

## **CSR OMNIBUS UPDATING: Proposed Amendments to Schedule 6**

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### **Summary of Proposed Updates for 2015/2016 Stage 10 amendments to CSR**

1. Repeal existing CSR Schedule 6 and move existing Schedule 6 substances into a proposed new schedule (Schedule W) that consolidates Schedule 6 and 10 water standards. List the substances in the new water schedule alphabetically by International Union of Pure and Applied Chemistry (IUPAC) name, with corresponding Chemical Abstract Service (CAS) number, maintaining consistency with other CSR schedules.
2. Where sufficient toxicological data exists or another approved jurisdiction has an available standard, subject to time and resources, derive or adopt aquatic life (AW) and/or drinking water (DW) standards for use in the proposed new Schedule W. Where such updates are not possible, retain the standard values of the existing Schedule 6 or 10.
3. Where sufficient toxicological data exists or another approved jurisdiction has an available standard, derive or adopt standards for new and emerging contaminants of concern of relevance to British Columbia (BC).

### **1.0 Introduction**

The Contaminated Sites Regulation (CSR) Schedule 6 numerical water standards protect aquatic life (AW) and water used for irrigation (IW), livestock watering (LW) and drinking water (DW). The Schedule 6 water standards were derived or adopted from British Columbia (BC) Aquatic Life Water Quality Guidelines (WQGs), Canadian Councils of Ministers of the Environment (CCME) WQGs for the Protection of Aquatic Life, Canadian DW guidelines, and BC DW guidelines. All CSR schedules are being updated as an omnibus package as part of legislative renewal planned for 2016. Thus, an opportunity exists to consider revising current water standards in Schedule 6 during Stage 10 amendments by:

- (1) using current scientific or toxicological information to update a standard or expand upon a standard to include a previously absent use;
- (2) deriving standards for substances where sufficient toxicological information exists, and if derivation is not possible, then adopting WQGs from other jurisdictions;
- (3) including emerging chemical compounds of concern or other new substances of relevance to BC.

This proposal paper will discuss the above considerations. For a current list of Schedule 6 substances and their standards, see: [http://www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/375\\_96\\_08](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/375_96_08).

## 2.0 Methods

### 2.1 Current Protocol

Currently, Schedule 6 provides water quality standards for the protection of aquatic life (AW), irrigation water (IW), livestock watering (LW) and drinking water (DW).

Schedule 6 is currently arranged alphabetically within groups of related compounds and contains only water-related standards. Schedule 6 water standards were derived in accordance with the “Procedure to establish Water Quality Standards used in Contaminated Sites Regulation” [1]. In brief, for AW standards, the derivation protocol involved multiplying the related available WQG from BC MOE or CCME by a factor of 10 as an allowance for an assumed consistent minimum level of dilution in the environment [2]. For IW, LW and DW standards, the related available WQGs from BC MOE, CCME or Health Canada (circa 1996) were adopted outright, and some standards, DW in particular, have been updated in the interim in response to changes by the above jurisdictions. Recently, *de novo* DW standards were derived for Aluminum, Iron and Manganese [3].

In the CSR, water standards are used to derive soil standards for the protection of a site-specific factor (e.g., in Schedule 5, ground water used for human consumption) using the Groundwater Protection Model, which was recently updated as a part of the omnibus CSR Stage 10 amendments [4].

### 2.2 Proposed Protocol for Stage 10 Amendments

It is proposed that the methods and rationales for deriving Schedule 6 standards previously [1, 2, 3] will be retained for use in the omnibus updating of water quality standards, including the 10 fold factor used to calculate AW standards<sup>1</sup>. As a result, it is anticipated that many standards will not require revision unless there is an updated standard available from another jurisdiction that is based on a scientifically credible derivation, or there is widely accepted new scientific information available, which would trigger a derivation of a new standard using methods as described in [1, 2, 3, 5, 6].

The following hierarchy of sources, mainly based on Technical Guidance 7 [7], will be used to inform decisions about the availability and/or suitability of new scientific information used to derive or adopt standards from other jurisdictions:

- *United States (US) Environmental Protection Agency (EPA) (e.g. for toxicity reference values (TRVs)).*
- *Health Canada.*
- *BC MOE approved or working Water Quality Guidelines for the protection of aquatic life, irrigation, livestock or drinking water.*

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<sup>1</sup> The 10 fold factor used to calculate AW standards is not being altered at present but is subject to re-evaluation as a future consideration. See the “Proposed Amendments to Schedule 5 Soil to Water Pathway Standards” white paper by G. Szefer for supporting information.

