File: 26250-20/20688
Source Site: 20688

VIA EMAIL

March 27, 2020

Tom Appleby
BC Hydro and Power Authority
6911 Southpoint Drive Burnaby, BC
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Tom.Appleby@bchydro.com

Dear Tom Appleby:

Re: Request for P6 approval for the derivation of a toxicity reference value for pyrene in porewater, Salmon River, BC.

The Ministry of Environment and Climate Change Strategy (the ministry) has completed a review of your application received January 8, 2020 for approval under Protocol 6 (P6) to derive a *de novo* toxicity reference value (TRV) for use in an ecological risk assessment to be performed at BC (the Site), also known as Site 20688. This letter provides my decision on your application for approval under P6, item 4 of Table 2.

In your application, the Site is defined as the following:

Legal Description:	Block H, District Lot 110, Sayward District
Latitude:	50 Degrees, 05 Minutes, 30.01 Seconds
Longitude:	125 Degrees, 40 Minutes, 19.99 Seconds

A Site Location Plan is attached in Attachment A for reference.

In reaching my decision I have relied on information provided in the following supporting document:

- ***Request for P6 approval for the derivation of a toxicity reference value for pyrene in porewater, Salmon River, BC,*** prepared by SLR Consulting (Canada) Ltd., dated January 8, 2020.

The document above describes the technical information and the lines of evidence to support a P6 approval, including the following rationale summarized below:

- *The derivation of the pyrene TRV was conducted in accordance with ENV guidance and reference documents as outlined in:*
    - *ENV (2017a) Technical Guidance 7 on Contaminated Sites: Supplemental Guidance for Risk Assessment. Version 5. November 2017; and*
    - *Environment Canada. March 2010. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance. Module 2: Supplemental Guidance for Ecological Risk Assessment, Selection or Development of Site-Specific Toxicity Reference Values.*

- *The development of the TRV also considered guidance outlined in the CSR Protocol 1 that requires a protection level appropriate for aquatic organisms. For aquatic organisms on urban park sites, this is the EC20. Specifically, the lowest single toxicity value or the geometric mean of multiple toxicity values (e.g., EC20) for non-lethal endpoints for the most sensitive species investigated should be used, as available. If chronic endpoints are not available, the TRV can be derived from acute studies by converting short-term median lethal or median effective concentrations (LC50 and EC50, respectively) to long-term no-effect concentrations using acute:chronic ratios or safety factors.*

- *In developing a protection of freshwater life TRV for pyrene for the Salmon River, preference was given to chronic sublethal toxicity data (e.g., EC20) for growth, reproduction and survival, if available, as these endpoints are relevant to freshwater algae and plants, aquatic invertebrates, and fish present in the Salmon River.*

- *The BCAWQG for pyrene is based on the water quality criterion for anthracene multiplied by the potency factor for pyrene to induce phototoxic effects relative to anthracene. For this reason, the BCAWQG for anthracene and the technical supporting documents were reviewed as were the main sources of information used by ENV to derive the BCAWQG for pyrene (Nagpal et al., 1993). A search for recent pyrene toxicity data was also completed to locate additional toxicity data.*

- *Pyrene is a high molecular weight PAH composed of four aromatic rings fused together and forming one plane. It is a non-polar, hydrophobic compound that does not ionize (Moore and Ramamoorthy, 1984). As a result, pyrene is only slightly soluble in water. As temperature and dissolved or colloidal organic fractions increase so does its solubility (Neff, 1979). Due to its hydrophobic nature, pyrene preferentially sorbs to suspended particulates in the water column, and eventually settles out onto the bottom sediments within a watercourse.*

- *Pyrene is weakly degraded through the process of photooxidation (Nagata and Kondo, 1977). In the water column, the rate of photodegradation will decrease with an increase in depth as a result of a decrease in light intensity, temperature and dissolved oxygen.*

Photooxidation of pyrene is considered negligible in bottom sediments (Neff, 1979; Moore and Ramamoorthy, 1984). Aquatic exposure studies involving fish and invertebrates exposed to various PAHs in water have demonstrated an increase in acute toxicity as photooxidation increases (Nagpal, 1993).

