Shore Gold Inc.

TECHNICAL MEMO

TO: **Mai-Linh Hunyh, Canadian Environmental Assessment Agency**
Ann Riemer, Saskatchewan Ministry of Environment

FROM: **Ethan Richardson, Shore Gold Inc.**

DATE: April 29, 2013

SUBJECT: Updated Water Quality Modeling- Star-Orion South Diamond Project

Introduction

AMEC Environment and Infrastructure (AMEC) has updated the water quality modeling for the Star-Orion South Project based on revisions to the water management system as described in a technical memo dated March 28, 2013 from Shore Gold Inc. (Shore) as part of the information package in response to comments on the Revised EIS. The attached report contains details of these updates, however the methods used and the mechanics in the model have not changed since the Revised Environment Impact Statement, and as such, the attached report updates Appendix 6.2.7-A of the revised EIS

End of Pipe Water Quality

Federally, Shore understands that the key parameter within the Mannville water is chloride. In 2012, Shore proposed to discharge only Mannville water (non-contact water with mine workings) directly from the dewatering wells. The attached report contains results of the updated model, as well as modeling conducted in 2012 predicting end of pipe water quality if all groundwater (surficial aquifers and Mannville aquifer water) and runoff from the Star pit above the ore were discharged through the diffuser for comparison. These results are compared to the chemistry of the pure Mannville water in Table 1 below. Note that modeling used the maximum chloride number measured (1,700 mg/l) during the 2010 pump test for the Mannville water instead of the average (1,620 mg/l) as an input. Note also that the mean chloride in the 2013 model is a 34% reduction as compared to the Mannville water.

Table 1. Summary of Modeled Chloride Content at End of Pipe

	Mannville Water	2013 Revised Discharge		Alternate 2012 Discharge	
	Maximum	Mean	Maximum	Mean	Maximum
Chloride (mg/l)	1,700	1,120	1,176	1,212	1,623

Closure

Please do not hesitate to contact me with any questions or comments about the attached information.

Sincerely,

Ethan Richardson
Environment Manager, Shore Gold Inc.

Memo

To:	Ethan Richardson	**File No:**	SX0373306
Company:	Shore Gold	**Date:**	24 April 2013
From:	Sergei Touchinski Gary Beckstead	**cc:**	Mark Humbert
Phone:	(403) 387-1789		
Email:	Sergei.touchinski@amec.com		
Subject:	Water Balance and Water Chemistry Results for Revised Water Management Scenario		

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC) has prepared the following interim deliverable to present a summary of the results derived from a revised water management scenario for the Star-Orion South Diamond Project.

1.0 REVISED WATER BALANCE

1.1 Background

The previously developed water balance was revised to reflect changes requested by Shore Gold Inc. (Shore Gold) on 06 February 2013. The essential changes summarized by Shore Gold are:

1. *Intake in the Saskatchewan River to provide process water to supply between 0% and 100%of requirements depending on recycling from the PKCF;*
2. *Overflow (decant) water from the Processed Kimberlite Containment Facility (PKCF) blended with Mannville water (either in the PKCF or in a mixing structure of some sort) and all site runoff, etc.; and*
3. *Blended effluent discharged to the river.*

Based on subsequent discussions, the water management scenario was fleshed out and the decision was made to assess water chemistry results for the "100% process water from the river" scenario only and an in-line structure was selected to co-manage effluents.

The updated water balance schematic is attached as **Figure 1.1** and the changes are discussed below.