- *CCME approved or interim Water Quality Guidelines for the protection of aquatic life, irrigation, livestock or drinking water.*
- *Federal Environmental Quality Guidelines (Environment Canada under CEPA, 1999)*
- *The World Health Organization (WHO).*
- *Canadian provincial government agencies (e.g., Ontario MOE).*
- *States in the US (e.g., State of California or Minnesota).*
- *European Union agencies (e.g., REACH).*
- *Nations in the British commonwealth (e.g., Australia, England).*

It is proposed that standards must comply with the level of risk described in CSR, which is 1 in 100,000 or  $10^{-5}$ , but consideration will be given for select compounds that have other levels of risk in their standard derived by other jurisdictions because it may be required by another government body (e.g., BC Ministry of Health or Health Canada).

It is proposed that the protocol to derive DW standards be changed to include consideration of incidental ingestion and inhalation while showering or grooming.

### **3.0 Discussion of Considered Updates and Additions**

#### **3.1 Substances Listed in Schedule 6**

##### **3.1.1 Compounds with absent standards**

*De novo* derivation of standards will be considered for priority substances in which no other jurisdiction has derived a defensible guideline or standard and for which there is deemed a need to develop a standard in BC. It is important to note that for some substances, water quality standards do not exist by design. For example, no AW standards currently exist for iron or manganese. It is proposed that the scope of the *de novo* derivation of standards be prioritized for substances currently considered important contaminants in BC (e.g., PAHs, volatile organic compounds, non-chlorinated phenols, metals) and be limited to AW and DW uses, as time and resources permit. This focus is needed to ensure critical updates to standards for the Stage 10 amendment to the CSR can be achieved. Table A1-1 in Appendix 1 lists substances lacking an AW and/or DW standard (the priority uses in Stage 10 amendments); IW and LW updates or derivations have been deferred to future amendment of the CSR.

##### **3.1.2 Potential changes based on updated toxicological information**

Toxicological knowledge for some Schedule 6 substances has increased over the almost two decades since the CSR was enacted. The Stage 10 CSR amendments present an opportunity to update standards based on widely accepted, recent knowledge regarding some substances. The goal is to use transparent, science-based information to make these changes. Note, however, that some assumptions or considerations (e.g., background concentrations or analytical detection limits) may be used by the ministry in the derivations of revised values but every attempt will be made to remain consistent with

previous derivations [1, 2, 3]. The main criterion for selecting certain substances as candidates for a derived standard from a broader family of related compounds is that there has to be known toxicity of the selected compounds and thereby substantive toxicological information to enable derivations. Two examples of proposed revisions to substances currently in Schedule 6 include:

- Repealing the Schedule 6 non-chlorinated phenols (total) AW standard and replacing with discreet AW standards developed by the ministry for a subset of toxicologically significant non-chlorinated phenols.
- Updating some outdated polycyclic aromatic hydrocarbon (PAH) AW standards (e.g., naphthalene).

Some DW standards listed in Schedule 6 are based on organoleptic endpoints (i.e., taste and odour) and not toxicity. These compounds include: chloride, copper, magnesium, sodium, sulphate, zinc, chlorinated benzenes, ethylbenzene, toluene, xylenes, and chlorinated phenols. It is proposed that these organoleptic based DW standards be repealed and replaced by toxicologically-based standards derived in accordance with the methods used previously to establish toxicity-based DW standards for iron and manganese [3].

### **3.1.3 Refinements**

It is proposed that water quality guidelines for dissolved substances be considered for derivation of, or adoption as, water standards during the omnibus update [8].

## **3.2 Adding Substances**

### **3.2.1 Schedule 10**

The ministry proposes to repeal Schedule 10 during the CSR Stage 10 amendments (2015/2016). Thus, it is proposed that substances with DW standards in Schedule 10 be incorporated in the revised water Schedule W. It is also proposed that current Schedule 10 DW standards be updated to reflect current US EPA DW standards [9] during the Stage 10 amendments. For example, acetone is in Schedule 10 and the value of the DW standard may change based on current toxicological information and the availability of an updated standard.

