative 2, there will be sludge waste from the WTP that will be placed in the TSF or a pit. This will affect pit lake water quality.

* Wastewater sludge has not been included in conceptual models or geochemical models.

Underground mining and YP diversion tunnel

The DEIS rather casually mentions potential underground mining. If underground mining occurs, waste rock will be removed and would need to be added to WRFs or pit lakes as backfill. This represents a big change from the geochemical conceptual models and the project the DEIS is being provided for.

* No conceptual model has been developed for underground mining or tunnel waste rock placement.
* No samples appear to have come from any of the tunnels. No sample testing has been done.

If underground mining is intended, an SEIS will need to be provided, and would need to include updated hydrologic models, geochemical models, and predicted water quality.

A diversion tunnel is proposed to route water around the YP pit during operations.

* The geochemical model does not consider potential leakage from the tunnel, nor does it consider that the tunnel walls or intercepted groundwater may contribute arsenic to the diverted water.

Were conceptual models for post-closure adequate?

* There is no conceptual model for proposed underground mining.
* There are no conceptual models for Alternatives 2, 3, and 4 at all; this is a major flaw in the DEIS. The only conceptual model figure provided is for the TSF in Alternative 1.78 Figures depicting WRF and pit lake conceptual models are available in referenced documents, but do not include models for Alternative 2.79 In Alternative 2, the West End WRF would be removed, West End waste rock would be re-allocated as backfill to the Midnight Pit and Hangar Flats pit, the remaining WRFs at Hangar Flats and Fiddle would be covered, and Meadow Creek would be routed around, not through, the Hangar Flats pit lake.

* No figures of conceptual models are provided for Alternatives 2, 3, 4.
* It is unclear whether models applied geosynthetic covers to WRFs for Alternative 2 modeling and no cover to modeling for Alternatives 1 and 3?
* It is unclear whether the different TSF liner systems were applied in models, and if so, how liner systems impacted drainage water quality.80

* Only one post-closure scenario is considered because "conditions won't change". However, this does not consider the planned transition from active to passive treatment decades after closure.81 Precipitation events that can be handled in active closure may overwhelm passive treatment systems.
* Faults intersect all three pits, but models do not consider the potential for faults to convey pit lake water to downgradient groundwater or surface water. The potential for blasting to impact faults - making them more or less likely to convey water - was not discussed.
* It is assumed that leachate leaking from the TSF liner or from below HF and WE WRFs will enter groundwater and follow groundwater to the pit lake. This does not consider that groundwater could move in other directions along faults or towards seeps.
* All WRF models and the TSF model assumed a 10m zone under the facility in which leachate could interact with groundwater. However, Fiddle WRF is anticipated to be underlain by 45% alluvial material and 55% bedrock, the HF WRF by 95% alluvial material, and WE WRF is almost entirely on bedrock.82. This does not support a common groundwater-leachate mixing zone depth for the TSF, Hangar Flats WRF, Fiddle WRF, and West End WRF.

Were geochemical model assumptions reasonable?

Some assumptions the model is based on are questionable; many of these have been described elsewhere in this comment letter.

* Steady state metal release concentrations from HCTs should not have been the only input; the full range of HCT concentrations should have been used to bound uncertainty and understand potential seasonal variability.

* The model is based on HCT samples that do not fully represent material.
* It is not reasonable to assume that all precipitation post-closure will run off WRFs regardless of whether covers are placed on them.
* It does not seem reasonable to assume that all drainage from the Hangar Flats WRF will enter groundwater, with none reporting as toe seepage.83
* It is unreasonable to assume that fresh rock material is representative of legacy waste rock.84
* HCT data scaling assumed a single temperature of 2.6C instead of applying monthly or seasonally variable temperature.
* Future climate was based on past climate. This will underestimate the extent and frequency of dry and wet periods.
* No waste rock management plan (WRMP). The DEIS relies on several assumptions made with respect to the WRMP, such as no blending of waste rock and the lithological composition of each WRF and the YP backfill.85 The final location of waste rock from different pits is necessary to inform the geochemical model.

Precipitation assumptions

Precipitation was assessed over a 122-year period and rolling averages of 14-consecutive years were determined for the driest and wettest set of years. The "average" years of 2004-2017 were chosen to represent precipitation during operations. However, the rolling average was not much different from the average and did not capture actual high and low years, which explains why SRK saw "little difference" in water quality with these adjustments.86 Nor did it capture how recent years have both more high and more low precipitation years close together - as predicted in general as the climate warms.

* Applying annual precipitation averages for years 2004-2017 directly to mining years provides insufficient results. As applied in the model, 2005 was a low water year, so predicted stream water quality in Mine Year 2 reflects a low water year (Fig. 8). This is inappropriate for understanding environmental impacts. Precipitation should be applied on a monthly or weekly basis and inform predictions for water quality at stream nodes on a monthly basis.

SEE LETTER SUBMISSION: Figure 8. Model of future contaminant concentrations based on past precipitation. (Upper) Annual average precipitation data applied in predictive SWWC model. (Lower) Predicted future arsenic concentrations at HF WRF. Source: SRK 2018c Fig 4-9, Fig 4-17, and others.

Infiltration assumptions

Post-closure assumes that WRFs will be covered and covers will not allow any infiltration, therefore runoff water quality will be represented by rainwater concentrations.

