

xałəmət ct tə səlılwət / Water Quality Objectives for səlılwət (Burrard Inlet)

British Columbia Ministry of Environment & Parks and Tsleil-Waututh Nation



May 2026



Tsleil-Waututh Nation
səlılwətəl



The **Water Quality Objective Series** is a collection of British Columbia (B.C.) Ministry of Environment and Parks water quality objectives reports. Water quality objectives are developed for a specific body of water to promote the protection and stewardship of provincially significant water resources. The səliłwət/Burrard Inlet water quality objectives constitute formal Ministry policy and must be considered along with other policies and procedures by statutory decision makers working under the *Environmental Management Act*. The policy may also be used by other agencies to inform resource management or land use decisions. For additional information visit:

<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives>

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The water quality objectives presented here are based on work to update the səliłwət/Burrard Inlet Water Quality Objectives, led by the Tsleil-Waututh Nation (TWN), in collaboration with the B.C. Ministry of Environment and Parks (ENV) the B.C. Ministry of Water, Land and Resource Stewardship (WLRS) and the B.C. Ministry of Health (HLTH). Progress on this work has been supported by:

- The project Coordination Team including: Anuradha Rao and Kate Menzies (TWN), Diane Sutherland and Kristy Gabelhouse (ENV), and Nicole Obee (WLRS).
- The Burrard Inlet Water Quality Technical Working Group and Roundtable (including representatives of First Nations, local, provincial, and federal government agencies, Health Authorities, industry, academia, and non-government organizations).
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This May 2026 version replaces previous versions and should be considered the official document for the xałəmət ct tə səliłwət / Water Quality Objectives for səliłwət (Burrard Inlet).

The xələmət ct tə səliłwət / Water Quality Objectives (WQOs) for səliłwət (Burrard Inlet) represent a collaborative effort led by Tsleil-Waututh Nation (TWN) with the Province of British Columbia (the Province), represented by the Ministry of Environment and Parks (ENV) and the Ministry of Water, Land, and Resource Stewardship (WLRS). The WQOs have been co-developed by TWN, ENV, and WLRS and are benchmarks to inform the management of water quality in səliłwət/Burrard Inlet and protect the water values for the benefit of all.

While approval of the səliłwət/Burrard Inlet WQOs does not imply any obligation to conduct monitoring by either the Province of B.C. or TWN, efforts will be made to continue monitoring the water quality of səliłwət/Burrard Inlet. The Province of B.C. and TWN recognize that improving and protecting the water quality of səliłwət/Burrard Inlet requires a collective approach from all governments, jurisdictions, sectors and stakeholders.

Signed on behalf of TWN:

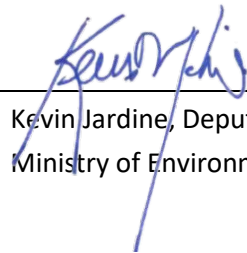


Erin Hanson, Acting Director
Treaty, Lands and Resources
Tsleil-Waututh Nation

Date:

May 26, 2026

Signed on behalf of the Province of British
Columbia:



Kevin Jardine, Deputy Minister
Ministry of Environment and Parks

Date:

May 20, 2026

EXECUTIVE SUMMARY

Tsleil-Waututh means “People of the Inlet”, referring directly to səliłwət (Burrard Inlet) up to the Indian River and including Indian Arm. We were born with a sacred obligation to protect the waters. It’s really important to weave together western science and Indigenous science. The Inlet is coming back, but we need more. We have to do this work together. You’re not going anywhere. We’re not going anywhere. We have to find a way to co-exist. We have that shared responsibility. That’s what Tsleil-Waututh has done from the very beginning. We know we have to build those relationships around us because we can’t do the work alone. We’re looking in the same direction. We have to weave all our knowledge together so that our grandchildren will be able to grow up on the mudflats like we did as kids.

- Carleen Thomas, Tsleil-Waututh Nation

Tsleil-Waututh means “People of the Inlet”, demonstrating TWN’s deep relationship to the water body known as Burrard Inlet - səliłwət in the hənqəmihəm language – since time out of mind. Water quality objectives (WQOs) for səliłwət/Burrard Inlet were previously developed by the Province of B.C. in 1990. The səliłwət/Burrard Inlet WQOs have been updated to promote the protection of water quality and the associated water values. The development of the updated xələmət ct tə səliłwət / Water Quality Objectives for səliłwət (Burrard Inlet) has been undertaken in partnership between the Province of British Columbia (the Province), represented by the Ministry of Environment and Parks (ENV) and the Ministry of Water, Land and Resource Stewardship (WLRS), and Tsleil-Waututh Nation (TWN), and demonstrates the Province’s commitment to implementing the *Draft Principles that Guide the Province of British Columbia’s Relationship with Indigenous Peoples*. Updating the WQOs is the first of six priority actions proposed by TWN in their 2017 Burrard Inlet Action Plan. TWN has provided leadership in initiating inter-agency collaboration, overall project management, and conducting the technical assessments required for the project. Updating the WQOs lays the foundation for further efforts to protect the water quality and values of səliłwət/Burrard Inlet.

The WQOs for səliłwət/Burrard Inlet marine waters are to protect human consumption of shellfish, human consumption of finfish, aquatic life, wildlife, cultural practices, recreational uses, and institutional water uses. The WQOs for freshwater tributaries to səliłwət/Burrard Inlet are provided in a separate policy document.

This report presents updated and existing WQOs for the marine waters of səliłwət/Burrard Inlet, including the Central, Inner and Outer Harbours, False Creek, Indian Arm, and Port Moody Arm. The updated WQOs are based on extensive technical assessments led by TWN, undertaken by Qualified Professionals, with input from the Province and formally approved by both TWN and the Province.

The WQOs are summarized in the following tables, and are established for contaminants of emerging concern, metals, microbiological indicators, microplastics, nutrients, oil and grease, polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs or dioxins), and polychlorinated dibenzofurans (PCDFs or furans), polycyclic aromatic hydrocarbons (PAHs), pesticides, pharmaceuticals and personal care products, and physical parameters. The absence of a specific water quality parameter in the WQOs does not imply its irrelevance to səliłwət/Burrard Inlet; reducing contamination of any kind in səliłwət/Burrard Inlet stands as an overarching objective.

Readers should refer to the supporting technical reports available online for more complete information on each parameter. If there is a discrepancy between the values in the policy document and the supporting technical reports, the policy document should be followed.

Technical reports are here: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-objectives/south-coast-region-water-quality-objectives/burrard-inlet-water-quality-objectives>

Parameters – All Anthropogenic Inputs to səlilwət/Burrard Inlet

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water, sediment, tissue	Should not be present; if detected, then decreasing concentrations from current levels					

Contaminants of Emerging Concern

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
All	All CECs: decreasing concentrations from current levels					
Water	Alkylphenols and their Ethoxylates Nonylphenol and its Ethoxylates: 0.7 µg/L (max) (total toxic equivalent of nonylphenolic compounds)					
	Bisphenols Bisphenol A (BPA): 0.9 µg/L (max)					
	Phthalates Di-methyl phthalate (DMP): 2000 µg/L (max) Di-ethyl phthalate (DEP): 600 µg/L (max) Di-n-butyl phthalate (DnBP): 30 µg/L (max) Benzyl butyl phthalate (BBP): 0.1 µg/L (max) Di-(2-ethylhexyl) phthalate (DEHP): 0.37 µg/L (max) Di-n-octyl phthalate (DnOP): Do not detect ¹ and/or decrease from current levels					
	6PPD and 6PPD-quinone 6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins Tributyltin (TBT): 0.001 µg/L (max)					
	Brominated Flame Retardants Hexabromocyclododecane (HBCD): 0.56 µg/L (max) Tetrabromobisphenol A (TBBPA): 3.1 µg/L (max) Hexabromobenzene (HBB): Do not detect ¹ and/or decrease from current levels					
	Perfluoroalkyl and Polyfluoroalkyl Substances Perfluorooctanoic acid (PFOA): Do not detect ¹ and/or decrease from current levels Perfluorooctanesulfonic acid (PFOS): 3.4 µg/L (max)					
	Sediment	Alkylphenols and their Ethoxylates Nonylphenol and its Ethoxylates: 1.0 µg/g dry weight (max) (total toxic equivalent of nonylphenolic compounds; adjust objective to site-specific levels of total organic carbon [TOC])				
Bisphenols BPA: 0.025 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)						
Phthalates DMP: 0.53 µg/g dry weight (max) (adjust objective to site-specific levels of TOC) DEP: 0.61 µg/g dry weight (max) (adjust objective to site-specific levels of TOC) DnBP: 2.2 µg/g dry weight (max) (adjust objective to site-specific levels of TOC) BBP: 0.049 µg/g dry weight (max) (adjust objective to site-specific levels of TOC) DEHP: 0.47 µg/g dry weight (max) (adjust objective to site-specific levels of TOC) DnOP: 0.58 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)						