### **3.2.2 Emerging compounds and new important contaminants**

The scientific fields of chemistry, toxicology, biology, and environmental studies have increased greatly in knowledge since the standards in Schedule 6 were implemented, circa 1997. This section presents a list of substances that could be included for the first time in the CSR. Considerations include whether the substance is present, used or manufactured in BC, as well as the presence or absence of WQGs in other jurisdictions, and whether analytical chemistry methods are available. Table 1 lists substances or families that were considered for addition during Stage 10 amendments and their proposed prioritization (Low or High) for inclusion in the Stage 10 amendment of the

CSR. Appendix 2 has information on the substances and their families as well as additional factors considered.

Table 1. New and emerging compounds (or families of compounds) of environmental concern and relevance to BC and an indication of the proposed priority regarding the development of CSR AW or DW water standards (IW and LW deferred to future amendments). Note, specific chemical names and information on the substances are listed in Appendix 2 as well as details on the consideration of factors leading to prioritization.

<b>Family</b>	<b>Aquatic Life</b>	<b>Drinking Water</b>
<b>New and emerging compounds/parameters</b>	<b>(AW) Priority</b>	<b>(DW) Priority</b>
<b>Alkylated PAHs</b>		
1-methylnaphthalene	High	High
2-methylnaphthalene	High	High
alkylated PAHs (total)	High	High
<b>Alkylphenols and Alkylphenol Ethoxylates</b>		
nonylphenol	High	Low
nonylphenol ethoxylates	High	Low
octylphenol	High	Low
octylphenol	High	Low
alkylphenols (total)	High	Low
alkylphenol ethoxylates (total)	High	Low
<b>Antimicrobials</b>		
triclosan	High	Low
triclocarban	High	Low
<b>Estrogen Hormones</b>		
17 $\alpha$ -ethinylestradiol	High	Low
<b>Naphthenic Acids</b>		
naphthenic acids (individual or total)	Low	Low
<b>Nanometals</b>		
nanocarbon	Low	Low
nanosilver	Low	Low
nanocadmium	Low	Low
nanometals (total)	Low	Low
<b>Paraffins</b>		
paraffins (individual or total)	Low	Low
<b>Parameter</b>		
hardness	High	High

Table 1 continued:

Family	Aquatic Life (AW) Priority	Drinking Water (DW) Priority
<b>New and emerging compounds/parameters</b>		
PBDEs		
triBDE	High	High
tetraBDE	High	High
pentaBDE	High	High
hexaBDE	High	High
heptaBDE	High	High
octaBDE	High	High
PBDEs (total)	High	High
Perfluorinated Substances		
PFOS	High	High
PFOA	High	High
related perfluorinated substances (12)	High	High
Pesticides		
permethrin	High	High
Pharmaceutical and Personal Care Products		
ibuprofen	Low	Low
tonalide	Low	Low
naproxen	Low	Low
Siloxanes		
siloxanes (individual or total)	Low	Low
Speciation of Metals		
selenate	Low	Low
selenite	Low	Low
arsenate	Low	Low
arsenite	Low	Low
chromate	Low	Low

### 3.3 Listing Compounds

Substances in the current version of Schedule 6 are grouped by family, which is an arrangement of grouping related compounds based on chemical class. The current naming convention in Schedule 6 includes the common name and also an abbreviation or a systematic name for some substances. It is proposed to eliminate listing of substances by chemical class in the new Schedule W in favour of a simple alphabetical list using the International Union of Pure and Applied Chemistry (IUPAC) naming convention and a Chemical Abstract Services (CAS) number will be included for further clarity regarding the identity of substances.

## 4.0 Summary of Changes to Schedule 6

### 4.1 Proposed Updates and Additions for 2015/2016, Stage 10 Amendments

1. Integration of Schedule 10 DW standards with current Schedule 6 substances into a new water schedule (tentatively called Schedule W).

2. *De novo* derivation of AW and/or DW standards for some substances currently listed in Schedule 6 that do not have these standards presently (Appendix 1, Table A1-1) or updating of substances which currently have existing AW and DW water standards to reflect derivations based on current toxicological information. For example, this will include non-chlorinated phenols and PAHs. Also, derivations of DW standards for aesthetically-based standards.
3. If derivation is not possible, adoption of updated standards from other jurisdictions for substances currently in Schedule 6. This may include adoption of AW or DW standards for substances that previously did not have AW or DW standards.
4. Inclusion of DW and/or AW water standards for the following families or specific substances of new and emerging contaminants presented in Table 1: perfluorinated compounds, synthetic estrogen hormone, alkylphenols and alcohol ethoxylates, antimicrobials, current use pesticides, and PBDEs. See Table 1 and Appendix 2 for a list of substance names and related additional information.
5. Listing the substances in Schedule W alphabetically by IUPAC systematic names, along with a CAS number, without grouping by related families.