At closure, the DRSFs will be regraded to promote positive drainage and a growth media cover will be established on the facilities. Post-closure, precipitation will continue to either infiltrate the flat upper surfaces of the DRSFs or run off the side slopes; however, any surface runoff from the facilities will only interact with the growth media cover and will not encounter the underlying development rock. As such, post-closure runoff from the facilities can be represented by rainwater chemistry[hellip].87

This is highly dependent on the cover (some combination of geosynthetic liner and/or clay, soil, vegetation), as well as natural events such as

landslides and storms that could affect cover integrity. The area is well-documented as having landslide and avalanche risks (Fig. 9), which could increase after wildfires have moved through the landscape.

Additionally, while there may be an annual water deficit - more evaporation than precipitation - there will be daily and weekly periods of water surplus with potential to infiltrate through vegetation, soil, and a synthetic liner into underlying waste rock or tailings.

* The model should assume some degree of infiltration into waste rock and tailings over weeks or months of wet periods in perpetuity

Were model inputs appropriate?

Inputs relied on average concentrations for analytes in baseline water quality and in predicted wastewater leachate, an average annual temperature to which waste would be exposed, and relied on historical averages for precipitation. A greater range should have been applied to model inputs. These were discussed in the prior section on Assumptions.

SEE LETTER SUBMISSION: Figure 9. Avalanche, rockfall, and other geohazard risks. Source: Midas 2016 PRO Appendix G, Figure 9

Model inputs are only available for Alternative 1

For Alternative 2, there is no table with details of model inputs and source information for each input, nor tables of other details, such as how pit wall lithology above the water table will differ, how HCTs will represent lithologies in backfill in predictive PHREEQC modeling, or other of the kind of details available for Alternative 1.

DEIS Tables 4.9-5 to 4.9-8 show the surface area of each lithology in exposed or submerged pit walls.88 The caption indicates the same surface area would be applied to all Alternatives. However the text states that there would be less pit wall exposed in Alternative 2 due to backfill. This is exactly why new conceptual models and details of geochemistry sources and inputs need to be developed for each alternative, to avoid confusion. The changes associated with pit backfill at Hangar Flats could reverberate all the way to the lower EFSFSR.

The surface area of different lithology types in the Yellow Pine, Hangar Flats, West End, and Midnight area pit walls would remain the same. However, the exposed surface area of the Hangar Flats and Midnight area pit walls would be reduced due to partially backfilling these pits.89

Representation of lithological units

The geochemical model relies on HCT "steady state" leachate as solution inputs to assess future leachate quality for WRFs, pit walls, and possible construction material. However it appears that models were run using only HCTs for 14 waste rock and 3 SODA materials (Phase 1). An additional 8 HCT columns were added to address data gaps in the types of rock materials tested, some of which had no prior testing at all (Phase 2). Phase 2 included new material (HF breccia and gouge, YP QM and granite), additional testing of major waste rock lithologies (HF QM, West End carbonate, YP alaskite) and the only ore sample (YP QMA). Yet the results from these columns do not appear to have been applied. This will need to be rectified. Some of the material leached not only As, Sb, Al, and Mn but also Cu, Cd, and Zn.

Range of water quality inputs

* An average groundwater chemistry is used as a model input. What is the number of samples these are based on? What is the range? Did sampling encompass a range of dry and wet years? A range of groundwater chemistry, particularly if it changes with seasons, should be applied to develop model uncertainty - that is, reasonable model outputs given reasonable range of possible inputs.90
* Secondary salt formation could happen during dry periods, and flush into waters as a slug with the first rain or snowmelt. Early HCT leachate concentrations should be used as model inputs as part of the range of what could

occur throughout a given year.
* The model assumes no load to groundwater of ammonia or nitrate from blasting.
* The model has no empirical data for water in tunnels. There is no understanding of whether water chemistry in former underground workings has evolved over time. This introduces additional uncertainty into model inputs, both for a model of impacts from open pit mining and certainly for a model of impacts if underground mining occurs.

Model calibration, sensitivity testing, and uncertainties

Calibration of model

Failure to calibrate to existing conditions91

A model needs to be checked against real data. SRK developed a geochemical model and ran it to determine whether it accurately predicted measured baseline water quality at stream reaches. The model predicted 75% of constituents as roughly accurate to measured conditions. However, it under-predicted important contaminants in some stream reaches.92

* Arsenic at YP-SR-2, 4 under average flow
* Antimony at YP-SR-2, 4, 6, 8, 10 under average flow
* Mercury at YP-SR-2 under average flow

This is an indication that the model was missing contaminant sources. Predictions at YP-SR-2, in Sugar Creek, may be influenced by conditions outside the EFSFSR valley; Hg may be coming from Sugar Creek upstream sources. However, Sb is apparently mis-calculated throughout the entire valley.

Concentrations of these constituents were underpredicted by up to 48%, 60% and 88%, for sulfate, arsenic antimony, respectively, indicating that constituent loading upgradient of these nodes potentially originates from both specific sources (i.e., streamflow, adit seeps and development rock seeps that are currently accounted for the in the model) in addition to diffuse sources and/or unquantified sources that are not quantified in the calculations and available dataset. It is also possible that the loading from legacy facilities has been underpredicted based on available data.93

Instead of working to understand contaminant sources that were missing in the model, SRK applied baseline (degraded) water quality data as inputs to their model.94 If the sources are not well understood, then the model may not accurately predict changes that will occur from moving existing sources (e.g. moving legacy waste, drying up groundwater by dewatering during operations) and adding new sources (re-processed legacy tailings, fresh tailings, fresh waste rock, new pit faces).