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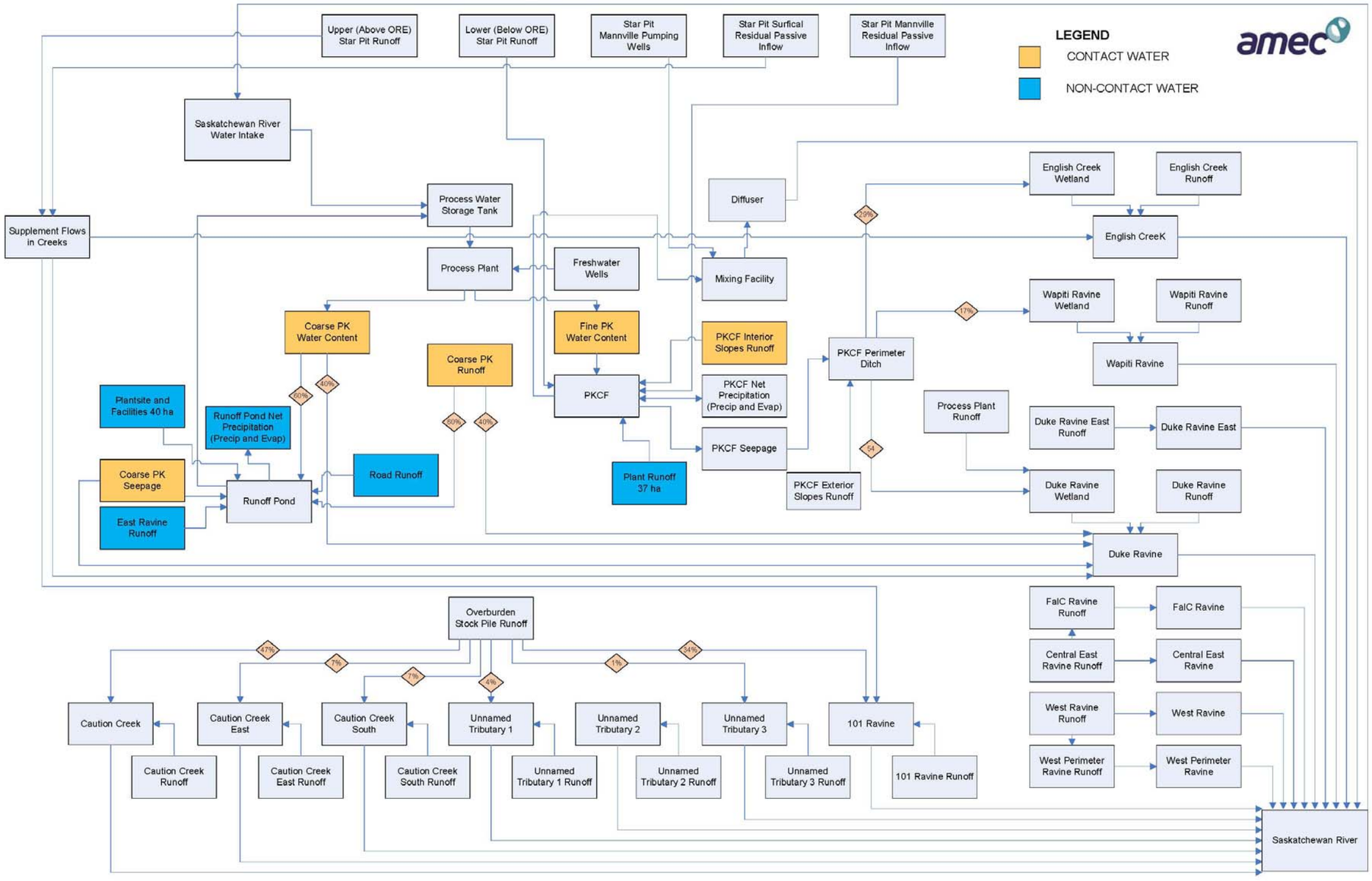
Figure 1.1 Star Pit Operation Water Balance Flow Chart



1.2 Primary Changes to the Water Balance

1.2.1 Water Supply from Saskatchewan River

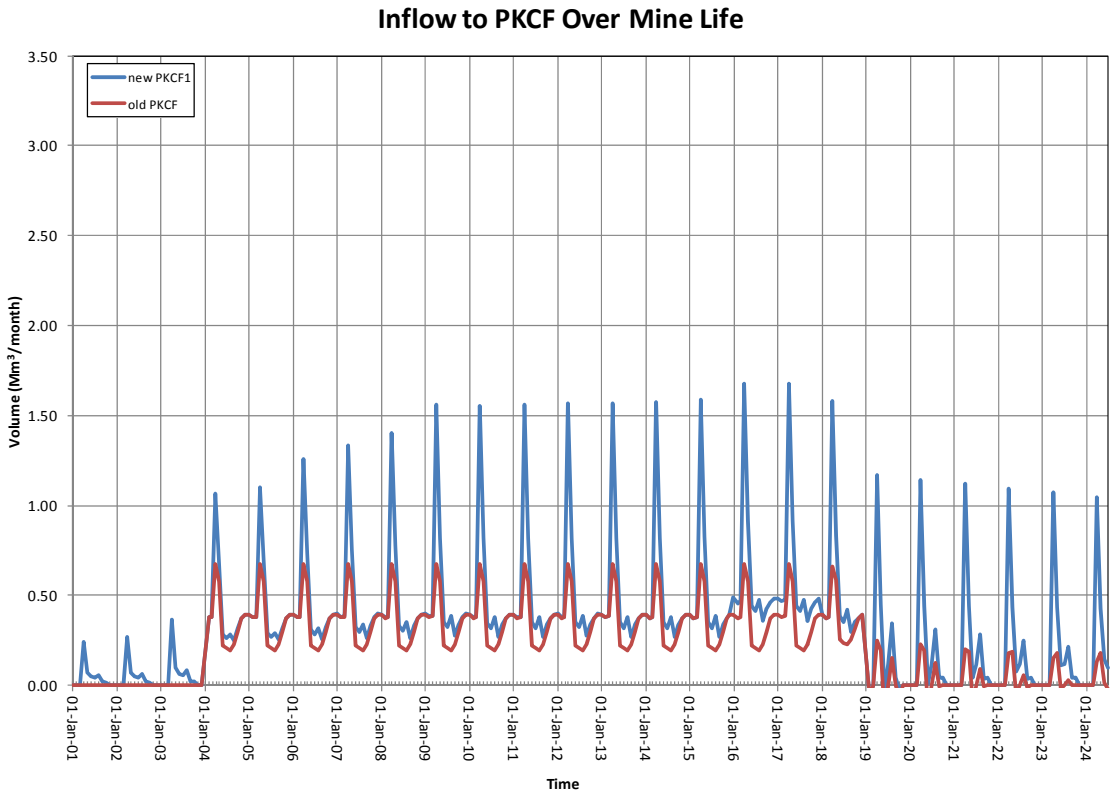
Process water demand will be met by pumping water from the runoff pond and any additional required water will be pumped from the Saskatchewan River. In order to pump water from the Saskatchewan River, a water license will need to be obtained.

