Memorandum

Monitoring, Assessment and Stewardship

Date: June 22, 2017

To: AJ Downie, Director Authorizations South
Cc: Cindy Meays, Water Quality Section Head
Douglas Hill, Director Monitoring, Assessment and Stewardship

Re: Review of water quality data from Cobble Hill Holdings contaminated soil facility

Background:

An amended Spill Prevention Order (SPO) was issued on March 15th 2017, which requires the parties listed on the SPO to decide whether to proceed with final closure activities for the contaminated soil facility, or develop and implement a plan to remove the soil from the site. In the short-term, the SPO also requires that the facility remain covered, and any leachate generated must be collected and managed so it is not discharged to the environment, and taken off-site to an authorized facility for treatment and/or disposal.

To help determine if existing activities at the contaminated soil facility are impacting downstream water quality, Associated Environmental Consultants Inc. was retained by the Ministry of Environment to provide an independent water quality study in the mainstem of South Shawnigan Creek, along with key tributaries. Sampling was conducted monthly from July 2016 to June 2017 (along with two 5-in-30 sampling events during low summer flows and high fall flows), at multiple sites upstream and downstream of the contaminated soil facility at 460 Stebbings Road, Lot 23. The study is intended to determine water quality along South Shawnigan Creek, and determine if previously permitted activities on Stebbing Road Lot 23, historical activities on Lot 21 or other activities in the watershed are impacting water quality.

Data review and assessment:

The purpose of this data review is to determine if there is any evidence in the sampling data to suggest that the containment liner at the contaminated soil facility (Lot 23) is leaking, and if potential contaminants are being released to a nearby ephemeral stream.

The following points are based on a review of the surface water data collected by Associated Environmental (recent laboratory data and three quarterly summary reports) & Hemmera, along with surface water data collected by a group of local residents called the Shawnigan Research Group, upgradient site groundwater data, and site leachate data. The assessment of this data primarily focuses on more recent data (December 2016 to June 2017) from three key surface water sites (S-1, S-2, S-3; Figure 1), but also includes a review of onsite data from Lot 23 (upgradient groundwater well SW-6, and site leachate). See Appendix 1 for a data table of key indicator parameters from these sites.