Contaminants of Emerging Concern *continued*

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Sediment	6PPD and 6PPD-quinone 6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins Do not detect ¹ and/or decrease from current levels					
	Brominated Flame Retardants HBCD: 1.6 µg/g dry weight (max) TBBPA: 0.6 µg/g dry weight (max) HBB: Do not detect ¹ and/or decrease from current levels					
	Perfluoroalkyl and Polyfluoroalkyl Substances PFOA: Do not detect ¹ and/or decrease from current levels PFOS: Do not detect ¹ and/or decrease from current levels					
Tissue	Alkylphenols and their Ethoxylates Nonylphenol and its Ethoxylates: 0.018 µg/g wet weight (max)					
	Bisphenols BPA: Do not detect ¹ and/or decrease from current levels					
	Phthalates DMP: Do not detect ¹ and/or decrease from current levels DEP: Do not detect ¹ and/or decrease from current levels DnBP: Do not detect ¹ and/or decrease from current levels BBP: Do not detect ¹ and/or decrease from current levels DEHP: Do not detect ¹ and/or decrease from current levels DnOP: Do not detect ¹ and/or decrease from current levels					
	6PPD and 6PPD-quinone 6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins TBT: 0.0088 µg/g wet weight (max) Organotins: 0.0088 µg/g wet weight (max)					
Brominated Flame Retardants HBCD: Do not detect ¹ and/or decrease from current levels TBBPA: Do not detect ¹ and/or decrease from current levels HBB: 0.070 µg/g wet weight (max)						
Perfluoroalkyl and Polyfluoroalkyl Substances PFOA: 0.0007 µg/g wet weight (max) PFOS: 0.0021 µg/g wet weight (max)						

¹Any objective of 'do not detect' implies non-detection when using best available detection limits.

Metals

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Arsenic (total)	Water	2.4 µg/L (mean) ¹					
	Sediment	7.24 µg/g dry weight (max) ²					
	Tissue	0.0018 µg/g wet weight (max) ³					
Cadmium (total)	Water	0.12 µg/L (mean) ¹					
	Sediment	0.7 µg/g dry weight (max) ²					
	Tissue	0.03 µg/g wet weight ³					

Metals continued

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Chromium (total)	Water	Cr VI: 1.5 µg/L, Cr III: 56 µg/L (mean) ¹					
	Sediment	52.3 µg/g dry weight (max) ²					
	Tissue	Cr VI: 0.08 µg/g wet weight (max) ³					
Copper (total)	Water	1.3 µg/L (mean) ¹					
	Sediment	18.7 µg/g dry weight (max) ²					
	Tissue	15 µg/g wet weight (max) ³					
Lead (total)	Water	2 µg/L (mean) ¹					
	Sediment	30.2 µg/g dry weight (max) ²					
	Tissue	0.16 µg/g wet weight (max) (short-term to 2025) ³					
0.070 µg/g wet weight (max) (long-term by 2050) ³							
Manganese (total)	Water	22.6 µg/L (mean) ¹					
Mercury (total)	Water	0.016 µg/L (mean) ¹					
	Sediment	0.13 µg/g dry weight (max) ²					
	Tissue	0.033 µg/g wet weight (max) ³					
Nickel (total)	Water	0.8 µg/L (mean) ¹					
	Sediment	30 µg/g dry weight (max) ²					
	Tissue	0.42 µg/g wet weight (max) ³					
Selenium (total)	Sediment	2 µg/g dry weight (max) ²					
	Tissue	0.21 µg/g wet weight (max) ³					
Silver (total)	Water	0.5 µg/L (mean) ¹					
	Sediment	1 µg/g dry weight (max) ²					
Thallium (total)	Water	0.27 µg/L (mean) ¹					
Zinc (total)	Water	10 µg/L (mean) ¹					
		55 µg/L (maximum – level not to be exceeded at any time)					
	Sediment	124 µg/g dry weight (max) ²					
	Tissue	17 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

Microbiological Indicators

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Short-term: 2021 - 2025							
Fecal coliforms (MPN/100 mL)	Water (shellfish harvest)						≤14 (median); ≤10% of results >43
<i>E. coli</i> (CFU or MPN/100mL)	Water	≤1,000 (geo mean) ^{1,2}	≤200 (geomean) ^{1,3} ; ≤400 (max) ^{3,4}				
Enterococci (MPN/100 mL)	Water (shellfish harvest)						≤4 (median); ≤11 (90 th percentile)
Enterococci (CFU or MPN/100 mL)	Water	≤175 (geo mean) ^{1,2}	≤35 (geomean) ^{1,3} ; ≤70 (max) ^{3,4}				
Medium-term: 2025 - 2050							
Fecal coliforms (MPN/100 mL)	Water (shellfish harvest)		≤14 (median); ≤10% of results >43		≤14 (median); ≤10% of results >43		
<i>E. coli</i> (CFU or MPN/100mL)	Water		≤200 (geo mean) ^{1,3} ; ≤400 (max) ^{3,4}				
Enterococci (MPN/100 mL)	Water (shellfish harvest)		≤4 (median); ≤11 (90 th percentile)		≤4 (median); ≤11 (90 th percentile)		
Enterococci (CFU or MPN/100 mL)	Water		≤35 (geo mean) ^{1,3} ; ≤70 (max) ^{3,4}				
Long-term: 2050 onwards							
Fecal coliforms (MPN/100 mL)	Water		≤14 (median); ≤10% of results >43				
<i>E. coli</i> (CFU or MPN/100mL)	Water		≤200 (geomean) ^{1,3} ; ≤400 (max) ^{3,4}				
Enterococci (MPN/100 mL)	Water (shellfish harvest) ⁵		≤4 (median); ≤11 (90 th percentile)				

¹ Geomean is based on at least 5 weekly samples over a 30-day period. Compare geomean to WQO.²To protect secondary contact activities only (Health Canada 2012).

³To protect both primary and secondary contact activities (ENV 2019).

⁴Single sample maximum allowable concentration.

⁵Note that these thresholds are lower than thresholds for recreation and cultural practices, and therefore also protect these values.

Microplastics

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Microplastics	Water	No increase over current levels - short-term WQO to 2025 Decrease from current levels - long-term WQO by 2050					
	Sediment						
	Tissue						

Nutrients

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total ammonia nitrogen	Water	See criteria table from the B.C. Water Quality Guidelines (mean) ¹ . If toxicity modifying factors (salinity, pH, and temperature) were not measured, the objective is 23 mg/L for ammonia as N (mean). ¹					

¹ Mean is based on at least 5 weekly samples over a 30-day period. Compare mean to WQO.