Formerly, water from the Star Pit Manville pumping wells was incorporated in the process water. In the current case, Mannville water will be pumped straight to a blending facility to be co-managed with PKCF decant water and released to the Saskatchewan River.

1.2.2 PKCF Seepage Management

Water collected in the PKCF perimeter ditch from seepage and exterior slope runoff will be released into the English Creek, Wapiti Ravine and Duke Ravine wetlands, based on the relative lengths of the perimeter ditch in each catchment (as was apportioned in the previous water balance model) or pumped back to the PKCF if it is determined that the wetlands do not have the capacity to achieve applicable water quality. For modeling, all seepage was considered appropriate for wetland treatment. Approximately 29% will flow to English Creek wetland, 17% will flow to Wapiti Ravine wetland and 54% will flow to Duke Ravine wetland. **Figure 1.2** illustrates the changes to inflow volumes to the PKCF for the “new” water management scenario and the “old” scenario.

Figure 1.2 Inflows to PKCF for New and Old Water Management Scenarios



Despite the apparent increase in flow to the PKCF (see **Section 1.2.3**), there is no accumulation of water in the PKCF over time. The water decant from the PKCF to the mixing facility is sufficient to keep the water in the PKCF in an approximate balance. Note also that leap years have been removed from this plot; (i.e., all years have 365.25-days).

1.2.3 Plant Site Runoff

Runoff from 37 ha of the plant will be pumped to PKCF, representing a new inflow to the PKCF, compared to the former water management plan. Formerly all runoff (from 77 ha) went to the runoff pond; now runoff from only 40 ha will go to the runoff pond.

2.0 WATER QUANTITY AND QUALITY FINDINGS

2.1 Discharge to the Saskatchewan River

2.1.1 Volume

The following points summarize changes to flow discharges to the Saskatchewan River during the life of the Star Pit Mine:

- No discharge in first 3 years. This is unchanged from the previous model.
- In Year 4, discharge to the Saskatchewan River is purely decant water from PKCF (1.61 Mm^3 to 1.78 Mm^3 per month depending on number of days in the month). These volumes are greater than the volumes from the previous water balance model where the discharge volumes ranged between 0.00 Mm^3 and 0.34 Mm^3 in Year 4.
- Year 5 through Year 7, the discharge to the Saskatchewan River is decant water from PKCF and Star Pit Manville Pumping Wells (range from 4.36 Mm^3 to 4.82 Mm^3 per month). These volumes are greater than the volumes from the previous water balance model where the discharge volumes ranged between 2.85 Mm^3 to 3.32 Mm^3 per month in Years 5 through Year 7.

2.1.2 Concentration at End of Pipe

Characteristics of water quality are presented in **Table 2.1** for PKCF decant water discharge and seepage from the facility collected in a perimeter ditch and directed to wetlands; for co-management facility in comparison with pure Manville formation water going to the Saskatchewan River.

Water quality parameters leaving wetlands after seepage is collected and mixed with external PKCF slopes runoff along with resultant concentrations in lower reaches of receiving streams are presented in **Table 2.2**.