#### **4.2 Next Cycle of Proposed Amendments (deferred or future updates and additions for water standards, Stage 11 amendments and beyond)**

1. Continued revisions to existing water standards for AW, DW, IW and LW uses where new toxicological information exists, or adoption from another jurisdiction is possible, to update a standard or provide a standard for a previously absent use.
2. Consideration of including new substances presented and discussed in Table 1 and Appendix 2 that are not (ultimately) included in the Stage 10 amendments (2015/2016) omnibus update: derivatives of metals, naphthenic acids, alkylated PAHs, chlorinated paraffins, nanotechnology products, and siloxanes, as well as other substances that were missed and could be important contaminants in BC (e.g., some pharmaceuticals, current-use pesticides, and others).
3. Removal of water standards for some outdated or obsolete substances. These substances have not yet been identified. For example, a pesticide may be eliminated if sufficient evidence exists that it is no longer relevant to BC or found in BC, and it is not a bioaccumulative or persistent toxicant, and thus it poses no concern to the mandate of the ministry to protect human health and the environment.

## 5.0 References

- [1] Ministry of Environment (BC). Procedure to establish Water Quality Standards used in Contaminated Sites Regulation. October 4, 1995. File 26000-03/CSSTG. 2 p.
- [2] Ministry of Environment (BC). BC Environment Responses to Expert Panel Recommendations. Sept. 16, 1996. 22 p.
- [3] Ministry of Environment (BC). Generic Numerical Drinking Water Standards for Aluminum, Iron and Manganese. Director's Interim Standards for Contaminated Sites. Effective June 1, 2010 to May 31, 2011. 7 p.
- [4] Ministry of Environment (BC). Groundwater Protection Model (revised 2015) in Technical Guidance 13. <http://www2.gov.bc.ca/gov/topic.page?id=9C64B5E8A88446B5A906A590D3B9A6ED>
- [5] Health Canada. (1995). Canadian Drinking Water Guidelines. Part 1. Approach to the Derivation of Drinking Water Guidelines. Federal-Provincial-Territorial Committee on Drinking Water. Ottawa, Canada. February, 1995.
- [6] Canadian Ministers of the Environment. (2003). Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. Canadian Environmental Quality Guidelines. 146 p.
- [7] Ministry of Environment (BC). (2012). Technical Guidance 7: Supplemental Guidance for Risk Assessments. Version 3. <http://www2.gov.bc.ca/gov/DownloadAsset?assetId=3EADE1EF798944ADA75A6A0009A57054&filename=tg07-v3.pdf>
- [8] Ministry of Environment (BC). Approved Water Quality Guideline: Cadmium. (2015). <http://www2.gov.bc.ca/gov/topic.page?id=044DD64C7E24415D83D07430964113C9&title=Approved%20Water%20Quality%20Guidelines>. 93 p.
- [9] United States Environmental Protection Agency (US EPA). (2014). Regional Screening Levels: Residential Tapwater. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/Generic\\_Tables/docs/restap\\_sl\\_table\\_run\\_NOV2014.pdf](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/docs/restap_sl_table_run_NOV2014.pdf)

*Note, some references are available on Land Remediation, BC MOE, webpages under 'Guidance and Resources' or 'Policies and Standards' (as of May 1, 2015):*

<http://www2.gov.bc.ca/gov/topic.page?id=29DDA7F63D594464B1EEF25659B186B7>

## Appendices for Proposed Updates for 2015/2016 Stage 10 amendments to CSR Water Standards

### Appendix 1

**Table A1-1.** Substances (listed alphabetically) that are missing either AW or DW in the current version of Schedule 6. It is proposed that substances missing AW or DW standards be candidates for standards development during Stage 10 amendments to the CSR. It is proposed that updating or deriving IW and LW standards will be deferred to the future.