* The existing conditions model should determine if loading from legacy facilities has been under- predicted.

Springs

SRK sampled additional springs to attempt to build a more robust database and see if the model better predicted existing conditions.95 It is not clear if this information was used or if the model performed better.

Calibration to existing conditions should be on a monthly scale

The model of existing conditions should have been calibrated against monthly, weekly, or daily -- not annual -- water quality. It should also be measured before and after freshet events and calibrated to water quality produced in these events.

* The existing conditions model should be calibrated on a weekly or monthly basis to narrow the potential sources causing the model to under-predict Sb.

Inconsistent application of measured or predicted water quality to the SWWC model

Based on tables in the Existing Conditions modeling report, when analytes were poorly predicted under average flow conditions, the measured baseline water quality was applied in the predictive model.

However, when analytes were poorly predicted under minimum or maximum flow conditions, the predicted concentration was applied to the model for the total analyte and the measured baseline applied to the dissolved analyte (Table 3). For example, at YP-SR-10:

SEE LETTER SUBMISSION: Table 3. Example of applying water quality as a model input. Source: SRK 2018 Existing Conditions Appendix B, Table B2

Time steps

One issue with model calibration, and prediction in general, is that SRK only attempted to calibrate to and predict annual average surface water quality. This does not provide sufficient information for potential effects to aquatic life post-closure. Predictions need to be made on a monthly, weekly, or daily basis, particularly given fluxes in the ratio of contributions of surface water and groundwater over seasons. This is a criticism that ERM noted in their review of the model,96 but it has not been rectified. Potential fluctuations and errors may be compounded by the broad time-steps on which predictions for surface water and groundwater flows were made.97 This may require an SEIS.

Sensitivity analysis

Sensitivity analysis is a way to test model inputs to determine which ones have a strong influence on model outputs - in this case, predicted water chemistry - and to estimate potential ranges of concentrations. The factors tested for sensitivity in the geochemistry modeling included (Table 4, 5):

SEE LETTER SUBMISSION: Table 4. Sensitivity testing - reasons for model input selections. Sources: SRK 2018c, SRK 2019b.

These were examined for the existing conditions and predictive water quality models. The reason for changing the applied percent of fines and temperature ranges was not explained.98

SEE LETTER SUBMISSION: Table 5. Sensitivity testing - differences in ranges applied. Sources: SRK 2018c Sections 5.1 and 5.2 and SRK 2019b Table 1

* Sensitivity analysis for post-closure notable did not include varying the leachate chemistry concentrations. The model simply assumed the steady-state HCT chemistry was sufficient, and did not consider the variability in HCT chemistry over time.
* Although it was clear that the site-wide water chemistry model was shifting to represent Alternative 2, the sensitivity analysis in 2019 applied sensitivities to Alternative 1.99

Some important findings in the sensitivity analyses that were done include finding an approximate linear response in constituent release with temperature, that more fine-grained material did release more constituents, and changing the NPR cut-off doubles the volume of PAG waste rock.100

* Temperature changes resulted in a minor (20% or less) change in predicted leach chemistry for existing conditions. However, it resulted in "substantial" (more than double) increases in As, Sb, and/or Hg post-closure in groundwater under WRFs, in pit lakes, and at some surface water sites. The response, however, should be different for low sulfide and high sulfide material. Warmer temperatures allow bacterial activity to increase, and the increase is likely to be greater than linear; similarly it should decline at a rate that is greater than linear as winter sets in.
* Changing the percent of fines resulted in only a variation of 5% in surface waters for existing conditions, but doubled the concentrations of As, Hg, and sulfate in leachate in post-closure predictions with some reduction in Fe and Mn due to solute precipitation; less of a response was observed in surface water.
* The primary impacts of increasing fines or the NPR cut-off in post-closure are at Fiddle Creek, where As and Hg increase substantially and exceed WQC.101

Other factors could have been varied to determine whether the model was sensitive to them, and for potential application in an uncertainty analysis.

* For existing conditions:

* Increasing or decreasing bedrock and alluvial groundwater volumes pumped during dewatering.

* For post-closure:

* Increasing or decreasing infiltration through the WRF and TSF covers and liners.
* Varying the flow of infiltration water from WRFs into pit lakes.
* Varying cover thickness or permeability (which affects infiltration into WRF and TSF).
* Varying the ratio of groundwater and surface water contributing to pit lakes (including wider variation in precipitation than observed historically)
* Changing the salinity of the pit lakes to determine frequency of mixing and resulting water quality. Changing pit lake salinity at snowmelt (influx of fresh water layer).
* Allowing pit wall runoff water quality to evolve over time (e.g. from oxidation, slumping that exposes fresh highwall material).
* Placing different volumes and pit sources of backfill in HF, YP, and Midnight pits.

This would determine whether the model designed to predict future water quality is sensitive to these types of factors. The next step would be an uncertainty analysis, applying ranges to parameters, especially - but not solely - to ones to which the model is sensitive.

Uncertainty

Determining how the model reacts to changing model inputs is sensitivity analysis. Uncertainty analysis attempts to capture the range of conditions that could be experienced when there is a degree of uncertainty in model inputs. For example, sensitivity analysis showed the model is sensitive to the amount of fine-grained material in mine waste; an uncertainty analysis would apply a range of 10% to 50% fines (from the literature) to determine the range of water quality resulting from such variation. Some work was done to predict water quality under minimum, average, and maximum flow conditions, which provides some range to predictions, but this had its own limitations. Further work could have been done.