TABLE 2.1
Water Quality Parameters Based On the April 2013 Water Balance

Parameter	Units	Saskatchewan River	PKCF Decant Water / Seepage Water				Option 2013 - Manville Formation and PKCF Decant Water Discharge from Mixing Facility				Option 2012 - Manville Formation Water Discharge from Dewatering Wells Only			
		Background	Mean	Median	95th Percentile	Maximum	Mean	Median	95th Percentile	Maximum	Mean	Median	95th Percentile	Maximum
Conventional Parameters														
Specific conductivity	µS/cm	443	842	858	979	995	4232	4216	4412	4419	4618	5430	5808	5916
Total alkalinity	mg/L	159	183	183	189	190	314	313	321	321	337	360	379	384
Total dissolved solids	mg/L	262	492	*502*	*578*	*589*	*2688*	*2678*	*2805*	*2809*	*2865*	*3398*	*3702*	*3781*
Total hardness	mg/L	188	214	214	222	223	408	406	418	418	421	464	500	506
Major Ions														
Bicarbonate	mg/L	187	210	210	216	218	378	377	387	387	390	425	458	464
Calcium	mg/L	48	54	54	56	57	105	105	108	108	108	120	129	131
Carbonate	mg/L	4	3	3	3	3	1.3	1.3	1.4	1.4	0.5	0.5	0.5	0.5
Chloride	mg/L	7	110	115	*149*	*155*	*1120*	*1116*	*1173*	*1176*	*1212*	*1454*	*1588*	*1623*
Fluoride	mg/L	0.1	*0.3*	*0.3*	*0.3*	*0.3*	*1.7*	*1.7*	*1.8*	*1.8*	*2*	*2*	*2*	*2*
Hydroxide	mg/L	1	0.7	0.7	0.8	0.8	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Magnesium	mg/L	17	19	19	19	19	35	35	36	36	35	40	43	44
Potassium	mg/L	3	7	7	8	8	38	38	40	40	40	48	52	53
Sodium	mg/L	20	94	97	122	125	*809*	*806*	*847*	*849*	*876*	*1050*	*1140*	*1165*
Sulfate	mg/L	67	107	108	122	124	*509*	*507*	*530*	*531*	*537*	*641*	*692*	*707*
Nutrients														
Ammonia as nitrogen	mg/L	0.05	0.2	0.2	0.3	0.3	1.3	1.3	1.4	1.4	1.4	1.7	1.8	1.9
Nitrate	mg/L	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.02	0.02	0.04	0.04
Total Phosphorus	mg/L	***0.1***	***0.1***	***0.1***	***0.1***	***0.1***	***0.06***	***0.06***	***0.06***	***0.06***	0.04	0.04	**0.05**	**0.05**

Parameter	Units	Saskatchewan River	PKCF Decant Water / Seepage Water				Option 2013 - Manville Formation and PKCF Decant Water Discharge from Mixing Facility				Option 2012 - Manville Formation Water Discharge from Dewatering Wells Only			
		Background	Mean	Median	95th Percentile	Maximum	Mean	Median	95th Percentile	Maximum	Mean	Median	95th Percentile	Maximum
Metals														
Aluminum	mg/L	***0.4***	***0.4***	***0.4***	***0.4***	***0.4***	***0.2***	***0.2***	***0.2***	***0.2***	0.003	0.002	0.005	0.006
Antimony	mg/L	0.0004	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
Arsenic	mg/L	0.0007	0.8	0.8	0.8	0.8	0.4	0.4	0.4	0.4	0.0003	0.0002	0.0005	0.0007
Barium	mg/L	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.08	0.04	0.3	0.3
Beryllium	mg/L	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00005	0.00005	0.00005	0.00005
Boron	mg/L	0.03	0.1	0.2	0.2	0.2	1.3	1.3	1.3	1.3	1.4	**1.7**	**1.8**	**1.8**
Cadmium	mg/L	**0.00008**	**0.00008**	**0.00008**	**0.00009**	**0.00009**	0.00004	0.00004	0.00004	0.00004	0.00006	0.00003	**0.0003**	**0.0003**
Chromium	mg/L	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	0.0007	0.0007	0.0008	0.0008	0.0008	0.0006	**0.003**	**0.003**
Cobalt	mg/L	0.0005	0.0006	0.0006	0.0006	0.0006	0.0003	0.0003	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001
Copper	mg/L	0.002	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	mg/L	***0.6***	***0.8***	***0.8***	***0.8***	***0.8***	***0.4***	***0.4***	***0.4***	***0.5***	0.2	0.2	0.2	0.2
Lead	mg/L	0.0006	0.0008	0.0008	0.0009	0.0009	0.0005	0.0005	0.0005	0.0005	0.0002	0.0003	0.0003	0.0003
Manganese	mg/L	*0.05*	*1.9*	*1.9*	*1.9*	*2.0*	*0.7*	*0.7*	*0.8*	*0.8*	*0.06*	*0.07*	*0.08*	*0.08*
Molybdenum	mg/L	0.001	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.004	0.01
Nickel	mg/L	0.002	0.002	0.002	0.003	0.003	0.001	0.001	0.001	0.001	0.0005	0.0005	0.0007	0.001
Selenium	mg/L	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0002	0.0002	0.0004	0.0007
Silver	mg/L	**0.0002**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	0.00005	0.00005	0.00005	0.00005	0.00002	0.000009	0.00005	0.00005
Strontium	mg/L	0.4	0.5	0.5	0.5	0.5	1.8	1.7	1.8	1.8	1.8	2	2	2
Thallium	mg/L	0.00009	0.00009	0.00009	0.00009	0.00009	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Tin	mg/L	0.0002	0.0003	0.0002	0.0003	0.0003	0.0001	0.0001	0.0001	0.0002	0.003	0.002	0.005	0.006
Titanium	mg/L	0.008	0.008	0.008	0.009	0.009	0.003	0.003	0.003	0.003	0.0002	0.0002	0.0003	0.0005
Vanadium	mg/L	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.0006	0.003	0.005
Zinc	mg/L	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	**0.07**	**0.07**