Oil and Grease

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	Should not be present					

PBDEs

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
PBDEs (all)	All	Decreasing concentrations from current levels					
PBDEs (total)	Sediment	1 ng/g dry weight (max)					
Tri-BDE (total)	Water	46 ng/L (mean) ¹					
	Tissue	120 ng/g wet weight (max)					
Tetra-BDE (total)	Water	24 ng/L (mean) ¹					
	Tissue	44 ng/g wet weight (max)					
Tetra-BDE-47	Tissue	4 ng/g wet weight (max)					
Penta-BDE (total)	Water	0.2 ng/L (mean) ¹					
	Tissue	1 ng/g wet weight (max)					
Hexa-BDE (total)	Water	120 ng/L (mean) ¹					
	Tissue	4 ng/g wet weight (max)					
Hepta-BDE (total)	Water	17 ng/L (mean) ¹					
	Tissue	64 ng/g wet weight (max)					
Octa-BDE (total)	Water	17 ng/L (mean) ¹					
	Tissue	63 ng/g wet weight (max)					
Nona-BDE (total)	Tissue	78 ng/g wet weight (max)					
Deca-BDE (total)	Tissue	9 ng/g wet weight (max)					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO.

PCBs, PCDDs, and PCDFs

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total PCBs	Water	6.2 x 10 ⁻⁴ ng/L (max)					
2,3,7,8-TCDD		5.1 x 10 ⁻⁶ ng/L (max)					
Total PCBs	Sediment	3.7 x 10 ⁻⁶ µg/g (dry weight) (max)					
Total PCDDs and PCDFs		8.5 x 10 ⁻⁷ µg/g (dry weight) (max)					
Total PCBs	Tissue	3.47 x 10 ⁻⁴ µg/g (wet weight) (max)					

PCBs, PCDDs, and PCDFs continued

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total PCDDs, PCDFs, and Dioxin-like PCBs	Tissue	8.0 x 10 ⁻⁸ µg/g (wet weight) (max)					
PCBs, PCDDs, and PCDFs	All	Decreasing concentrations from current levels					

PAHs

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Acenaphthene	Water	6 µg/L (mean) ¹					
	Sediment	6.71 ng/g dry weight (max) ²					
Anthracene	Sediment	46.9 ng/g dry weight (max) ²					
Benzo(a)pyrene ³	Water	0.01 µg/L (mean) ¹					
	Sediment	88 ng/g dry weight (max) ²					
	Tissue	0.0025 µg/g wet weight (max) ⁴					
Benzofluoranthene ⁵	Sediment	2.3 µg/g dry weight (max) ²					
Chrysene	Water	0.1 µg/L (mean) ¹					
	Sediment	108 ng/g dry weight (max) ²					
Fluoranthene	Sediment	113 ng/g dry weight (max) ²					
Fluorene	Water	12 µg/L (mean) ¹					
	Sediment	21.2 ng/g dry weight (max) ²					
Naphthalene	Water	1 µg/L (mean) ¹					
	Sediment	34.6 ng/g dry weight (max) ²					
2-methylnaphthalene	Sediment	20 ng/g dry weight (max) ²					
Phenanthrene	Sediment	86.7 ng/g dry weight (max) ²					
Pyrene	Sediment	153 ng/g dry weight (max) ²					

¹ Mean is based on at least 5 weekly samples over a 30-day period. Compare mean to WQO.

² Based on a minimum of 1 composite sample composed of at least 3 replicates. Compare maximum to WQO.

³ The benzo(a)pyrene WQO provides a benchmark to evaluate exposures to mixtures of carcinogenic PAHs by totaling their measured concentrations adjusted according to their potency equivalence factors (Health Canada 2021). See text and Table 25 for details.

⁴ Based on a composite sample consisting of at least 5 individual fish or 25 bivalves. Compare maximum to WQO.

⁵ This objective applies to the sum of all benzofluoranthenes. Concentrations are expressed in terms of sediment containing 1% organic carbon. Adjustments to guidelines are required for sediment with different organic carbon content.

Pesticides

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
All pesticides	All	Decreasing concentrations from current levels					
Legacy Pesticides							
Aldicarb	Water	Not available					
	Sediment	Not available					
	Tissue	0.0351 µg/g wet weight (max)					
Aldrin	Water	0.000077 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels ⁴					

Pesticides *continued*

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Chlordane	Water	0.000093 µg/L (max)					
	Sediment	0.00226 µg/g dry weight (max)					
	Tissue	0.0026 µg/g wet weight (max)					
2,4,6-Trichlorophenol	Tissue	0.161 µg/g wet weight (max)					
2,4-Dichlorophenol	Tissue	3.47 µg/g wet weight (max)					
2,3,4,6-Tetrachlorophenol	Tissue	0.35 µg/g wet weight (max)					
Monochlorophenol	Water	0.1 µg/L (max)					
Total Dichlorophenols	Water	0.3 µg/L (max)					
Total Tetrachlorophenols	Water	1 µg/L (max)					
Total Trichlorophenols	Water	2 µg/L (max)					
DDE	Water	0.000018 µg/L (max)					
	Sediment	0.00207 µg/g dry weight (max)					
	Tissue	0.01 µg/g wet weight (max)					
DDT	Water	0.000025 µg/L (max)					
	Sediment	0.00119 µg/g dry weight (max)					
	Tissue	0.01 µg/g wet weight (max)					
DDD	Water	Not available					
	Sediment	0.00122 µg/g dry weight (max)					
	Tissue	0.014 µg/g wet weight(max)					
Diazinon	Water	0.03 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Dieldrin	Water	0.0000012 µg/L (max)					
	Sediment	0.00071 µg/g dry weight (max)					
	Tissue	0.00020 µg/g wet weight (max) ⁴					
Endosulfan	Water	0.0016 µg active ingredient/L (max)					
	Sediment	Not available					
	Tissue	0.21 µg/g wet weight (max)					
Endrin	Water	0.0023 µg/L (max)					
	Sediment	0.00267 µg/g dry weight (max)					
	Tissue	0.011 µg/g wet weight (max)					
Heptachlor	Water	0.0000059 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels ⁴					
Hexachlorobenzene	Water	0.000079 µg/L (max)					
	Sediment	0.0038 µg/g dry weight (max)					
	Tissue	0.002 µg/g wet weight (max)					
Methoxychlor	Water	0.02 µg/L (max)					
	Sediment	Not available					
	Tissue	0.17 µg/g wet weight (max)					
Mirex	Water	Not available					
	Sediment	Not available					
	Tissue	0.007 µg/g wet weight (max)					
Oxy-chlordane	Water	Not available					
	Sediment	Not available					
	Tissue	Do not detect ³ and/or decrease from current levels					

Pesticides *continued*

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Toxaphene	Water	Not available					
	Sediment	0.0001 µg/g dry weight (max)					
	Tissue	Do not detect ³ and/or decrease from current levels					
Current Use Pesticides (CUPs)							
Atrazine	Water	1.8 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Carbaryl	Water	0.29 µg/L (max)					
	Sediment	Not available					
	Tissue	Do not detect ³ and/or decrease from current levels					
Chlorpyrifos	Water	0.002 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Lindane (<i>gamma</i> -hexachlorocyclohexane (γ -HCH))	Water	0.010 µg/L (max)					
	Sediment	0.00032 µg/g dry weight (max)					
	Tissue	0.00289 µg/g wet weight (max)					
Imidacloprid	Water	0.65 µg/L (max)					
	Sediment	Not available					
	Tissue	2.11 µg/g wet weight (max)					
Malathion	Water	0.1 µg/L (max)					
	Sediment	Not available					
	Tissue	Do not detect ³ and/or decrease from current levels					
Permethrin	Water	0.001 µg/L (max)					
	Sediment	Not available					
	Tissue	1.74 µg/g wet weight (max)					

¹ Any water sample to be analyzed for organic substances should not be filtered.

² For sediment guidelines that are expressed as µg/g, is based on the sediment as a whole and does not require adjustment for organic carbon content. Adjustments to guidelines are only required when they are expressed in terms of the sediment containing 1% organic carbon. For sediments with organic carbon other than 1%, an adjustment in guidelines should be made by multiplying the guideline by the % organic carbon content of the sediment.

³ Any objective of 'do not detect' implies non-detection when using best available detection limits

⁴ Aldrin, dieldrin, heptachlor, and heptachlor epoxide assessed together: add measured concentrations in tissue and compare to screening value.