- *Aquatic organisms are exposed to pyrene within the water column, and in particular, benthic organisms may absorb pyrene from contact with both the bottom sediments, overlaying water, and porewater within sediments.*

- *The BCAWQG for pyrene (0.02 ?g/L) is based on phototoxicity and is an extrapolation from a value determined for anthracene. A surface water guideline based on phototoxicity is a conservative and realistic metric based on the freshwater aquatic life exposure pathways. Phototoxicity is not of primary concern for the porewater samples collected within the sediment at Salmon River. Porewater was collected below the sediment:water interface in the River with running water, and beneath substrate that was a dominant mix of cobble and gravel. The ability for sunlight to penetrate sediments and contribute to toxicity associated with photooxidation is not supported under these conditions. Therefore, SLR conducted a literature search to support the use of a de novo TRV within the current P6 application for Salmon River.*

- *The US EPA ECOTOX database was searched to obtain toxicity data for pyrene that excluded studies related to photooxidation. The exposures considered included aquatic plants/algae, invertebrates and fish exposed to pyrene in marine and freshwater. The search returned limited data on species potentially inhabiting a coastal freshwater riverine system. Species for which data were available, for the considered exposure scenario, included a sand shrimp, water flea, Atlantic cod, guppy, Atlantic herring, rainbow trout, soft shell clam, Mediterranean mussel, blue mussel, and zebra mussel. Effects considered included: survival, growth, reproduction and feeding rates. Table A [below] summarizes the range of concentrations per effects and endpoints that were evaluated and met the relevant evaluation criteria.*

- *Based on the above toxicity information, an updated screening level of 8.06 µg/L is recommended for pyrene in porewater. A geometric mean was generated using the four NOEC, EC10, LOEC, and HC5 values presented in the above Table A [below]. These values represent either no adverse effects or minimal effects (10%) for the test organisms. The lowest observable effect level (LOEC) was not relied upon if the level of effects associated with the measurement endpoint were not always transparent, or highly variable. The ENV water quality guideline for pyrene (0.02 µg/L) still applies to Salmon River surface water.*

Based on the information above, the P6 approval of a *de novo* TRV is as follows:

- Pyrene Porewater Concentration: 3.64 µg/L

This porewater concentration for pyrene applies to porewater collected at depths in which *the ability for sunlight to penetrate sediments and contribute to toxicity associated with photooxidation is not supported.*

I base this decision primarily on the following:

- The applicant provides a reasonable case as to why the BCAWQG for pyrene is not suitable for comparison to porewater concentrations at this Site. The McGrath and Di Toro (2009) study appears to be one of the most recent sources of toxicity data and provides a hazardous concentration for five percent (HC5) of the species in the species sensitivity distribution. Given that the toxicity value obtained from McGrath and Di Toro (2009) is the lowest value in the dataset provided in Table A and it is significantly greater than the maximum reported porewater concentration for pyrene at the Site, it is approved by the ministry that this value be used as the TRV for pyrene in porewater instead of the geomean approach that was presented in the application.

Please note that this approval is specific to ecological risk assessment to be performed at Site 20688. Aside from the specific relief granted above, this approval does not constitute review or acceptance by the Director of any other aspect of the investigations or remediation (including risk assessment) conducted at or planned for the Site.

Please ensure that a copy of this letter is included in relevant future applications to the ministry.

This decision is based on the most recent information provided to the ministry regarding the above-referenced Site. The ministry, however, makes no representation or warranty as to the accuracy or completeness of this information. The ministry expressly reserves the right to change or substitute different requirements where circumstances warrant.

Please contact the undersigned at Heather.Osachoff@gov.bc.ca or at 236-468-2243 if you have any questions regarding this letter.

Heather Osachoff

Heather Osachoff
for Director, *Environmental Management Act*

Manager, Risk Assessment and Remediation

cc: Joline Widmeyer, Risk Assessor/Toxicologist, SLR Consulting Canada Ltd. (BY EMAIL) jwidmeyer@slrconsulting.com
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