Multiple uncertainties are inherent in determining WRF leachate

An important assumption is made about how much waste rock material is available to undergo weathering reactions. There are a series of other assumptions that feed into this. While none of the assumptions is necessarily incorrect, it demonstrates why an improved uncertainty analysis is needed.

* The amount of each lithological type in each WRF is assumed. Although detailed tables of the volume and proportion that each lithological type in each WRF were provided, there are uncertainties.

* These details of proportions of lithological units for each WRF and how HCT results were proportioned out for leachate calculations were only provided for Alternative 1.102
* No waste rock management plan has been proposed; calculations went forward on a set of assumptions about waste rock management.103 This introduces considerable uncertainty.

* The calculations determining the leachate water quality at WRFs are based on the "steady-state" concentrations of each analyte for each HCT column representing a lithological unit, mixed in ratios representing the proportion each lithological unit in the WRF. Again, the full range of analyte concentrations produced in HCT leachate should be used to bound uncertainty; first flush concentrations won't be represented in an average or steady-state value, but will be concentrations that enter the pit lake or other waters periodically.
* The mass of material that will react is uncertain - both 4% and 8% were used in developing models. These differences are based on different assumptions of the percent of fine-grained material in a WRF, but could be based on other factors.

* An assumption in the predictive chemistry model is that 20% of the WRF mass would consist of fine-grained material. Fines have greater surface area per unit volume than large cobble and boulders on which weathering reactions can occur. More fines drive worse leachate water quality. Based on the literature, fines make up 10%-50% of WRFs. The existing conditions geochemistry model assumed 40% of the mass was fines, based on their own data from drilling 42 holes in the SODA facility.104
* An assumption in the existing conditions and predictive geochemistry models that 20% of the WRF mass would be in contact with meteoric water (rain and snowmelt). Masses of heterogenous rock material develop preferential pathways along which water flows - water does not generally infiltrate evenly throughout a mass. The 20% is based on a single document.105 More information, and more recent information, on meteoric water infiltration should be available.
* Together, these feed into an assumption of the reactive mass. In the predictive geochemistry model, the total reactive mass in the WRF is assumed to be 20% x 20% = 4% of the mass.106 However, in the geochemical model developed for existing conditions, they assumed 8% of the mass of legacy material available for weathering as 40% fines x 20% of area contacted by water.107

* Even if the mass reacting is accurately applied to a model, it would be difficult to assess what material within a WRF or TSF was reacting, which will depend on air flow in addition to water flow and mineralogy.
* The model appears to assume that no large material undergoes weathering. This defies logic.

Additional areas for uncertainty analysis

* The full range of HCT analyte concentrations should be applied to bound the range of uncertainty in chemical weathering, instead of only applying the steady-state end-of-testing concentrations.
* Apply different ratios of WRF leachate entering groundwater and exiting as toe seepage.
* Apply actual measured mine-impacted groundwater in the model rather than baseline groundwater water quality.108
* Apply different ratios of groundwater and surface water.

* Different ratios of surface water and groundwater entering the pit lakes should be applied as an uncertainty analysis. It is apparent that seeps and springs in the Hangar Flats area are not well-characterized and could change the ratio of groundwater and surface water entering pit lakes.
* As noted previously, minimum and maximum precipitation years have not been well captured, particularly facing a warming climate.

* Apply pit wall slumping to look at ranges of uncertainty in pit lake water quality and mixing.
* Apply longer stretches between wet and dry periods. As climate changes, a range of conditions could occur in spring, from very little snowmelt to greater depths of snow than usual, with potentially a very rapid rain and snowmelt period or prolonged snowmelt. Using existing data does also not consider future impacts of climate change.109
* A wider range of precipitation needs to be considered in bounding uncertainty (Fig. 10).
* There is uncertainty associated with future wildfires, and their effect on soil (soil chemistry, ability to hold moisture, slumping and landslides) and water quality (increase in mercury from air deposition and ash, turbidity, increased dissolved organic carbon concentrations in streams, which can change the bioavailability of certain metals, etc.). Wildfires may increase in frequency and intensity and this type of hazard is one reason why uncertainty analyses are necessary, to acknowledge that water quality is not going to neatly follow models, particularly when looking out 100 years or more and that in fact a wide range of natural changes may add or subtract from a wide range of reasonable model outcomes.

SEE LETTER SUBMISSION: Figure 10. Determination of average precipitation and precipitation sensitivity limits. (Left) The average precipitation as a 14-year moving average. Green line (far right of graph] is the most recent 14-year average precipitation. Blue and orange lines are the 14-year averages of low and high precipitation, respectively. Note that they do not capture actual high or low precipitation evens, or what appears to be more extremes more frequently in recent years. (Right) Average annual precipitation applied to predictive water quality model based on historic precipitation. Source: SRK 2018a Fig. 4-8 and 4-9

Additional issues

Available Alternatives

From the perspective of mine waste, Alternatives should be assessed by how they reduce the footprint and impact of waste materials.