Pharmaceuticals and Personal Care Products

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	Short-term (to 2025): No increase over current levels Long-term (by 2050): Decreasing concentrations from current levels					
Sediment						
Tissue						

Physical Parameters

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Temperature	Water	No further increase in temperature; the natural temperature cycle ¹ characteristic of the site should not be altered in amplitude or frequency by human activities					
Salinity	Water	No change in concentration (NaCl or equivalent) from the expected natural level ¹ at that time and depth					
Dissolved Oxygen ²	Water	8 mg/L 30-day mean ³					
		5 mg/L instantaneous minimum					
pH	Water	7.7 to 8.8 ⁴					
Total Suspended Solids	Water	No increase from the expected natural levels in the ambient background, defined by best available data ⁵ as 10 mg/L ⁶					
Turbidity	Water	No increase from the expected natural levels in the ambient background, defined by best available data ⁵ as < 1 NTU ⁶					

¹ Data are unavailable to conclusively define “natural” levels; until additional information becomes available, monitoring results can be compared to conditions as described in Björklund et al 2024.

² In cases where natural dissolved oxygen concentrations do not meet the criteria, no statistically significant reduction below natural levels should be applied.

³ Mean is based on at least 5 weekly samples over a 30-day period.

⁴ To be refined when data are available for additional sub-basins.

⁵ See Appendix B in Björklund et al 2024 for details on how background concentrations were determined. Although other datasets may exist, the datasets used for determining the background (i.e., data available in ENV’s database) were found to be the ‘best available data’ within the constraints of the project. As more data becomes available, the background concentration may be revisited.

⁶ For comparison to the background, a mean is based on at least 5 weekly samples over a 30-day period.

Monitoring of additional parameters of concern that have limited data is recommended to determine if other WQOs are needed. These parameters are as follows:

Parameters for additional monitoring in søilwæt/Burrard Inlet to determine if a WQO is needed

Parameter	Medium
1,2,4-trichlorobenzene	Water
1,2-dichlorobenzene	Water, sediment, tissue
17 α -ethinylestradiol (EE2) plus other hormones/steroids	Water
Aluminum*	Water, sediment, tissue
Arsenic (speciated data)*	Water, sediment, tissue
Benzene, toluene, ethylbenzene, xylene, styrene (BTEXS)	Water
Biotoxins	Water and tissue
Chlorate and free chlorine	Water
Chlorine-produced oxidants (CPOs)	Water
Chromium (speciated data)	Water and tissue
Cobalt*	Water, sediment, tissue
Contaminants of emerging concern (CECs) - consider novel CECs in future monitoring	Water, sediment, tissue
Cotinine (metabolite of nicotine)	Water
Current use pesticides (CUPs) – consider additional CUPs in future monitoring. Consider glyphosate, s-metolachlor, and 2,4-D	Water, sediment, tissue
Cyanide (e.g., weak acid dissociable)	Water
Ethylene dichloride	Water, sediment, tissue
Ethylene glycol	Water

Parameter	Medium
Hexachlorobutadiene (HCBD)	Sediment
Iron*	Water, sediment, tissue
Light extractable petroleum hydrocarbon (LEPH)	Water
Methyl tert-butyl ether (MTBE)	Water
Molybdenum**	Water, sediment, tissue
Monochlorobenzene	Water
Pharmaceuticals and personal care products (PPCPs) – consider additional PPCPs in future monitoring	Water, sediment, tissue
Polychlorinated Biphenyls (PCBs), Dioxins (PCDDs) and Furans (PCDFs) - incorporate analysis of dioxin-like PCBs into monitoring programs, along with analyses of other PCBs, PCDDs and PCDFs	Water, sediment, tissue
Selenium	Water
Sulphide (as unionized H ₂ S)	Water
Tin*	Water, sediment, tissue
Total extractable hydrocarbons (TEH)*, ***	Water
Total Phenols	Water, tissue
Volatile petroleum hydrocarbons (VPHs) and volatile hydrocarbons (nC6 - nC10) (VH6-10)	Water

* There is currently no benchmark for comparison for marine water. Continue to monitor these metals in Burrard Inlet, as an applicable benchmark may be developed in the future.

** There is currently no reliable benchmark for comparison for marine water; however, there exists an interim working level of 23 µg/L from the Australia and New Zealand Environment and Conservation Council (ANZECC 2000, Commonwealth of Australia 2000), and some exceedances of this interim working level have been observed in Burrard Inlet.

*** Constituents should also be monitored (i.e., polycyclic aromatic hydrocarbons [PAHs] and total PAH).

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ACRONYMS AND ABBREVIATIONS

BBP	Benzyl butyl phthalate
B.C./BC	British Columbia
BDE	Brominated diphenyl ethers
BPA	Bisphenol A
CCME	Canadian Council of Ministers of the Environment
CEC	Contaminants of Emerging Concern
CFIA	Canadian Food Inspection Agency
CFU	Colony forming unit
CUP	Current use pesticide
DEHP	Di-(2-ethylhexyl) phthalate
DEP	Di-ethyl phthalate
DMP	Di-methyl phthalate
DnBP	Di-n-butyl phthalate
DnOP	Di-n-octyl phthalate
DRIPA	Declaration on the Rights of Indigenous Peoples Act
dw	Dry weight
ENV	B.C. Ministry of Environment and Parks
HBB	Hexabromobenzene
HBCD	Hexabromocyclodecane
MP	Microplastics
MPN	Most probable number
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dinzofurans
PEL	Probable effect level
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PPCPs	Pharmaceuticals and personal care products
TBBPA	Tetrabromobisphenol A
TBT	Tributyltin
TEL	Threshold effect level
TOC	Total organic carbon
TWN	Tsleil-Waututh Nation
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WLRS	B.C. Ministry of Water, Land and Resource Stewardship
WQG	Water quality guideline(s)
WQO	Water quality objective(s)
WSQG	Working sediment quality guideline
WWQG	Working water quality guideline
ww	Wet weight

1. INTRODUCTION

Tsleil-Waututh means “People of the Inlet”, referring directly to səliłwət (Burrard Inlet) up to the Indian River and including Indian Arm. We were born with a sacred obligation to protect the waters. Our first grandfather was transformed from a wolf into a human being. When it was time for him to have a mate, the Creator gave him a vision that he was to dive off one of the tallest cliffs in Indian Arm, grab two handfuls of sediment from the floor of the Inlet and bring them back to the beach. Our first grandmother was transformed from that sediment – our first grandmother comes from the Inlet. Our ties to this Inlet run deep. It’s important that we hold that responsibility, that as a Nation we gather people around who see our vision, and that our work resonates with their own spirit.

- Carleen Thomas, Tsleil-Waututh Nation

In British Columbia (B.C.), water quality objectives (WQOs) are developed for specific waterbodies of regional, provincial, inter-provincial, and international significance to promote the protection and stewardship of our shared water resources. WQOs define conditions that represent levels of low risk to water values. WQOs are set with the goal of protecting water values by maintaining existing water quality, improving existing water quality, or protecting water quality for a specific use. They formalize expectations with respect to water quality for a given waterbody and are used to inform land and resource management decisions. Once approved, WQOs constitute formal Provincial policy and are considered in decisions under the *Environmental Management Act*.

WQOs consider the characteristics of the waterbody, including: the ambient water quality; the aquatic life, wildlife, and related habitat; the climate; the hydrology; the sediments; the potential contaminant loadings from point and non-point source waste discharges; and the cultural and social values associated with a waterbody.

WQOs for the water body known as Burrard Inlet - səliłwət in the hənqəminəm language - were initially developed in 1990 (Nijman and Swain 1990) to protect:

- aquatic life, wildlife, and primary-contact recreation in səliłwət/Burrard Inlet, Lynn Creek and School House Creek;
- aquatic life and wildlife in False Creek; and
- aquatic life, wildlife, primary-contact recreation, and drinking water supplies in the Capilano River.