Substance	Standard Missing
2,4,5-T (2,4,5-trichlorophenoxy acetic acid)	AW
aluminum	AW*
acenaphthene	DW
acridine	DW
acrolein	AW, DW
ammonia	DW
aniline	DW
anthracene	DW
azinphos-methyl	AW
bendiocarb	AW
benzo[a]anthracene	DW
beryllium	DW
bromate	AW
bromocil	DW
bromodichloromethane	AW
calcium	DW*
captan	DW
chlorine	DW*
chlorothalonil	DW
chrysene	DW
cobalt	DW
cyanide (SAD)	AW
cyanide (WAD)	DW
deltamethrin	DW
di(2-ethylhexyl) phthalate (DEHP)	DW
dibromochloromethane	AW
dibutyl phthalate (DBP)	DW
dichlorobenzene, 1,3-	DW
dichloroethylene, 1,1- (dichloroethene, 1,1-)	AW
di-n-butyltin	DW

diquat	AW
diuron	AW
endosulfan	DW
endrin	DW
ethylene glycol	DW
fluoranthene	DW
fluorene	DW
hexachlorobenzene	AW, DW
hexachlorobutadiene, 1,3	DW
iron	AW*
LEPHw	DW
linuron	DW
lithium	AW, DW
magnesium	AW
manganese	AW*
methoxychlor	AW
naphthalene	DW
nickel	DW
nitritotriacetic acid (NTA)	AW
nonchlorinated phenols (total)	DW
paraquat (as dichloride)	AW
parathion	AW
pentachlorobenzene	DW
phenanthrene	DW
phorate	AW
propylene glycol, 1,2-	DW
pyrene	DW
quinoline	DW
salinity	DW*
silver	DW
sodium	AW
styrene	DW
tebuthiuron	DW
temephos	AW
terbufos	AW
tetrachlorobenzene, 1,2,3,4-	DW
thallium	DW
titanium	DW
toxaphene (all isomers)	DW
tribromomethane (bromoform)	AW
tributyltin	DW
trichlorobenzene, 1,2,3-	DW
trichlorobenzene, 1,2,4-	DW

tricyclohexyltin	AW, DW
triethyltin	DW
triphenyltin	DW
vanadium	AW, DW
vinyl chloride	AW
VPHw	DW*
xylene (total)	AW

\*This standard was intentionally omitted from Schedule 6 previously and will remain absent in the omnibus update.

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## Appendix 2

**Table A2-1.** List of substances (with Chemical Abstract Service (CAS) # and other information) proposed to be added to the revised water schedule for the CSR Stage 10 amendments; the priority is adding AW and DW standards for each substance, if possible. Corresponding matrix soil standards may be developed using the Groundwater Protection Model [4] if sufficient information exists for a substance regarding its physical and chemical properties (e.g., Henry's Law constant).

Family	Substance (common name and/or abbreviation)	CAS #	Additional Information
Perfluorinated Compounds (PFCs)	perfluorooctanesulfonic acid or perfluorooctane sulfonate (PFOS)	1763-23-1	IUPAC name: heptadecafluorooctanesulfonic acid
	perfluorooctanoic acid or perfluorooctanoate (PFOA)	335-67-1	IUPAC name: pentadecafluorooctanoic acid
	14 additional PFCs that could be regulated, if sufficient toxicological data exists		See Maxxam Analytics guide to PFCs (14 other PFCs and overview of DW standards in other jurisdictions):  Maxxam_env_PFCs_06282014.pdf  Alternatively, US EPA analytical method "537 Rev 1.1":  US EPA PFCs Method 537_FINAL_rev1.1.pdf
Estrogen Hormones	17 $\alpha$ -ethinylestradiol (EE2)	57-63-6	IUPAC name: 19-nor-17 $\alpha$ -pregna-1,3,5(10)-trien-20-yne-3,17-diol  US EPA analytical method:  US EPA Hormones Method 539.pdf  <a href="http://water.epa.gov/scitech/drinkingwater/labcert/analyticalmethods_ogwdw.cfm">http://water.epa.gov/scitech/drinkingwater/labcert/analyticalmethods_ogwdw.cfm</a>