* Alternative 3 should be dismissed. It would place tailings in two valleys instead of one, creating additional un-necessary issues.
* An Alternative that removes the Fiddle WRF should be added. Fiddle is the only WRF that does not drain into a pit lake (if Alternative 3 is dismissed). It would drain directly into a creek, which is an un-necessary risk to natural waters and to a valley that currently has no mining impacts. Instead, waste rock that would go into Fiddle - nearly all YP pit rock - should be used for the TSF embankment and/or stockpiled around the YP pit for backfill into pits at the end of mining or added to other WRFs.
* All Alternatives should include covers on WRFs and a water treatment plant.
* The No Action alternative should consider that, if no mining occurs, it is reasonable and foreseeable that cleanup of legacy mining will continue. While the No Action alternative would result initially in water quality that continues to be degraded in the short term from legacy material, in the long term it is reasonable to expect water quality will improve greatly over both current conditions and conditions predicted post-closure if the Stibnite Gold Project goes forward.

Water treatment lacks detail and pilot testing

Final predicted water quality as presented in Brown & Caldwell (2020) assumes water treatment. However the DEIS and supporting documents have little to say about treatment, particularly about the passive treatment system. The DEIS provides a general concept for active water treatment - relying primarily on arsenic co-precipitation with iron - and provides volumes of chemicals. No schematic for a treatment plant is provided, nor has there been any pilot plant testing.

The passive treatment system has very little information, other than it could be a combination of a "biochemical reactor" and an "aerobic vertical flow wetland" - both very vague terms -- and may need to treat about 400 gpm of contaminated water, possibly in perpetuity.110 This is a much higher flow than most passive systems are able to manage. The specific processes they intend to rely on need to be much more fleshed out and pilot testing conducted.

Financial feasibility of re-processing legacy tailings

In Alternative 3, legacy tailings in Meadow Creek would not be re-processed and spent ore that covers the tailings would not be moved. This suggests there is no financial incentive to process old tailings, making this a likely corner to be cut if possible once in operation - made more likely by the willingness of the DEIS to place it as an Alternative.

* Because of a lack of conceptual models and model input tables for each Alternative, we do not know the degree of influence of leaving legacy tailings (and presumably some waste rock, which leaches too much As and Sb to be used in construction other than in the TSF embankment) in place, with no liner.

The need for a Geochemistry appendix

There is no Geochemistry appendix, and Geochemistry sections for Alternatives 2 and 3 within the Water Quality section of DEIS Chapter 4 "Environmental Consequences" provided only the results, not the conceptual model or tables of model inputs. These are needed to explain and clarify specific model inputs for each of the geochemistry models underlying predicted surface and groundwater water quality for each Alternative.

Clarify model inputs for Alternatives

* Conceptual models for Alternatives 2 and 3 will be different than for Alternative 1 and need to be presented.
* Although there are documents that explain the inputs for the model for Alternative 1, it is not evident from the referenced documents what inputs are relied on for predictions in the other Alternatives.
* Models in one document applied a reactive mass of 4% in WRFs and another document applied a reactive mass of 8%. This turns on whether the mass is assumed to have 20% or 40% fine-grained material in the waste rock mass. 111 The 40% is based on their own empirical information from their own drilling.112 However, in the Sensitivity Analysis (SRK 2019b) 20% fines is assumed. There is no explanation for the change.

Presentation of geochemistry results

Geochemistry sections are available in the DEIS in Chapter 3, Affected Environment and Chapter 4, Environmental Consequences as part of the Water Quality sections but do not provide a level of information sufficient to understand what was done to characterize the present environment.

* Chapter 3 provides virtually no information on testing, other than a total number of samples and very broadly what was sampled.
* In Chapter 4, the lithological units of mine waste are adequately described for Alternative 1 and is useful. An overview of acid generating potential and contaminant leaching is provided.

* However, there is no list of the tests performed or the number of samples from each source that went through each test. This is material that is difficult to extract from the original (cited) documents, and should have been summarized in a Geochemistry appendix.
* The Geochemistry sections for Alternative 2 and 3 provided no information on geochemistry or environmental consequences but only re-iterated waste material location changes relative to Alternative 1. This is insufficient.

* The DEIS references the SRK 2018 Phase 2 HCT update report in Section 3.9 (Existing Conditions) but there is a more recent Phase 2 HCT update report (SRK 2020) referenced in Section 4.9.
* The DEIS does not provide a table of tailings production by year, only a figure.
* Raw data for HCTs, ABA and MWMP tests, and mineralogy could be available as tables in a Geochemistry appendix.
* Most importantly, there is no clear section or table on how geochemical models were set up - what the inputs were - for each alternative. This is particularly important because the preferred alternative changed from Alternative 1 - on which geochemical model information is available - to Alternative 2. The outlines of the model should be provided in the main body of the DEIS, with greater detail in an Appendix.

Documentation of references

It is good that many of the source documents that inform the DEIS are available electronically. However the presentation and referencing of the source material that the DEIS relied on for geochemistry and water quality predictions is poor relative to what is provided for other mining project DEIS's.