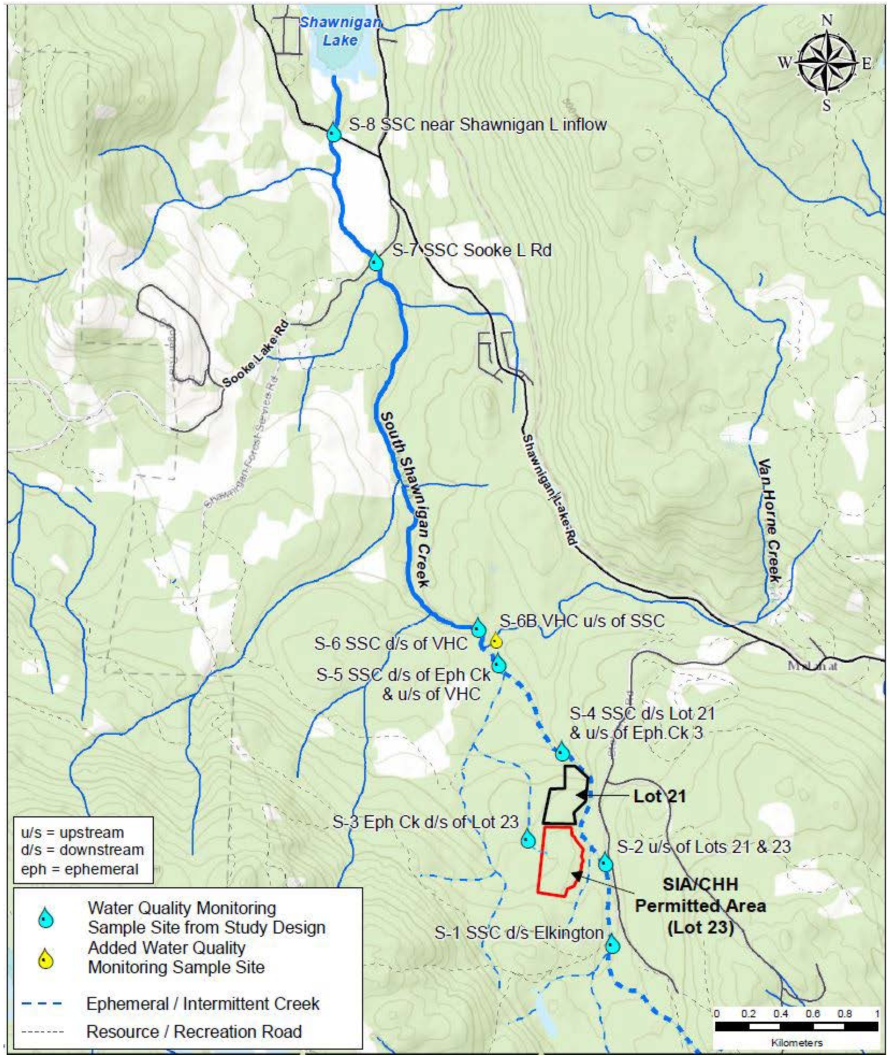

Figure 1. Sampling site location map

Surface water quality summary

Several monthly water quality samples were collected by Associated Environmental at two sites on South Shawnigan Creek upstream of Lot 23 (S-1 and S-2), and at a site near the top of the ephemeral creek immediately downstream of Lot 23 (S-3), which is a tributary to South Shawnigan Creek.

Surface water quality data from the two upstream sites indicate they are quite similar. The water at these sites is quite soft, with low hardness and low dissolved ions. Concentrations of nutrients and metals are also relatively low, with site S-2 often having slightly higher concentrations of most parameters. Overall, water quality at both sites is very good, with some seasonal variability likely related to flow conditions. There are no obvious seasonal trends, but concentrations of several parameters (i.e., conductivity, hardness, Cl, SO_4, Ca, Mg) increased from March to June in both South Shawnigan Creek sites, as well as the ephemeral creek.

Site S-3 is located on the ephemeral creek immediately downstream of Lot 23, near the location where the settling pond water treatment facility discharges. Field observations by Associated Environmental and Ministry of Environment staff indicated that the water flowing at S-3 was a combination of water from the discharge pipe from the settling pond treatment facility (which received both treated leachate, as well as non-contact surface water from the rock quarry), and from groundwater seepage. However, once the permit was suspended (and later cancelled) discharge from the settling pond would have been limited to non-contact surface water from the rock quarry (rainfall and snow melt runoff) and groundwater that is daylighting to the surface. Furthermore, the water elevations of the groundwater wells and the elevation of the headwaters of the ephemeral creek are very similar, indicating strong potential for groundwater to surface water connectivity.

Water quality at site S-3 is quite different from that in South Shawnigan Creek (e.g., moderately hard water with increased ions and metal concentrations), which is expected considering the strong groundwater influence at the site. While the concentrations of most ions, nutrients, and metals at S-3 are higher than those of S-1 and S-2, water quality was still relatively good compared to BC water quality guidelines. Also, there was no evidence that site S-5, which is downstream of the confluence of the ephemeral creek on South Shawnigan Creek, was influenced by the higher concentrations of parameters found at S-3.

Groundwater quality summary

Upgradient groundwater well MW-6 is located at the southeast portion of Lot 23, and is representative of background groundwater quality of the shallow aquifer in the vicinity of Lot 23. This well is monitored quarterly, but only has data for 2016, as it was constructed to replace the old background well (MW-4), which was damaged in 2015. Overall, concentrations of chemical parameters in groundwater samples are much higher than in all surface water samples. The 2016 data indicate some parameters are relatively similar throughout the year (i.e., Cl, Ca, Mg), while others differ seasonally with higher values in June and December (i.e., conductivity, SO_4, Fe, Mn, Na). While the groundwater dataset is limited, it does provide valuable information to understand background conditions of the shallow aquifer that most likely provides the majority of the flow to the ephemeral creeks in the local watershed.

Leachate quality summary

Leachate data was collected onsite at the contaminated soil facility on May 4th, 2017 and submitted for comprehensive laboratory analyses. Generally, concentrations of metals and ions were elevated, while most VOCs, hydrocarbons, PAHs, and glycols were below laboratory detection limits, or were very low. Of particular interest are the very high values of conductivity (11,400 µS/cm), hardness (3730 mg/L), total dissolved solids (8160 mg/L), along with elevated concentrations of ions (Cl and SO_4) and metals (Cd, Cu, Mn, and Fe). Water quality data indicate high concentrations of several parameters that if released to surface waters, would have the potential to cause pollution and acute toxicity to aquatic life.

Water quality data assessment

Generally, water quality at the creek sampling sites upstream and downstream of the contaminated soil facility at Lot 23 is quite good. Recent data collected over the past seven months indicate very few exceedances of BC water quality guidelines. With the exception of one sample, the exceedances of some total metals (Cr, Cu, Fe) in both South Shawnigan Creek and the ephemeral creek corresponded with rainfall events, which increased turbidity and total suspended solids in the creeks. The suggests that the higher concentrations of total metals are associated with the sediments in the water.