Alkylphenols and Alcohol Ethoxylates	nonylphenol and its ethoxylates or carboxylates  octylphenol  and its ethoxylates or carboxylates	84852-15-3 25154-52-3 104-40-5 104-35-8 (and 19 more CAS #s)  27193-28-8 (or 1806-26-4, 140-66-9) 68987-90-6 9002-93-1 9036-19-5	<p>Many individual compounds can be called an ethoxylate or carboxylate of nonylphenol (or octylphenol) due to branching or position relative to the phenol group. Therefore, it is possible that a toxic equivalency approach could be used for a standard, as described in the "Canadian WQG for the Protection of Aquatic Life" document:</p>  <p>CCME Nonylphenol and its ethoxylates (er</p> <p>Analytical method from ASTM "Standard Test Method for Determination of Nonylphenol, Bisphenol A, p-tert -Octylphenol, Nonylphenol Monoethoxylate and Nonylphenol Diethoxylate in Environmental Waters by Gas Chromatography Mass Spectrometry": <a href="http://www.astm.org/Standards/D7065.htm">http://www.astm.org/Standards/D7065.htm</a></p> <p>Federal Environmental Quality Guidelines (FEQGs): <a href="http://www.ec.gc.ca/ese-ees/default.asp?lang=En&amp;n=164786DB-1">http://www.ec.gc.ca/ese-ees/default.asp?lang=En&amp;n=164786DB-1</a></p>
Antimicrobials	triclosan  triclocarban	3380-34-5  101-20-2	<p>Phenol, 5-chloro-2-(2,4-dichlorophenoxy)</p> <p>N-(3,4-Dichlorophenyl)-N'-(4-chlorophenyl)urea</p>
Current-use Pesticides	permethrin  mancozeb(?)  others from Env Canada program(?)	52645-53-1	 <p>CCME Permethrin (en).pdf</p>  <p>PresenceAndLevelsOf PriorityPesticidesInSel</p> <p>Axys analytical method includes 64</p>

		priority pesticides: <a href="http://www.axysanalytical.com/services/specialty_analysis/current_use_pesticides/">http://www.axysanalytical.com/services/specialty_analysis/current_use_pesticides/</a>
Hardness	Parameter calculated from the concentration of calcium and magnesium in water samples (units are mg/L of CaCO <sub>3</sub> )	Propose to develop a definition of hardness in the CSR, and to specify whether dissolved or total hardness is required with a water standard where hardness modifies the water standard.  Additionally, a standard may be developed that follows the future draft BC Ministry of Environment Water Protection and Sustainability Section's hardness WQG (or guidance document).
PBDEs	triBDE tetraBDE pentaBDE hexaBDE heptaBDE octaBDE	FEQGs: <a href="http://www.ec.gc.ca/ese-ees/default.asp?lang=En&amp;n=05DF7A37-1">http://www.ec.gc.ca/ese-ees/default.asp?lang=En&amp;n=05DF7A37-1</a>

**Table A2-2.** New and emerging compounds (or families of compounds) of environmental concern and relevance to BC and the main uses or anthropogenic factors for those substances, parameters regarding the relevance of including those substances, and a recommendation regarding the development (or not) of CSR standards in Stage 10 amendments to the CSR.

<i>Family and Substance(s)</i>	Uses or Anthropogenic Factors	Implications		Recommendation
<p><i>Perfluorinated Compounds</i></p> <p>Perfluorooctanesulfonic acid or perfluorooctane sulfonate (PFOS)</p> <p>Perfluorooctanoic acid or perfluorooctanoate (PFOA)</p>	<p>Used in:</p> <p>-fabric protectors, stain repellants</p> <p>-fire-fighting foams</p> <p>-aviation hydraulic fluids</p>	Persistent	Y	<p>Develop CSR standards in Stage 10 amendments.</p> <p>Widespread toxicant from consumer products (found in human and animal tissues); these compounds are of serious international concern. Landfills, airports and fire suppression would most likely be the main industrial or commercial activities in BC impacted by regulation.</p> <p>CCME has draft PFOS standards and a contractor working on PFOA standards. Possibly, use the CCME data sets in derivations or adopt the CCME guidelines as standards.</p>
		Toxic	Y	
		Carcinogenic	Y	
		Present in BC	Y*	
		Concerning (in BC)	Y	
<p>*airports, fire fighting training facilities, furniture manufacturing?, landfill leachates, waste water treatment plants</p>				
<p><i>Derivatives of Metals</i></p> <p>Selenate (<math>\text{SeO}_4^{2-}</math>)</p> <p>Selenite (<math>\text{SeO}_3^{2-}</math>)</p> <p>Arsenate (<math>\text{AsO}_4^{3-}</math>)</p> <p>Arsenite (<math>\text{AsO}_3^{3-}</math>)</p> <p>Chromate (<math>\text{CrO}_4^{2-}</math>)</p> <p>... and more.</p>	<p>Anthropogenic Factors:</p> <p>-released by mining activities; found in tailings or leachate</p>	Persistent	Y	<p>Do not develop CSR standards at this point in time.</p> <p>Potentially add standards, if possible, in future amendments (i.e., deferred to Stage 11).</p> <p>The toxicity of these forms of metals is modified in competition with sulphate or other parameters.</p>
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y	
<p>*downstream of mining activities or natural mineralized regions</p>				