The significance of səliłwət/Burrard Inlet to Indigenous Nations along with information from Indigenous science, Indigenous knowledge, and western science showing that the health of the Inlet was deteriorating over time, indicated a need to update the WQOs for səliłwət/Burrard Inlet. Updating the provincial WQOs for səliłwət/Burrard Inlet was identified as a priority for the Province, Metro Vancouver, and Tsleil-Waututh Nation (TWN); it is the first of six priority actions proposed by TWN in their 2017 Burrard Inlet Action Plan (TWN 2017) and represents the first co-developed water quality objective policy between B.C. and a First Nation.

This update combines Tsleil-Waututh Indigenous science and knowledge, improved western science regarding the biological thresholds and pathways of contaminants in aquatic organisms, a more complete understanding of contaminants of concern, more recent monitoring data and documentation of discharges into the Inlet, agreement by multiple sectors on sensitive water uses and values, and future goals for the health of the Inlet. Updating the WQOs lays the foundation for further efforts to protect the water quality and values in səliłwət/Burrard Inlet for current and future generations.

The səliłwət/Burrard Inlet WQO process aligns with the standards of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the *Declaration on the Rights of Indigenous Peoples Act* (DRIPA) and speaks to numerous actions under the DRIPA Action Plan. The Province’s collaboration on the TWN-led development of the technical assessments for the updated WQOs demonstrates a commitment to recognizing Indigenous rights of First Nations and the critical role of Indigenous Peoples in the stewardship of natural resources. The səliłwət/Burrard Inlet WQOs, which emphasize the continuous improvement of water quality and the protection of associated cultural and ecological values, work to advance TWN's Burrard Inlet Action Plan (TWN 2017) while reflecting the Province’s implementation of the *Draft Principles that Guide the Province of British Columbia’s Relationship with Indigenous Peoples* (B.C. Government 2017).

This report focuses on the marine environment and presents updated and existing WQOs for səliłwət/Burrard Inlet, including the Central, Inner, and Outer Harbours; False Creek; Indian Arm and Port Moody Arm. The updated WQOs are based on extensive technical assessments led by TWN. Readers should refer to Rao et al. (2019) for a detailed description of the approach taken and an overview of the water quality of səliłwət/Burrard Inlet. The updated WQOs have been co-developed by TWN and the Province and approved by both but does not imply any obligation with respect to future monitoring for attainment. The WQOs for freshwater tributaries to səliłwət/Burrard Inlet are being developed in a separate policy document. The absence of a specific water quality parameter in the WQOs does not imply its irrelevance to səliłwət/Burrard Inlet; reducing contamination of any kind in səliłwət/Burrard Inlet stands as an overarching objective.

2. TSLEIL-WAUTUTH NATION

Current Tsleil-Waututh leaders have the responsibility to speak for the damaged land and waters of our traditional territory. It is important that our territory begin to be restored to its prior state. And in this journey to restoration, so will our People be restored as the caretakers of their territory, and we will once again assume the responsibility that belongs to and defines the Tsleil-Waututh, the People of the Inlet.

- Tsleil-Waututh Nation

Tsleil-Waututh (səliłwətəl) means “People of the Inlet”, referring specifically to səliłwət/Burrard Inlet. Since time out of mind, Tsleil-Waututh people have used, occupied, governed, and stewarded their territory. Tsleil-Waututh hold a sacred, legal obligation and responsibility to protect, defend, and steward the lands and waters of their territory, in accordance with Tsleil-Waututh law, for past, present, and future generations. This stewardship responsibility requires restoring conditions that provide the environmental, cultural, spiritual, and economic foundation for Tsleil-Waututh people to thrive.

Updating the WQOs is a key priority in the 2017 TWN Burrard Inlet Action Plan (TWN 2017), a science-based, TWN-led initiative to improve the health of the səliłwət/Burrard Inlet ecosystem for the benefit of all. The Burrard Inlet Action Plan presents a shared vision for environmental stewardship and identifies key issues, knowledge gaps and priority actions to begin addressing legacy, and contemporary, impacts that infringe upon TWN’s rights and ways of life. Development of the Burrard Inlet Action Plan included a review of existing information and interviews with traditional knowledge holders, key experts, and resource managers (including representatives from Fisheries and Oceans Canada, Environment and Climate Change Canada, B.C. Ministry of Environment and Parks (ENV), post-secondary institutions, non-governmental organizations and consulting companies), to help identify important sources of data and information, critical knowledge gaps, and priority actions (TWN 2017). A forthcoming update to the

Burrard Inlet Action Plan (TWN in prep) will highlight progress made to date and identify further actions needed to restore the health of səliłwət/Burrard Inlet.

Cumulative effects of colonial settlement and development have eroded the ecological health, integrity, and diversity of the Inlet. Urbanization and industrialization have brought a complex cocktail of contaminants, transforming səliłwət/Burrard Inlet from Tsleil-Waututh’s primary food source into a heavily polluted system. By 1972, sanitation and contamination concerns led to the closure of the Inlet to bivalve harvesting (Tsleil-Waututh Nation’s Treaty Lands and Resources Department 2021).

TWN considers the level of contamination in səliłwət/Burrard Inlet to have long exceeded what is allowable under Tsleil-Waututh law; the cumulative impacts of contamination from urban and industrial development have impacted TWN’s Aboriginal rights and interests by reducing or eliminating opportunities to fish, harvest shellfish and practice culture. Improving the water quality in səliłwət/Burrard Inlet through the adoption, implementation and attainment of the WQOs will help advance TWN’s goal of being able to sustainably harvest healthy, wild marine resources, and to practice spiritual, cultural, ceremonial, and recreational activities in clean water free of risk from contamination and harmful pathogens.

3. SITE DESCRIPTION

Since time out of mind, Tsleil-Waututh have used and occupied səliłwət and surrounding watersheds. Generations of Tsleil-Waututh people were brought up with the teaching, “When the tide went out, the table was set.” About 90% of our diet was once derived from səliłwət and the Fraser River, but today the Inlet is unable to support our needs. Tsleil-Waututh Nation has a goal to restore the health of the Inlet so that we, and future generations of Tsleil-Waututh People, can once again harvest wild marine resources and continue to practice our cultural and ceremonial activities in a clean and healthy environment. The return of herring and orcas shows us that the Inlet is coming back, but there is more work to be done, and we need to do the work together.

- Tsleil-Waututh Nation’s Treaty Lands and Resources Department (2021)

səliłwət/Burrard Inlet is located off the Strait of Georgia near Vancouver and extends to Port Moody and the head of Indian Arm (Figure 1). The Inlet can be divided into six sub-basins: False Creek, Outer Harbour, Inner Harbour, Central Harbour, Port Moody Arm, and Indian Arm (Figure 2). Each sub-basin has its own distinct oceanographic and usage characteristics, allowing for the meaningful subdivision of analyses as well as the analysis of the Inlet as a whole. The characteristics of the individual sub-basins, including oceanography, are described in Rao et al. (2019). The Inlet’s outer boundary, closest to its mouth, is defined as the line connecting Point Atkinson (West Vancouver) and Point Grey (Vancouver).

səliłwət/Burrard Inlet is 113 km² in size, extending 46 km from its outer boundary to the head of Indian Arm (with Port Moody Arm adding 7 km) and includes 190 km of shoreline. Its catchment area is 1,288 km² (Rao et al. 2019). səliłwət/Burrard Inlet supports Canada’s largest and busiest port and is a major transportation hub.

Approximately 1.2 million people live in the eight municipalities and local First Nations communities bordering səliłwət/Burrard Inlet (2021 Statistics Canada census – Government of Canada 2022). Coast Salish First Nations have occupied the area and depended on the health of səliłwət/Burrard Inlet for their sustenance since time out of mind. Intensive settlement and industrial development over the last 150 years have impacted the health of səliłwət/Burrard Inlet, including its water quality. Urban development is expected to increase as the population in the region continues to grow (Rao et al. 2019), increasing the pressure on the receiving waters of səliłwət/Burrard Inlet.