Note: **Bolded** and shaded cells indicate an aquatic life guideline exceedance.
Italicized and shaded cells indicate a drinking water exceedance.

Note: Guidelines are summarized in **Table A-1** in **Appendix A**.

TABLE 2.2
Water Quality Parameters in Wetlands and Lower Reaches of Streams

Parameter	Unit	Minimum	Mean	Median	95th Percentile	Maximum	Minimum	Mean	Median	95th Percentile	Maximum
		English Creek Wetland					English Creek Lower Reach				
Chloride	mg/L	45.51	96.96	100.39	**129.84**	**149.74**	1.89	5.00	5.05	7.69	8.73
Boron	mg/L	0.050	0.109	0.112	0.142	0.161	0.035	0.038	0.038	0.041	0.042
Cadmium	mg/L	0.0000062	0.0000156	0.0000169	0.0000180	0.0000180	0.0000483	0.0000486	0.0000486	0.0000491	0.0000494
Chromium	mg/L	**0.000181**	**0.000460**	**0.000497**	***0.000525***	***0.000526***	**0.000370**	**0.000379**	**0.000380**	**0.000382**	**0.000383**
Selenium	mg/L	0.00009	0.00024	0.00026	0.00027	0.00027	0.00020	0.00020	0.00020	0.00020	0.00020
Zinc	mg/L	0.00196	0.00488	0.00528	0.00559	0.00563	0.00507	0.00515	0.00516	0.00517	0.00517
		Wapiti Ravine Wetland					Wapiti Ravine Lower Reach				
Chloride	mg/L	45.51	96.96	100.39	**129.84**	**149.74**	6.74	13.66	13.90	19.06	20.65
Boron	mg/L	0.050	0.109	0.112	0.142	0.161	0.026	0.032	0.032	0.036	0.038
Cadmium	mg/L	0.0000062	0.0000156	0.0000169	0.0000180	0.0000180	0.0000403	0.0000454	0.0000458	0.0000461	0.0000462
Chromium	mg/L	**0.000181**	**0.000460**	**0.000497**	**0.000525**	**0.000526**	**0.001829**	**0.002053**	**0.002070**	**0.002086**	**0.002093**
Selenium	mg/L	0.00009	0.00024	0.00026	0.00027	0.00027	0.00033	0.00038	0.00038	0.00038	0.00039
Zinc	mg/L	0.00196	0.00488	0.00528	0.00559	0.00563	0.01288	0.01450	0.01464	0.01473	0.01475

Parameter	Unit	Minimum	Mean	Median	95th Percentile	Maximum	Minimum	Mean	Median	95th Percentile	Maximum
		Duke Ravine Wetland					Duke Ravine Lower Reach				
Chloride	**mg/L**	45.51	96.96	100.39	**129.84**	**149.74**	12.69	23.52	24.36	30.23	33.56
Boron	**mg/L**	0.050	0.109	0.112	0.142	0.161	0.035	0.048	0.048	0.054	0.057
Cadmium	**mg/L**	0.0000062	0.0000156	0.0000169	0.0000180	0.0000180	0.0000479	**0.0000601**	**0.0000612**	**0.0000636**	**0.0000639**
Chromium	**mg/L**	**0.000181**	**0.000460**	**0.000497**	**0.000525**	**0.000526**	**0.000620**	**0.000974**	**0.001024**	**0.001071**	**0.001087**
Selenium	**mg/L**	0.00009	0.00024	0.00026	0.00027	0.00027	0.00022	0.00029	0.00030	0.00031	0.00031
Zinc	**mg/L**	0.00196	0.00488	0.00528	0.00559	0.00563	0.00578	0.00863	0.00895	0.00951	0.00961