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation
<i>Natural and Synthetic Estrogen Hormones</i> 17 $\alpha$ -ethinylestradiol (EE2) 17 $\beta$ -estradiol (E2) Estrone (E1) Estriol (E3)	Anthropogenic Factors: -excreted by vertebrates both naturally and as a result of prescription hormone usage -used in aquaculture facilities for reproduction timing	Persistent	Y?	Develop CSR standards in Stage 10 amendments.  A BC WQG exists for EE2 (FW). EE2 is a synthetic estrogen; thus, it will only be found as a result of anthropogenic activities. EE2 may be able to break down into E2 or E1, which are both natural estrogen hormones (inter-convertible). It is proposed that the EE2 WQG be adopted as-is in Stage 10 but that standards for other estrogen hormones not be developed at this time.
		Toxic	Y	
		Carcinogenic	N	
		Present in BC	Y*	
		Concerning (in BC)	Y	
		*aquaculture, waste water treatment plants, biosolid applications (remediation at mines, and agriculture)		
<i>Alkylphenols and Alcohol Ethoxylates</i> Nonylphenol and its ethoxylates Octylphenol and its ethoxylates	Anthropogenic Factors: -widely used surfactants, in consumer products as well as pesticide formulations; used in manufacturing of textiles and many other industries.	Persistent	Y	Develop CSR standards in Stage 10 amendments.  Widespread toxicant from consumer products; these compounds are of serious international concern.  New Federal Guidelines are coming. Possibly, these could be adopted as standards or the data sets could be used to derive standards.
		Toxic	Y	
		Carcinogenic	N	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*waste water treatment plants, biosolid applications, various industrial applications (secondary products)		

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation	
<p><i>Antimicrobial Products</i></p> <p>Triclosan</p> <p>Triclocarban</p>	<p>Anthropogenic Factors: -additives to consumer products (soaps, toothpastes, socks, backpacks, etc.) -triclosan is one of the most commonly found substances in surface water downstream of sewage discharges</p>	Persistent	Y	<p>Develop CSR standards in Stage 10 amendments.</p> <p>Widespread toxicant from consumer products; these compounds are of serious international concern.</p> <p>Under FDA review; WQGs in some US states.</p>	
Toxic	Y	Carcinogenic	N?		
Present in BC	Y*	Concerning (in BC)	Y?		
<p>*waste water treatment plants, biosolid applications, various industrial applications?, landfill leachate</p>					
<p><i>Naphthenic Acids</i></p> <p>Large family of diverse compounds, all based on naphthalene.</p>		Anthropogenic Factors:	Y?		<p>Do not develop CSR standards at this point in time.</p> <p>Relatively new toxicants, toxicological profile still emerging. A standard could be the total sum of related compounds, with further analysis triggered if a total value is exceeded.</p> <p>Important nationally - federal investigations into oil sands. Could be applicable in some areas of BC (e.g. Northeast sector). However, toxicity information is still being researched and not widely available yet.</p>
-products of oil and gas activities; each O&G activity can result in a unique set of compounds		Toxic	Y		
		Carcinogenic	N?		
		Present in BC	Y*		
		Concerning (in BC)	Y		
		<p>*oil and gas activities: refineries, spills, etc.</p>			

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation
<i>Current Use Pesticides</i>  Permethrin	Uses: -agricultural, industrial, pest control	Persistent	N?	Develop CSR standards in Stage 10 amendments.
		Toxic	Y?	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*waste water, storage and transport locations, agricultural run-off, precipitation		
<i>Nanotechnology Products</i>  Nanocarbons  Nanosilver  Nanocadmium  Nanotellurium  "Quantum dots"	Uses: -semiconductors and technology (nanocarbons) -antimicrobial in consumer products (nanosilver) -medical imaging and laboratory assays (nanocadmium, nanotellurium, nanocopper, and more)	Persistent	Y	Do not develop CSR standards at this point in time.  These compounds are simply too new, with too many unknowns to consider their adverse toxic effects (although fish immune impacts are known) and/or fate and transport in BC.
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*waste water treatment plants, biosolid applications, various industrial applications?, landfill leachate		