While there are no consistent seasonal trends in the data, concentrations of several parameters (i.e., conductivity, hardness, Cl, SO_4, Ca, Mg) increased from March to June in both the ephemeral creek and South Shawnigan Creek. This may be due to increased contributions of groundwater throughout the spring, and does not appear to be related to operations at Lot 23.

The ephemeral creek had consistently higher concentrations of most ions, nutrients, and metals compared to South Shawnigan Creek, but this is understandable considering the fact that the majority of the flow at site S-3 is groundwater. When treated leachate from the contaminated soil facility was discharging into the ephemeral creek via the settling pond, many parameters were elevated at S-3, and once the discharge stopped, concentrations of many parameters similarly decreased. However, the groundwater upgradient of the contaminated soil facility still has elevated concentrations of several key parameters (i.e., conductivity, hardness, Cl, SO_4, Ca, Mg, Na, Cd, Cu, Fe, Mn), that is likely maintaining the elevated concentrations of these parameters in the ephemeral creek.

On June 2, the Shawnigan Research Group (SRG) had water samples collected for them, and analyzed by Maxxam Analytics Laboratory. Water samples were obtained from Shawnigan Creek upstream of Lot 23 and from the ephemeral creek. The data are summarized in a document submitted to MOE entitled “2-Leachate and Water Quality Data Analysis-Juurlink”. The primary assertion of this document is that the contaminated soil facility is leaking, and contaminants are being released into the surrounding environment. This assertion is based on the fact that the leachate concentrations are very high, and the downstream ephemeral creek parameter concentrations are much higher than the upstream South Shawnigan Creek site data. However, this is a misleading representation of the data. As previously mentioned, water in the ephemeral creek is primarily groundwater that has surfaced, and has quite a different chemical composition to South Shawnigan Creek. As such, it is not appropriate to use sites S-1 or S-2 as background sites for comparison, as was done in the SRG data analysis. Without a comparison to upgradient groundwater quality, the information is incomplete and conclusions may be erroneous. While the available groundwater data is limited, it likely provides a more appropriate background comparison to the ephemeral creek.

The SRG data analysis also states that “the chemical footprint of the contaminants that are elevated in the Ephemeral Stream compared to Shawnigan Creek is almost identical to the May

4th, 2017 leachate chemical footprint". While this may be somewhat true, there is a similar pattern of elevated parameters in the leachate, the ephemeral creek, and the upgradient groundwater. In fact, the ephemeral creek data is much more similar to the upgradient groundwater than to the highly elevated concentrations of parameters found in the leachate (see Appendix 1).

Conclusions and Recommendations:

Based on the available data, there is no strong evidence to indicate that contaminants are leaching into the shallow aquifer at Lot 23 and surfacing downstream in the ephemeral creek. However, it cannot be said with certainty that the containment liner is not leaking. More information is needed about upgradient and nearby groundwater quality, and other ephemeral creek water quality, to make further conclusions about whether the concentrations at site S-3 are usual for the area or not. While it was beyond the scope of this review, additional monitoring of leachate, surface water, shallow groundwater, deep groundwater, and a comprehensive assessment of results, may be warranted.

It should be noted that not all the lab data from the June sampling event (e.g., sites S-1 and S-2) conducted by Associated Environmental was available in time for this review. However, with the addition of this data, it is not expected to change the assessment and conclusions provided above.

If you have any further questions, comments or concerns, please do not hesitate to contact me.

Thank you,

Michael Sokal, Ph.D.
Impact Assessment Biologist
Environmental Protection
Ministry of Environment
102 Industrial Place, Penticton BC V2A 7C8
Tel: (250) 490-2284 Fax: (250) 490-2231
E-mail: Mike.Sokal@gov.bc.ca

Appendix 1. Select water chemistry parameters from South Shawnigan Creek, ephemeral creek, leachate, and upgradient groundwater.