Bolded and shaded cells indicate an aquatic life guideline exceedance.
Italicized and shaded cells indicate a drinking water exceedance.
Cadmium guideline (mg/L)= (10[0.86 [log(hardness)] - 3.2])*1000. Calculated exceedance is based on a water hardness of 214 mg/L.
Guideline is for hexavalent chromium (CrVI) because its guideline is more stringent than the trivalent chromium (CrIII) guideline of 0.009 mg/L.s

2.1.3 Co-management Facility

Table 2.3 highlights the breakdown of the component inflows to the co-management facility (i.e., the component outflows to the Saskatchewan River).

TABLE 2.3
Mixing Facility Inflows

Year	Total Inflow (Mm^3)	PKCF Decant		Manville Pumping Wells	% of Total
		(Mm^3)	% of Total	(Mm^3)	
1	0	0	N/A	0	N/A
2	0	0	N/A	0	N/A
3	0	0	N/A	0	N/A
4	20.99	20.99	100%	0	0%
5	56.83	20.99	37%	35.84	63%
6	56.83	20.99	37%	35.84	63%
7	56.83	20.99	37%	35.84	63%

The percentage contribution from each of the inflow sources are stable until mining is completed at Star in year 7. Note that leap years have been removed from this table; (i.e., all years have 365.25 days).

2.2 Water Withdrawal from the Saskatchewan River

2.2.1 Annual Volumes

The water balance indicates volumes ranging from 23 Mm^3 to 24 Mm^3 annually being withdrawn from the Saskatchewan River. Considering the outflow volumes from the mixing facility to the river (**Table 2.3**) there is a net inflow to the river in during mining at Star.

2.2.2 Monthly Variability

Monthly variability of water taken from the Saskatchewan River is driven by runoff from East Ravine into the runoff pond, which is now directed to the Plant. The percentage of plant demand met by water from the runoff pond per month is presented in **Table 2.4**.

TABLE 2.4
Plant Demand Met by Runoff Pond

Month	% Plant Demand Met by Runoff Pond
January	4
February	4
March	4
April	27
May	9
June	6
July	6
August	8
September	4
October	4
November	4
December	4
Annual	7

Overall, the runoff pond provides approximately 7% of the plant demand. Thus, the Saskatchewan River provides approximately 93% of the plant water demand (for the "100% process water from the river" scenario. The variability is illustrated in **Figure 2.1**.

2.3 Hydrology Summary

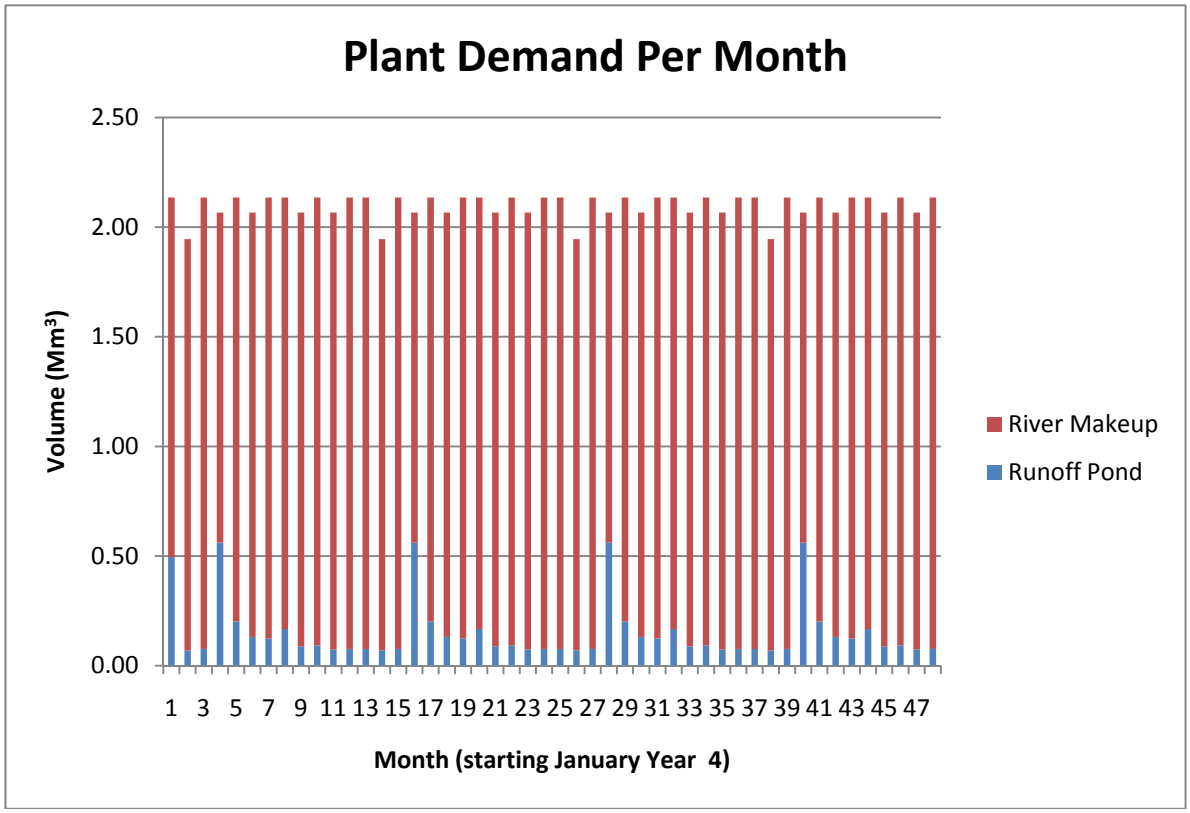
Table 2.5 summarizes the salient changes to the hydrological water balance compared to the 2012 model.