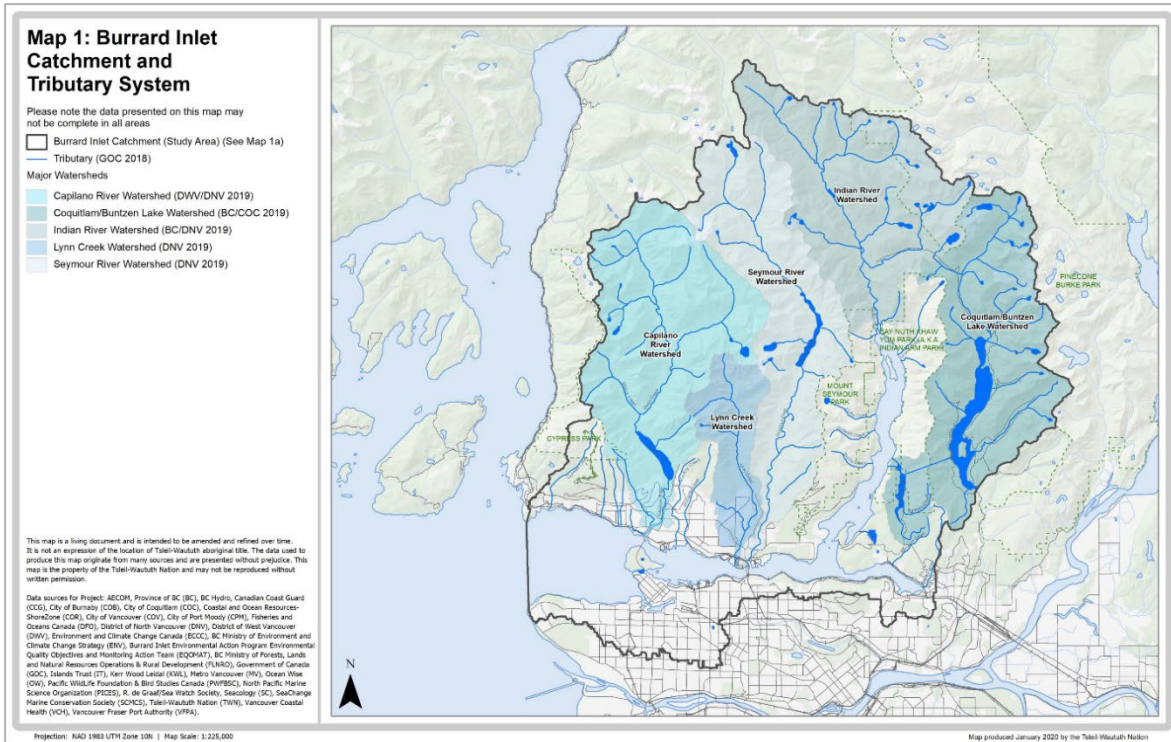


Figure 1. səliwəṭ/Burrard Inlet catchment and tributary system (from Rao et al. 2019).

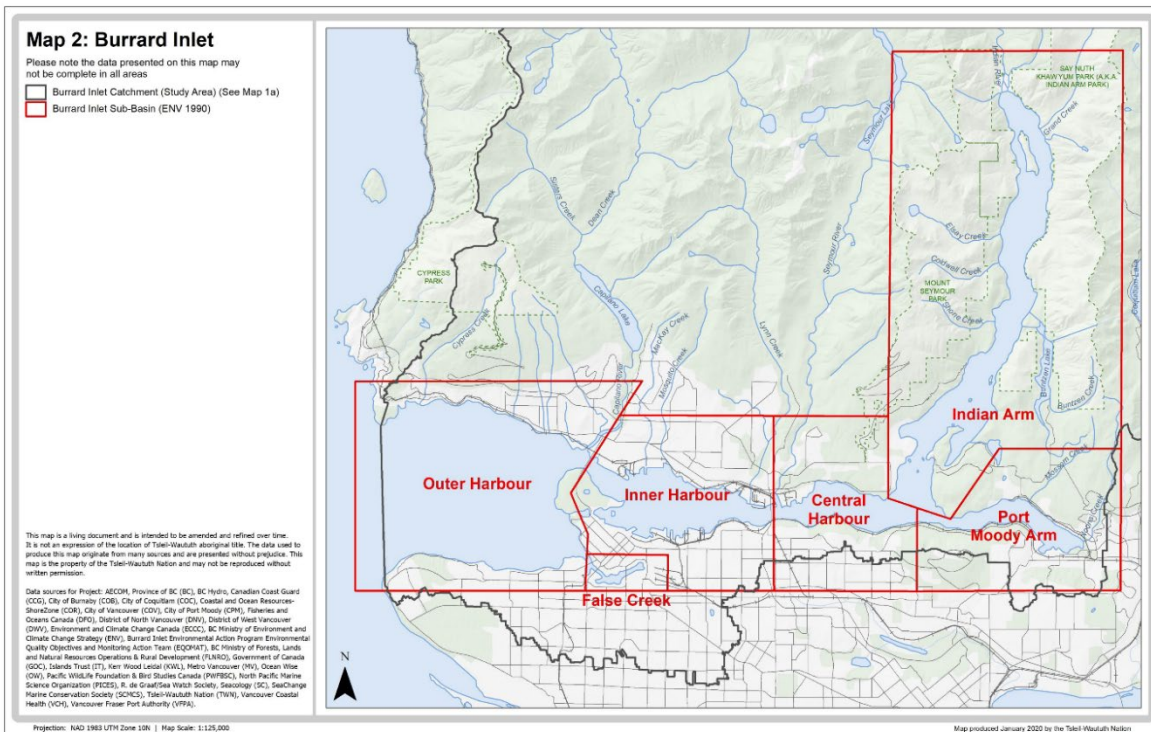


Figure 2. səliwəṭ/Burrard Inlet sub-basins (from Rao et al. 2019).

4. WATER VALUES

The overall vision of the səlilwət/Burrard Inlet WQOs (as developed by the Burrard Inlet Water Quality Roundtable) is *to increase the benefits of səlilwət to all in the region by reducing stressors and improving water quality while balancing ecological, social, economic, health, and First Nation cultural values*. TWN’s 2017 Burrard Inlet Action Plan provides the basis for the water values identified for səlilwət/Burrard Inlet. As stated in the Burrard Inlet Action Plan (TWN 2017):

TWN envisions a productive, resilient, and diverse səlilwət ecosystem where:

- *healthy, abundant wild foods can be harvested safely and sustainably;*
- *water and sediment are safe and clean for cultural, spiritual, ceremonial, and recreational activities;*
- *important habitats are plentiful, productive and connected; and*
- *high levels of biodiversity and healthy populations of key species are viable and continue to persist in the long term.*

The water values to be protected in səlilwət/Burrard Inlet include:

- human consumption of shellfish;
- human consumption of finfish;
- aquatic life (including reproduction);
- wildlife (including reproduction);
- cultural practices and recreational uses; and
- institutional water uses.

Note that the term “water values” is a replacement for what was previously referred to by the Province as “designated uses”. These values (Table 1), and the short-term (by 2025), medium-term (2025 to 2050) and long-term (2050 onwards) goals associated with each, were developed with consideration of each sub-basin’s characteristics. For example, the water quality of False Creek and the Inner Harbour has been heavily impacted, limiting the extent to which they can be realistically improved in the short term. Conversely, the water quality in certain areas of Indian Arm can potentially support values such as shellfish consumption in the short term.

The long-term goals reflect TWN’s aspiration to improve overall water quality and restore values and traditional uses throughout səlilwət/Burrard Inlet. The short-term goals and medium-term goals reflect what may be attainable in a shorter time frame. Where appropriate, short-term, medium-term, and long-term WQOs will be set for water quality parameters based on the short-term, medium-term and long-term goals for the most sensitive value for that parameter. In this way, all water values will be protected. It is important to note that WQOs are set for the ambient environment. Although in some instances they are set in consideration of the requirements to enable certain activities (e.g., swimming, shellfish consumption), they are not in themselves a statutory decision or statement about which activities are possible in which areas.