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation
<p><i>Alkylated PAHs</i></p> <p>Large family of diverse compounds. Example: 1-methylnaphthalene</p>	<p>Anthropogenic Factors: -products of oil and gas activities; each O&amp;G activity can result in a unique set of compounds -other industrial activities?</p>	Persistent	Y	<p>Develop CSR standards in Stage 10 amendments.</p> <p>New federal standards coming in 2015. Possibly, use the federal data set in derivations or adopt the federal guidelines as standards.</p>
		Toxic	Y	
		Carcinogenic	Y	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*oil and gas activities: refineries, spills, etc.		
<p><i>Pharmaceuticals and Personal Care Products</i></p> <p>Naproxen</p> <p>Ibuprofen</p> <p>Salicylic Acid</p> <p>Musks (e.g., tonalide)</p> <p>(other prescription medicines)</p>	<p>Anthropogenic Factors: -found in surface waters, tend to be water soluble and long-lived (pseudopersistence) -additives to consumer products (soaps, toothpastes, socks, backpacks, etc.)</p>	Persistent	Y?	<p>Do not develop CSR standards at this point in time.</p> <p>Widespread toxicants in surface waters downstream of waste water treatment plants and also present in leachates from landfills.</p> <p>Some substances under FDA or EPA review; WQGs in some US states.</p>
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*waste water treatment plants, biosolid applications, various industrial applications?, landfill leachate		

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation
<p><i>Hardness</i></p> <p>Secondary consideration: Artificially increasing hardness could mask the toxicity of some substances but once significant dilution occurs (e.g., downstream), then those substances may cause adverse effects.</p>	<p>Anthropogenic Factors: -various industrial activities can release substances that alter hardness. For example, sulphate, nitrate, carbonate, among others.</p> <p>Widespread problem in surface waters downstream of various anthropogenic activities.</p>	Persistent	N	<p>Develop a CSR definition and standard, if possible, during Stage 10 amendments.</p> <p>Under BC MOE review - possibly adopt Water Protection and Sustainability Section's future draft hardness criteria or guidance.</p>
		Toxic	Y	
		Carcinogenic	N	
		Present in BC	Y*	
		Concerning (in BC)	Y	
		*waste water treatment plants, biosolid applications, various industrial applications, landfill leachate, mining activities, oil and gas activities		
<p><i>Paraffins</i></p> <p>Saturated hydrocarbons that are linear, branched or cyclic</p>		Persistent	Y?	<p>Do not develop CSR standards at this point in time.</p> <p>New federal guidelines coming out (2015). Possibly, use the federal data set in derivations or adopt the federal guidelines as standards.</p>
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y?	
		*waste water treatment plants, biosolid applications, various industrial applications?, landfill leachate		

Family and Substance(s)	Uses or Anthropogenic Factors	Implications		Recommendation
<p><i>PBDEs (polybrominated diphenyl ethers)</i></p> <p>Large family of related brominated compounds, similar in persistence and bioaccumulation to historic chlorinated contaminants.</p>	<p>Anthropogenic Factors: -various industrial activities cause releases and also widely used in consumer products (in foams, plastics, etc. for fire retardant purposes).</p> <p>Widespread problem in surface waters, sediments, soils and ground water downstream of various anthropogenic activities.</p>	Persistent	Y	<p>Develop CSR standards in Stage 10 amendments.</p> <p>New federal environmental quality guidelines available. Possibly, use the federal data set in derivations or adopt the federal guidelines as standards.</p>
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y	
		*waste water treatment plants, storm water, various industrial applications, landfill leachate, fire-fighting activities, oil and gas activities?		
<p><i>Siloxanes</i></p> <p>Family of branched organosilicone compounds.</p>	<p>Anthropogenic Factors: -widely used by consumers, including cosmetics, personal care products, and also used in food industry</p>	Persistent	Y?	<p>Do not develop CSR standards at this point in time.</p> <p>New federal guidelines coming out (2015).</p>
		Toxic	Y	
		Carcinogenic	N?	
		Present in BC	Y*	
		Concerning (in BC)	Y	
		*waste water treatment plants, biosolid applications, various industrial applications, landfill leachate		