TABLE 2.5
Summary of Changes to Water Balance compared to 2012 Model

Hydrology Component	Change in Annual Magnitude (Mm^3)	
	2012	April 2013
Withdrawal from Saskatchewan River	0	23.00 to 23.42
Inflow to PKCF	23.85	23.52
Runoff Pond contribution to Plant	0	1.74 to 2.16
Release directly to Saskatchewan River	36.24 to 36.49	20.99 to 56.83

Other than the components listed in **Table 2.5**, all other hydrological components in the Water Balance remained unchanged from the 2012 model.

Figure 2.1 Variability in Makeup Water Volume from Saskatchewan River in Years 4 to Year 7



3.0 CLOSURE

This report has been prepared for the exclusive use of Shore Gold Inc. This report is based on, and limited by, the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

We look forward to the opportunity to discuss these results further and to prepare any documents required by Shore Gold Inc. to present the findings to regulatory authorities.

Yours truly,

AMEC Environment & Infrastructure

Sergei Touchinski
Associate Environmental Scientist

Gary Beckstead
Principal Water Resources Engineer

GREB/jp

Appendix A
Water Quality Guidelines

TABLE A-1

Water Quality Guidelines Applicable During the Study

Parameter	Units	Guidelines			
		Liquid Effluent	Aquatic Life		Drinking Water
		Mineral Industry (1996)	CCME (2012)	SK MOE (2006)	Health Canada (2012)
Field Measured		-	-	-	-
pH	pH units	-	6.5 to 9.0	-	6.5 to 8.5 [d1]
Dissolved Oxygen (DO)	mg/L	-	6.5 or 9.5 [a1]	-	-
Temperature	°C	-	-	-	≤15 [d1]
Conventional Parameters and Major Ions					
pH	pH Units	-	6.5 to 9.0	-	6.5 to 8.5 [d1]
Total Dissolved Solids (TDS)	mg/L	-	-	-	≤500 [d1]
Total Suspended Solids (TSS)	mg/L	-	[a2]	-	-
Turbidity	NTU	-	-	-	1 [d2]
Sodium	mg/L	-	-	-	≤200 [d1]
Chloride	mg/L	-	120	-	≤250 [d1]
Sulphate	mg/L	-	-	-	≤500 [d1]
Nutrients and Organics					
Ammonia	mg/L	-	0.02 - 190 [a3]	-	-
Nitrate-Nitrogen	mg/L	-	2.9 [a4]	-	10 [d3]
Nitrite-Nitrogen	mg/L	-	0.06 [a5]	-	1 [d3]
Phosphorus, Total	mg/L	-	[a6]	-	-
Phenols	mg/L	-	0.004	-	-
Total Metals					
Aluminum	mg/L	-	0.005 or 0.1 [a7]	-	0.1 [d4]
Antimony	mg/L	-	-	-	0.006 [d2]
Arsenic	mg/L	0.5 [b1]	0.005	-	0.01 [d2]
Barium	mg/L	-	-	-	1 [d2]
Boron	mg/L	-	1.5	-	5 [d2]
Cadmium	mg/L	-	[a8]	[c1]	0.005 [d2]
Chromium	mg/L	-	0.0001 [a9]	-	0.05 [d2]
Copper	mg/L	0.3 [b1]	[a10]	-	≤1 [d1]
Iron	mg/L	-	0.3	-	≤0.3 [d1]
Lead	mg/L	0.2 [b1]	[a11]	-	0.01
Manganese	mg/L	-	-	-	≤0.05 [d1]
Mercury	mg/L	-	0.00003	0.00003	0.001 [d2]
Molybdenum	mg/L	-	0.073	-	-
Nickel	mg/L	0.5 [b1]	[a12]	-	-
Selenium	mg/L	-	0.001	-	0.01 [d2]
Silver	mg/L	-	0.0001	-	-
Thallium	mg/L	-	0.0008	-	-
Uranium	mg/L	2.5 [b1]	0.015	0.015 [c2]	0.02 [d2]
Zinc	mg/L	0.5 [b1]	0.03	-	≤5 [d1]