Table 1. Water values and goals for səlilwət/Burrard Inlet by sub-basin. The timeframe for short-term goals (S) is 2025, and 2050 for long-term goals (L).

Value	Outer Harbour		False Creek		Inner Harbour		Central Harbour		Port Moody Arm		Indian Arm	
	S	L	S	L	S	L	S	L	S	L	S	L
Human consumption of shellfish ¹	-	✓	-	✓	-	✓	-	✓	-	✓	✓	✓

Value	Outer Harbour		False Creek		Inner Harbour		Central Harbour		Port Moody Arm		Indian Arm	
	S	L	S	L	S	L	S	L	S	L	S	L
Human consumption of finfish	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓
Aquatic life	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wildlife	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cultural/Recreation ²	✓	✓	✓ ⁴	✓	✓	✓	✓	✓	✓	✓	✓	✓
Institutional water uses ³	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

¹ The goal of shellfish consumption could potentially be reached via medium-term goals of enabling harvest from marginally affected areas according to recommended Canadian Shellfish Sanitation Program procedures.

² Cultural practices and recreational uses refer to primary contact activities such as bathing and swimming. Secondary contact activities could include canoeing, fishing, and boating.

³ Institutional water uses include industrial, commercial, and municipal intakes and discharges, as well as on-water uses such as shipping.

⁴ The short-term goal is for secondary contact activities.

5. WATER QUALITY OBJECTIVES FOR səliłwət/BURRARD INLET

Prior to contact, our ancestors thrived for thousands of years by living in harmony with Nature, and governing the waters and lands in our traditional territory in a sustainable manner. TWN culture and heritage is built on a strong connection with, and a deep obligation to be the caretakers and protectors of, our traditional lands and waters. Natural resources continue to be vitally important, not only for staple foods (e.g., salmon, clams and crab), but also for cultural and spiritual practices, artistic representation, recreation, and technological and economic development. The ability to access and sustainably manage these resources is directly linked to our community health and provides important opportunities to pass on cultural teachings and the hə̀n̓q̓ə̀m̓i̓n̓ə̀m̓ language to the next generation.

- Tseil-Waututh Nation (2020)

The update of the səliłwət/Burrard Inlet WQOs includes an extensive set of parameters of concern which are listed in Appendix 1 along with references. This section summarizes the WQOs for specific parameters which have been updated. The absence of a specific water quality parameter in the WQOs does not imply its irrelevance to səliłwət/Burrard Inlet; reducing contamination of any kind in səliłwət/Burrard Inlet stands as an overarching objective.

The səliłwət/Burrard Inlet WQOs consider the updated parameters of concern identified in Rao et al. (2019). WQOs for parameters that are no longer of concern (e.g., barium) are not included while parameters with updated WQOs (e.g., cadmium) or new WQOs (e.g., microplastics) are included.

For some parameters, short-term, medium-term, and long-term WQOs are specified. The short-term WQOs are intended to prevent any further degradation of conditions while the medium- and long-term WQOs provide a goal for improvements. To ensure clarity and consistency in the application of WQOs beyond the original short-term timeframe, the following guidance is provided: Short-term WQOs established for achievement by 2025 shall remain valid and applicable beyond 2025. Short-term WQOs represent minimum acceptable benchmarks for water quality. Where medium- or long-term WQOs are not yet attainable, short-term WQOs are used as interim objectives with the goal to work towards meeting the medium- and long-term objectives.

For the purposes of this policy, “current conditions” and “current levels” refer to parameter concentrations as summarized in the supporting technical reports referenced in this document. Where specific numeric values are not provided, these terms should be interpreted as referring to:

- The most recent available data at the time of WQO development (typically 2018 to 2025).
- Median or mean (average) values derived from composite sampling across sub-basins, as described in the relevant technical reports.

To support future application:

- Monitoring programs should continue to track changes from “current conditions” and “current levels”.
- Where new data becomes available, analysis should be completed to assess whether conditions are improving, stable, or degrading relative to the conditions presented in the technical reports.
- If uncertainty arises, users are encouraged to consult the original technical reports for clarification.

It is recognized that measuring monitoring data against “current conditions” has limitations as a point of reference, as this can lead to shifting baselines such as where current conditions are normalized, and past conditions are disregarded or forgotten. While it can be useful to understand trends relative to current conditions, these conditions are not representative of a healthy səliłwət/Burrard Inlet ecosystem. Tsleil-Waututh has memory of pre-contact conditions when the contamination identified in the technical reports did not exist. Current conditions are a snapshot in time; current levels of contamination in səliłwət/Burrard Inlet already exceed what is allowable under Tsleil-Waututh law. If practicing rights or activities, such as harvesting clams or undertaking primary contact activities, are not safe to do today because of contamination, work is needed to improve the condition of səliłwət/Burrard Inlet and restore the practices and Water Values. The intent is for improvement, showing declining contaminant levels and improved water quality regardless of the latest current conditions.

The WQOs apply to all səliłwət/Burrard Inlet sub-basins, unless specified otherwise, with an overarching objective of decreasing concentrations in all contaminants in all media (water, sediment and tissue) over time (Table 2).

Table 2. Water quality objective for all anthropogenic contaminants for səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
All anthropogenic (human-made) contaminants	Water, sediment, tissue	Should not be present; if detected, then decreasing concentrations from current levels					

5.1 Contaminants of Emerging Concern

Contaminants of Emerging Concern (CECs) in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in Björklund and LeNoble (2024). CECs are not one group of chemicals with similar characteristics, but a unifying concept for chemicals for which environmental transport and fate, toxicity to aquatic life, and human exposure may not yet be fully understood, or which are not yet subjected to adequate regulatory criteria or norms for the protection of human health or the environment (Sauvé & Desrosiers 2014). CECs can refer to many kinds of chemicals – including those used in household, industrial and other products. Those covered in this report include:

- Alkylphenols and their ethoxylates;
- Bisphenols;
- Phthalates;

- 6PPD and 6PPD-quinone;
- Organotins;
- Brominated flame retardants; and
- Perfluoroalkyl and polyfluoroalkyl substances.

These CECs are of anthropogenic origin and, once in marine waters, can be persistent, bioaccumulative, and toxic to aquatic life at low concentrations. The most sensitive values requiring protection from CEC pollution are aquatic life and human consumption of finfish and shellfish, as well as wildlife due to bioaccumulation risks.

Sampling for CECs in səliłwət/Burrard Inlet has been limited to date. Available data from səliłwət/Burrard Inlet were used to screen CECs against relevant B.C. guidelines, and guidelines from other jurisdictions in the absence of B.C. guidelines. The majority of measured CECs were below laboratory detection limits but, in many cases, detection limits were higher than the available (at the time of reporting) screening benchmark value. Inadequate detection limits is an issue that needs to be resolved to enable meaningful setting and use of the objectives.

Among the available data, nonylphenol and its ethoxylates were detected in marine water samples; nonylphenol and its ethoxylates, bisphenol A, organotins, tributyltin, perfluorooctanesulfonic acid (PFOS) and hexabromobenzene (HBB) were detected in sediment samples; and nonylphenol and its ethoxylates were detected in tissue samples. The only compound that exceeded a screening benchmark was nonylphenol and its ethoxylates, which exceeded the tissue screening benchmark in blue mussels in 87% of 15 composite samples analyzed between 2015 and 2019.

At the time of writing, there were no marine monitoring data on 6PPD and 6PPD-quinone available for səliłwət/Burrard Inlet and there is no B.C. water quality guideline (WQG) for marine waters; however, 6PPD-quinone has been detected in tributaries to səliłwət/Burrard Inlet and there is a B.C. WQG for protection of freshwater aquatic life (Rao et al. in prep).

The WQOs for CECs are listed in Table 3.