* The DEIS sows confusion on which documents were relied on. The most recent document on water quality, is referenced as Brown & Caldwell 2019a in DEIS Chapter 4.8 and Brown & Caldwell 2019b in Chapter 4.9. In Chapter 4.9, the Brown & Caldwell 2019a cited a different document on streamflow and temperature, with a single mention related to geochemistry and water quality. It would be infinitely less confusing to create a single References chapter that provided all citations alphabetically without breaking them up by chapter.
* Appendix C of the Brown & Caldwell 2019 report provides predicted water quality, apparently relying on geochemical model outputs for the "Modified PRO" (Alternative 2). Alternative 2 has significant differences in geochemical contaminant sources from Alternative 1. The geochemical model inputs for Alternative 1 were described in several documents. No document I found described the model inputs for Alternative 2. Nor did the DEIS make it clear that the predicted water quality was based on the Brown & Caldwell document, rather than the SRK documents that are the source of geochemistry information.
* Documents do not have unique reference identifiers. Because they are based on chapters, the same document might be listed as 2018a in one chapter and 2018b in another. Or a reference like 2018b might refer to one document in one chapter and a different document in a different chapter. This makes it difficult to find the correct source document, particularly given the way documents are provided on the USFS Stibnite EIS site.
* Most documents do not have sections "bookmarked", making it very slow going to find sections of interest, particularly when there are hundreds of pages of figures or laboratory results from various labs doing different kinds of testing. It is standard practice to bookmark sections in pdfs.
* There is no obvious way to find documents on the USFS Stibnite EIS site (https://www.fs.usda.gov/project/?project=50516 or https://stibnite.consultation.ai/). It was through the efforts of NGOs that compiled links to source documents that I was able to access them. Otherwise this would have taken considerable time.

The fs.usda.gov/project site brings you to this screen.

SEE LETTER SUBMISSION: PALS Public Facing Webpage Screen Capture

The link "Stibnite Gold Project DEIS references" simply goes to a pdf with a different link in it, which leads you to this page.

SEE LETER SUBMISSION: Screen Capture of two Forest Service Websites.

It is apparent there are 333 files in the three "Public 2020" folders - which do not appear to be organized in any particular fashion. Clicking on the Project References sends you to a site with a single folder. Entering the folder provides 53 pages of pdfs in what appears to be no particular order: not organized alphabetically, by date, by

DEIS chapter, or by topic.

This is frankly a difficult document management system for interacting with the public, and this alone should be a reason to extend the comment period. I would strongly encourage setting up an online document system that is set up in a functional manner, such as by DEIS chapter, and incorporates a searchable function.

Discussion

The current mine plans - under any Alternative - would not return the currently degraded water to the natural background levels which can be found, for example, in Meadow Creek upstream of the legacy waste rock and tailings area. Instead, roughly similar poor water quality as exists now would be left behind, with some possible improvement in arsenic concentrations but a possible worsening of mercury for decades after the mine closes.

However, even this limpid approach to "improving" water quality is frustrated by data gaps and lack of clarity significant enough that no Alternative should be advanced until a Supplemental EIS (SEIS) is produced that addresses the numerous concerns in geochemistry and hydrology.

The use of averages throughout modeling, for geochemistry and hydrology, unrealistically constrain understanding the potential water quality that could develop. More realistic boundary conditions need to be set up, recognizing greater variation in precipitation, waste material leachate analyte concentrations, temperatures, and infiltration rates.

Although geochemistry tests have been conducted, there is no document that clearly lays out conceptual models for each alternative, and how changes in Alternatives (e.g. in liners, covers, backfill) result in differences in water quality during operations and at each type of material at closure (WRF toe seepage, groundwater, pit lakes, surface water nodes). Critically, the bulk of effort was afforded to defining the model of Alternative 1, and a similar clear set of modeling inputs was not provided for Alternative 2, which is now the preferred Alternative.

Critically, no models included underground mining, which could substantially change conceptual models and water quality.

An Environmental Impact Statement also should focus on limiting the mine waste footprint - for example by eliminating the Fiddle WRF in a currently uncontaminated valley. From this perspective, it is difficult to see why Alternative 3 was included. The DEIS should also have included basic mitigation such as covers on waste rock facilities and an active WTP in all alternatives; to limit these to a single alternative is nonsense. An EIS should also consider that the No Action alternative would not necessarily leave the area in a degraded state, but make it available for continued cleanup actions.

The lack of clear models for all Alternatives, the lack of sufficient discussion or modeling with respect to underground mining, the limits of the uncertainty analysis conducted, the lack of a Geochemistry appendix to clarify model inputs, and the limited options of Alternatives need to be re-dressed in an SEIS.

References

SUBMITED REFERENCE: Brodie Consulting, Ltd. 2003. A review of tailings relocation projects and methodology. Prepared for Department of Indian Affairs and Northern Development, Type II mines. 24p.

SUBMITTED REFERENCE: Brown & Caldwell. 2019. Stibnite Gold Project DEIS Modified Proposed Action. Technical memo, 140p. Brown & Caldwell. 2020. Stibnite Gold Project Water Quality Management Plan. 162p.

REFERENCE CITED BUT NOT SUBMITTED: HDR. 2016. Stibnite Gold Project: Groundwater Quality Baseline Study. December 2016. 1,665p. HDR. 2017. Surface Water Quality Baseline Study. December 2016, revised May 2017. 1,335p. Hodges, R. 2020. "Midas Gold takes no responsibility for pollution." The Star-News. Op-Ed. Sept 24.

SUBMITTED REFERENCE: ERM. 2019. Review of surface water and groundwater modeling for the Midas Gold Existing Conditions and Proposed Action. 20p.

SUBMITTED REFERENCE: Kwong, YTJ, A Kapoor, and J-F Fiset. 2002. Assessment of chemical stability of impounded tailings at Mount Nansen, Yukon Territory. CANMET Mining and Mineral Sciences Laboratory study for the Water Resources Division, Indian and Northern Affairs, Canada, Whitehorse. Project 602345, Report MMSL 02-011CR. 59p.

REFERENCE CITED BUT NOT SUBMITTED: M3.2019. Stibnite Gold Project Prefeasibility Study Technical Report. 642p.