Site	S-1 (South Shawnigan Creek upstream)						
Sampling Date	**2016-12-12**	**2017-01-18**	**2017-02-20**	**2017-03-20**	**2017-04-19**	**2017-05-25**	
Conductivity [uS/cm]	29.9	30.6	25.7	24.4	30.4	37.7	
Hardness (as CaCO3) [mg/L]	9.68	10.6	9.06	7.95	11.4	15	
Chloride (Cl) [mg/L]	2.29	2.77	1.95	1.53	1.54	1.59	
Sulfate (SO4) [mg/L]	1.42	1.22	1.31	1.29	1.25	1.1	
Cadmium (Cd)-Total [mg/L]	<0.000005	<0.000005	0.0000055	<0.000005	<0.000005	<0.000005	
Calcium (Ca)-Total [mg/L]	3.29	3.27	2.72	2.4	4.13	4.86	
Copper (Cu)-Total [mg/L]	0.000629	0.000498	0.00063	0.000499	0.000544	0.000397	
Iron (Fe)-Total [mg/L]	0.0447	0.0461	0.0318	0.0281	0.0345	0.0538	
Magnesium (Mg)-Total [mg/L]	0.671	0.588	0.552	0.474	0.726	0.923	
Manganese (Mn)-Total [mg/L]	0.00231	0.00695	0.00182	0.00205	0.00507	0.0147	
Sodium (Na)-Total [mg/L]	1.95	1.73	1.84	1.5	1.77	1.61	
Site	**S-2 (South Shawnigan Creek upstream)**						
Sampling Date	**2016-12-12**	**2017-01-18**	**2017-02-20**	**2017-03-20**	**2017-04-19**	**2017-05-25**	
Conductivity [uS/cm]	31	35.5	29.5	27	57	72.4	
Hardness (as CaCO3) [mg/L]	9.79	10.2	9.34	9.76	22.1	29.6	
Chloride (Cl) [mg/L]	2.38	2.95	2.25	1.99	7.4	5.76	
Sulfate (SO4) [mg/L]	1.44	1.24	1.32	1.33	1.44	0.79	
Cadmium (Cd)-Total [mg/L]	<0.000005	0.0000074	<0.000005	<0.000005	0.0000071	0.0000127	
Calcium (Ca)-Total [mg/L]	2.82	3.11	2.8	2.98	6.36	9.93	
Copper (Cu)-Total [mg/L]	0.000631	0.00367	0.000526	0.000704	0.000476	0.000681	
Iron (Fe)-Total [mg/L]	0.0582	1.1	0.0381	0.0577	0.226	0.827	
Magnesium (Mg)-Total [mg/L]	0.651	0.599	0.568	0.567	1.48	1.67	
Manganese (Mn)-Total [mg/L]	0.00655	0.0396	0.00352	0.0109	0.101	0.776	
Sodium (Na)-Total [mg/L]	1.76	1.78	1.55	1.64	3.12	2.95	
Site	**S-3 (ephemeral stream)**						
Sampling Date	**2016-12-12**	**2017-01-18**	**2017-02-20**	**2017-03-20**	**2017-04-19**	**2017-05-25**	**2017-06-09***
Conductivity [uS/cm]	334	358	392	327	392	552	664
Hardness (as CaCO3) [mg/L]	104	112	151	124	164	230	
Chloride (Cl) [mg/L]	28.7	40.4	33.6	21.5	26.6	37.6	53.2
Sulfate (SO4) [mg/L]	60.9	52.2	74.7	60.9	74.6	101	113
Cadmium (Cd)-Total [mg/L]	<0.000005	0.0000069	<0.000005	<0.000005	0.0000773	0.0000096	
Calcium (Ca)-Total [mg/L]	33.4	35.3	48.5	40.5	65.8	79	
Copper (Cu)-Total [mg/L]	0.0011	0.003	0.00144	0.00144	0.0134	0.00172	
Iron (Fe)-Total [mg/L]	0.0688	0.933	0.0436	0.0467	0.409	0.164	
Magnesium (Mg)-Total [mg/L]	6.04	6.05	7.39	6.21	8.59	11.1	
Manganese (Mn)-Total [mg/L]	0.00332	0.0245	0.0326	0.0197	0.885	0.0595	

Sodium (Na)-Total [mg/L]	13.2	15.8	16.4	12.7	17.7	15.8	
Site	**Leachate**		**MW-6 (upgradient GW well)**				
Sampling Date	**2017-05-04**		**2016-03-08**	**2016-06-27**	**2016-09-26**	**2016-12-29**	
Conductivity [uS/cm]	11400		1160	1290	1140	1270	
Hardness (as CaCO3) [mg/L]	3730		712	629	653	587	
Chloride (Cl) [mg/L]	3470		38.3	36.8	38.7	38.5	
Sulfate (SO4) [mg/L]	1760		52.9	76.8	52.1	77.2	
Cadmium (Cd)-Total [mg/L]	0.000444		0.00010	0.00015	0.00009	0.00006	
Calcium (Ca)-Total [mg/L]	947		213	219	210	197	
Copper (Cu)-Total [mg/L]	0.00347		0.0039	0.0156	0.0058	0.0014	
Iron (Fe)-Total [mg/L]	1.18		0.23	2.13	0.32	0.156	
Magnesium (Mg)-Total [mg/L]	337		43.7	38.7	41	40.8	
Manganese (Mn)-Total [mg/L]	24.2		0.757	1.82	0.652	2.49	
Sodium (Na)-Total [mg/L]	1780		21.2	52.7	21	74.5	
*note that the June 09, 2017 data from site S-3 was collected by Hemmera							