Part 1. Water Quality Guidelines for the Protection of Aquatic Life

CEQG (CCME - Federal)

a1 = Guideline is based on temperature preferences of biota. In this case, the cold water biota guidelines for both early life and other life stages are shown.

a2 = Guideline assumes clear flow conditions and is based on the following:

Clear flow - Maximum increase of 25 mg/L (TSS) or 8 NTU (turbidity) from background levels for any short-term exposure (e.g., 24-h period).

Maximum average increase of 5 mg/L (TSS) or 2 NTU (turbidity) from background levels for longer term exposures (e.g., > 24-h).

High flow - Maximum increase of 25 mg/L (TSS) or 8 NTU (turbidity) from background levels at any time when background levels are between 25 and 250 mg/L (TSS) or 80 NTU (turbidity). Should not increase more than 10% of background levels when background is >250 mg/L (TSS) or >80 NTU (turbidity).

a3 = Guideline is dependent on temperature and pH, and is expressed as Ammonia-N. The value ranges between

0.02 mg/L (pH= 10.0, temperature= 30^{o}C) and 190 mg/L (pH= 6, temperature= 0^{o}C).

a4 = Guideline is expressed as nitrate-N.

a5 = Guideline is expressed as nitrite-N.

a6 = The trophic status of lakes is assessed using the total phosphorus concentrations. The Canadian Trigger Ranges

are as follows: ultra-oligotrophic - <0.004 mg/L; oligotrophic - 0.004 to 0.01 mg/L; mesotrophic - 0.01 to 0.02 mg/L;

meso-eutrophic - 0.02 to 0.035 mg/L; eutrophic - 0.035 to 0.1 mg/L; and hyper-eutrophic - >0.1 mg/L.

a7 = Guideline = 5 µg/L at pH < 6.5, [Ca2+] < 4 mg/L and DOC < 2 mg/L;

Guideline = 100 µg/L at pH ≥ 6.5, [Ca2+] ≥4 mg/L and DOC ≥ 2 mg/L.

a8 = Cadmium guideline (mg/L)= $(10^{[0.86\ [\log(\text{hardness})]\ -\ 3.2]})*1000$

a9 = Guideline is for hexavalent chromium (Cr_{VI}) because its guideline is more stringent than the trivalent chromium (Cr_{III}) guideline of 0.009 mg/L.

a10 = Copper guideline is dependent on [CaCO3] with a minimum of 0.002 mg/L. Guideline (mg/L) $=(e^{0.8545[\ln(\text{hardness})]-1.465}*0.2)*1000$

a11 = Lead guideline (mg/L) is dependent on [$CaCO_3$]. Guideline = $(e^{1.273[\ln(\text{hardness})]-4.705})*1000$

a12 = Nickel guideline (mg/L) is dependent on [$CaCO_3$]. Guideline = $(e^{0.76[\ln(\text{hardness})]+1.06)}*1000$

The Ministry Environmental Protection Agency 1996

b1 = The Maximum Mean Monthly Arithmetic Concentration

SK MOE (Saskatchewan Water Quality Objectives)

c1 = Cadimum Objective: 0.000017 mg/L when hardness is 0 to 48.5 mg/L, 0.000032 mg/L where water hardness is 48.5 to 97 mg/L,

0.000058 mg/L where the water hardness is 97 to 194 mg/L, and 0.0001 mg/L where the water hardness is >194 mg/L.

c2 = The objective was developed by the Industrial, Uranium and Hardock Mining Unit of Saskatchewan Environment.

Part 2. Water Quality Guidelines for Human Consumption

GCDWQ (Health Canada - Federal)

d1 = Aesthetic objective.

d2 = Maximum allowable concentration (MAC).

d3 = Guideline corresponds to nitrate-N and nitrite-N.

d4 = A health-based guideline for aluminum in drinking water has not been established.

Operational guidance values of less than 100 µg/L total aluminum for conventional treatment plants and

less than 200 µg/L total aluminum for other types of treatment systems are recommended.