SUIBMITTED REFERENCE: Maest, A and DK Nordstrom. 2017. A geochemical examination of humidity cell tests. App. Geochem. 81: 109-131.

REFERENCE CITED BUT NOT SUBMITTED: MEND. 1995. Hydrogeology of Waste Rock Dumps, MEND Associate Project PA-1, July 1995. In SRK 2018c SGP Existing Conditions SWWC Midas Gold Inc. 2016. Plan of Restoration and Operations.

SUBMITTED REFERENCE: Newman, CP. 2018. Guidance for geochemical modeling at mine sites. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation.

SUBMITTED REFERENCE: Prucha, B. 2020. Review of hydrologic impacts of the proposed Stibnite Gold Project, Draft Environmental Impact Statement (DEIS), August 2020.

REFERENCE CITED BUT NOT SUBMITTED: SRK. 2017a. Stibnite Gold Project Baseline Geochemical Characterization Report. Stibnite Project Midas Gold, Inc. May 2017. 1,890p.

REFERENCE CITED BUT NOT SUBMITTED: SRK. 2018a. Stibnite Gold Project Proposed Action Site-Wide Water Chemistry modeling report. Prepared for Midas Gold Idaho, Inc. December 2018. 900p.

REFERENCE CITED BUT NOT SUBMITTED: SRK. 2019a. Stibnite Gold Project Phase 2 Geochemical Characterization update report, 321p.

REFERENCE CITED BUT NOT SUBMITTED: SRK. 2019b. Stibnite Gold Project Proposed Action Site Wide Water Chemistry (SWWC) Sensitivity Analysis Report, 218p.

SUBMITTED REFERENCE: Hodges. 2000. Star News Opinion Page: Reset summit on L. Cascade algae blooms.

1 We assume the inputs for Alternative 4 would be the same as for Alternative 1, with the exception that Alternative 4 intends to use a TSF liner that complies with Idaho state regulations and Alternative 1 does not. The change in liner will presumably change leachate inputs to groundwater.

2 SRK2018a

3 DEIS Section 4.7.2.5

4 Newman 2018 Section 3

5 DEIS Section 3.2.1.3.2 and Section 3.8.1.1.2.2

6 DEIS Section 4.8.8.2

7 DEIS Section 3.2.3.8.4

8 DEIS Section 3.2.3

9 SRK 2017a Section 3.1.5.1

10 DEIS Section 3.7.3, HDR 2017

11 Hodges, Op-Ed in Star News, Sept 24 2020

12 HDR 2017 Table 2-1

13 DEIS Sections 2.3.5 and 3.7.3

14 DEIS Section 2.3.5.6

15 HDR 2017; Brown & Caldwell 2020

16 HDR 2017 Section 4.1.2

17 DEIS Section 3.9.3.1 and HDR 2017 Section 4.1.2

18 HDR 2017 Section 4.2.1

19 HDR 2017 Section 4.2.1 MWH-A02 and MWH-B02

20 HDR 2017 Section 4.2.1 MWH-A04 and MWH-B04

21 SRK 2017a Table 7-5

22 SRK 2017a Section 3.5.1

23 DEIS Table 2.2-1, p2-6

24 SRK 2017a Table 3-26

25 SRK 2017a Table 3-6

26 SRK 2017a Appendix A4

27 No MWMP test was done on Bradley waste rock

28 SRK 2017a Appendix A1, WetLab MWMP results

29 SRK 2017a Section 3.1.5.1

30 SRK 2017a Appendix A1, WetLab MWMP results for sample HF-1. The reporting limit for Hg of 100 ng/L was too high to determine if Hg was leached in high concentrations.

31 SRK 2017a Table 3-10

32 SRK 2017a Appendix A1, WetLab results

33 HDR 2017 Surface water YP-M3, YP-T8A, YP-T7, YP-T37, YP-T6, YP-T1, YP-T44, YP-SR13, YP-T21, YP-SR11, YP-SR10, YP-T35, YP-SR8, YP-T42, YP-T10, YP-SR2 and seeps YP-S8, YP-S7, YP-S6, YP-S10, YP-S5, YP-T23A, YP-S2, YP-AS7, YP-AS1, YP-HP-S1, YP-S1, YP-S3, YP-T17, YP-S9, YP-AS3

34 HDR 2016 Section 4.1.2

35 SRK 2017a Table 3-1. Consolidation water is pore water that is pushed to the surface as tailings settle and pore water collected in TSF drains on top of the liner and pumped back into the TSF to a supernatant pond

36 M3 2019 p 18-20, DEIS Section 2.4.6.6., DEIS Figure 4.9-7, DEIS Table 4.9-9

37 SRK 2018a Section 4.10.2

49 SRK 2017a Table 3-2

50 Information in this section is from SRK 2017a Sections 3.3 to 3.5

51 DEIS Fig. 4.9-7

52 Kwong et al. 2002

53 Brodie 2003

54 SRK 2017a Table 3-2

55 SRK 2017a Section 3.3.2

56 SRK 2019b Section 3.3

57 SRK 2017a Section 4.2.3.2

58 SRK 2017a Appendix A1

59 SRK 2017a Section 3.1.5.1; however, in the Executive Summary they state there has been minimal development of secondary salts

60 SRK 2017a Executive Summary

61 SRK 2018a Tables 7-2 to 7-4

62 SRK 2017a Table 3-6

63 SRK 2017a Section 3.1.5.4

64 SRK 2017b: Based on the results of static testing and following finalization of the process flowsheet expected at the end of 2017, the sample(s) representative of the final tailings product will undergo kinetic testing to determine long-term information about tailings weathering and metal leaching from tailings. Kinetic testing will consist of humidity cell testing to represent mill tailings material that will be unsaturated during the post-closure period.

Saturated column tests will also be considered to represent tailings material that will be submerged within the TSF.

65 SRK 2017a Section 3.2.1

66 SRK 2017a Section 3.2.2

67 SRK 2019a Table 5-1

68 SRK 2019a Fig. 5-1

69 SRK 2017b Section 4.3.1 "Termination of the HCT testing will be assessed when the release rates of key constituents such as pH, sulfate, acidity, alkalinity and iron as well as dissolved metals and metalloids become relatively constant with time"; also SRK 2018b Section 3.3 "It is common practice to terminate cells when the release rates for these leachate parameters become relatively constant with time and there is no substantial change in the calculated release rate (INAP, 2014). A quantitative method was recently used to define stable conditions in the Phase 2 HCT assessment. As such, this quantitative method was not applied to the Phase 1 HCT program[hellip]., the ASTM methodology and Global Acid Rock Drainage (GARD) Guide (INAP, 2014) do not require that a quantitative method is used to support HCT termination."

70 HCT 14 did not develop acid conditions, but was chosen to represent "PAG" due to its high sulfide content.

71 SRK 2017a Table 3-14

72 Three samples from SODA spent ore were run in HCTs, but leached ore is not necessarily the same as waste rock.

73 SRK 2017a Appendix A3, SVL labs MWMP leachate results

74 SRK 2017c; SRK 2018a

75 SRK 2018a Section 4.1

76 SRK 2018a Section 3.1

77 SRK 2018a Section 4.1

78 DEIS Fig. 4.9-7

79 SRK 2018a Fig. 4-1 to 4-3 (Fiddle, Hangar Flats, West End WRFs] and Fig. 7-1 to 7-3 (Hangar Flats, West End, and Midnight pit lakes]

80 Different liner systems for Alternatives are provided in DEIS Table 2.2-1, p2-6. They may or may not include different liner thicknesses, clay, or meeting Idaho regulations for facilities utilizing cyanide.

81 SRK 2018a Section 4.1

82 SRK 2018a Table 4-7

83 SRK 2018a Section 4.10.2

84 SRK 2018c Section 4.1

96 ERM 2019

97 Prucha 2020

98 See SRK 2018c Section 5.1 and 5.2 and SRK 2019b Table 1

88 DEIS Section 4.9.2.1.1.2

89 DEIS Section 4.9.2.2.1

90 SRK 2018a Table 4-8

91 SRK 2018c

92 SRK 2018c Tables 6-1 to 6-6 and Figures 6-10 to 6-15. Additional analytes such as Cu and Mn were also poorly predicted, but existing condition and predicted concentrations were quite low, and it can be difficult to replicate concentrations near detection limits.

93 SRK 2018c Section 5

94 SRK 2018c Section 5 and Figures

99 SRK 2019b Executive Summary

100 SRK 2019b Table 4 and Table 5. When tons of PAG and non-PAG rock are summed, Table 4 indicates PAG will increase from 6% to 11% of waste rock; Table 5 indicates PAG waste rock will increase from 5% to 10% at Hangar Flats WRF and from 10% to 22% at Fiddle WRF.

101 SRK 2019b

102 SRK 2018a Tables 4-2 to 4-4 and Table 7-14

103 DEIS Section 4.9.2.1.1.1

104 SRK 2018c Section 4.2 Drilling in SODA determined 41%-53% of material was fines, but that some fines had been produced by the drilling action itself.

105 The 20% infiltration is based on MEND 1995

106 SRK 2018c Section 4.6 and 7.2.5; SRK 2017c Table 3-1 and Section 3.2

107 SRK 2018c Section 4.2, Section 4.3.2, Section 5.2

108 SRK 2017c Table 5-1

109 Prucha 2020

110 DEIS Section 2.4.6.6

111 Calculated as 40% of the material is fine grained and 20% of the material is contacted by meteoric water, 40% x 20% = 8%. If the fine-grained material is reduced to 20%, then possibly the reactive area is reduced to 20% x 20%= 4%.

112 Drilling in SODA determined 41%-53% of material was fines, but that some fines had been produced by the drilling action itself. SRK 2018c Section 4.2

38 SRK 2017a Fig. 3-1 to 3-3

39 SRK 2017a Fig. 3-2 and 3-3

40 SRK 2017b

41 SRK 2017a Section 3.1.5.1

42 SRK 2017a Section 4.5.1

43 SRK 2019b Table 5

44 SRK 2018a Table 4-5

45 SRK 2017a Table 3-2

46 SRK 2018b Sections 4.1.4 and 4.1.5

47 SRK 2017a Section 3.1.5.1

48 SRK 2017a Table 3-6

38 SRK 2017a Fig. 3-1 to 3-3

39 SRK 2017a Fig. 3-2 and 3-3

40 SRK 2017b

41 SRK 2017a Section 3.1.5.1

42 SRK 2017a Section 4.5.1

43 SRK 2019b Table 5

44 SRK 2018a Table 4-5

45 SRK 2017a Table 3-2

46 SRK 2018b Sections 4.1.4 and 4.1.5

47 SRK 2017a Section 3.1.5.1

48 SRK 2017a Table 3-6