Table 3. Contaminants of emerging concern (CEC) WQOs for the marine waters of səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
All	All CECs: decreasing concentrations from current levels					
Water	Alkylphenols and their Ethoxylates					
	Nonylphenol and its Ethoxylates: 0.7 µg/L (max) (total toxic equivalent of nonylphenolic compounds)					
	Bisphenols					
	Bisphenol A (BPA): 0.9 µg/L (max)					
	Phthalates					
	Di-methyl phthalate (DMP): 2000 µg/L (max)					
	Di-ethyl phthalate (DEP): 600 µg/L (max)					
	Di-n-butyl phthalate (DnBP): 30 µg/L (max)					
	Benzyl butyl phthalate (BBP): 0.1 µg/L (max)					
	Di-(2-ethylhexyl) phthalate (DEHP): 0.37 µg/L (max)					
	Di-n-octyl phthalate (DnOP): Do not detect ¹ and/or decrease from current levels					
	6PPD and 6PPD-quinone					
	6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins					
Tributyltin (TBT): 0.001 µg/L (max)						

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
	Brominated Flame Retardants					
	Hexabromocyclododecane (HBCD): 0.56 µg/L (max)					
	Tetrabromobisphenol A (TBBPA): 3.1 µg/L (max)					
	Hexabromobenzene (HBB): Do not detect ¹ and/or decrease from current levels					
	Perfluoroalkyl and Polyfluoroalkyl Substances					
	Perfluorooctanoic acid (PFOA): Do not detect ¹ and/or decrease from current levels					
	Perfluorooctanesulfonic acid (PFOS): 3.4 µg/L (max)					
Sediment	Alkylphenols and their Ethoxylates					
	Nonylphenol and its Ethoxylates: 1.0 µg/g dry weight (max) (total toxic equivalent of nonylphenolic compounds; adjust objective to site-specific levels of total organic carbon [TOC])					
	Bisphenols					
	BPA: 0.025 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	Phthalates					
	DMP: 0.53 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	DEP: 0.61 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	DnBP: 2.2 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	BBP: 0.049 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	DEHP: 0.47 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	DnOP: 0.58 µg/g dry weight (max) (adjust objective to site-specific levels of TOC)					
	6PPD and 6PPD-quinone					
	6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins					
	Do not detect ¹ and/or decrease from current levels					
	Brominated Flame Retardants					
	HBCD: 1.6 µg/g dry weight (max)					
	TBBPA: 0.6 µg/g dry weight (max)					
	HBB: Do not detect ¹ and/or decrease from current levels					
	Perfluoroalkyl and Polyfluoroalkyl Substances					
PFOA: Do not detect ¹ and/or decrease from current levels						
PFOS: Do not detect ¹ and/or decrease from current levels						
Tissue	Alkylphenols and their Ethoxylates					
	Nonylphenol and its Ethoxylates: 0.018 µg/g wet weight (max)					
	Bisphenols					
	BPA: Do not detect ¹ and/or decrease from current levels					
	Phthalates					
	DMP: Do not detect ¹ and/or decrease from current levels					
	DEP: Do not detect ¹ and/or decrease from current levels					
	DnBP: Do not detect ¹ and/or decrease from current levels					
	BBP: Do not detect ¹ and/or decrease from current levels					
	DEHP: Do not detect ¹ and/or decrease from current levels					
	DnOP: Do not detect ¹ and/or decrease from current levels					
	6PPD and 6PPD-quinone					
	6PPD and 6PPD-quinone: Do not detect ¹ and/or decrease from current levels					
	Organotins					
	TBT: 0.0088 µg/g wet weight (max)					
Organotins: 0.0088 µg/g wet weight (max)						

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
	Brominated Flame Retardants					
	HBCD: Do not detect ¹ and/or decrease from current levels					
	TBBPA: Do not detect ¹ and/or decrease from current levels					
	HBB: 0.070 µg/g wet weight (max)					
	Perfluoroalkyl and Polyfluoroalkyl Substances					
	PFOA: 0.0007 µg/g wet weight (max)					
	PFOS: 0.0021 µg/g wet weight (max)					

¹Any objective of 'do not detect' implies non-detection when using best available detection limits.

5.2 Metals

5.2.1 Arsenic

Arsenic (As) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and fully discussed in Sanchez et al. (2022a). The current B.C. WQG (12.5 µg/L) was defined as the screening benchmark to assess current conditions with respect to water As concentrations and derive an appropriate WQO to protect water values. The Canadian Council of Ministers of the Environment (CCME) has established two effect levels for sediments: the Threshold Effect Level (TEL) and a Probable Effect Level (PEL). Below the TEL, adverse effects are rarely observed whereas above the PEL, adverse effects are frequently observed. The lower value of the B.C. working sediment quality guideline (WSQG), is equivalent to a TEL. This WSQG is set at a concentration that will protect aquatic life from the adverse effects of a toxic substance in most situations and is rarely associated with adverse biological effects. Therefore, it was selected as the sediment WQO for *səlilwət*/Burrard Inlet and was applied as the sediment screening benchmark for As (7.24 µg/g dry weight [dw]).

Tissue screening levels were calculated to assess risks to human health as described in the tissue quality objective recommendations by ENV and HLTH (2021). Two screening benchmarks for concentrations of As in tissue were selected to capture a range of potential fishers, with the most sensitive receptor being an adult from a subsistence fishing population. A toddler from a subsistence fishing population was not considered for the tissue objective since the method used to derive the screening benchmark is based on lifetime (60 years) exposure to As as a carcinogen. The screening benchmarks also assume 10% of the total As to be inorganic resulting in screening benchmarks of 0.0018 µg/g wet weight (ww) for an adult subsistence fisher and 0.0510 µg/g ww for an adult recreational fisher. Note that the screening benchmark for an adult subsistence fisher differs slightly from that reported in Sanchez et al. (2022a) due to updated toxicological information from Health Canada (2021).

Arsenic concentrations in water were below the screening benchmark of 12.5 µg/L and the 1990 WQO of 10 µg/L in all basins. An updated WQO of 2.4 µg/L is based on 10 years of existing monitoring data from Metro Vancouver's Burrard Inlet Ambient Monitoring Program. This water objective is set to maintain or decrease existing levels of As in the water column. The toxicity and bioavailability of As depends on its chemical form and oxidation state. Trivalent species of As such as arsenite are more acutely toxic to aquatic organisms than pentavalent species like arsenate, and inorganic arsenic species are more toxic than organic species. Therefore, this WQO may be revised in the future pending further studies on As speciation in *səlilwət*/Burrard Inlet.

Sediment As concentrations exceeded the TEL of 7.24 µg/g dw in all basins; however, the most recent data showed results below this at sites in the Inner Harbour, Central Harbour, and Indian Arm. The PEL of 42 µg/g dw was not exceeded.

The available data showed liver, muscle, and whole-body English sole As concentrations, and blue mussel tissue As concentrations to be consistently higher than these screening benchmarks.

The As WQOs are listed in Table 4. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 4. Water quality objectives for arsenic in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	2.4 µg/L (mean) ¹					
Sediment	7.24 µg/g dry weight (max) ²					
Tissue	0.0018 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.2 Cadmium

Cadmium (Cd) levels in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in LeNoble et al. (2019). The current B.C. WWQG for Cd to protect marine aquatic life (30-d mean concentration of 0.12 µg/L) was used in the assessment as it provides a better reflection of the current level of knowledge than the 1990 WQO (see Nijman and Swain 1990). The B.C. lower WSQG of 0.7 µg/g dw (WLRS 2025) was applied for sediment. Details on the derivation of tissue screening levels is provided in ENV and HLTH (2021) and Rao (2021).

A review of available monitoring data shows that concentrations are consistently below 0.12 µg/L in all basins except the Outer Harbour and False Creek. In the Outer Harbour, mean Cd concentrations were generally <0.12 µg/L with individual measurements occasionally exceeding this level prior to 2014. Mean and maximum Cd concentrations in False Creek were occasionally above 0.12 µg/L, but there are no data available after 2009.

Sediment data are limited but Cd concentrations were generally below the B.C. lower WSQG of 0.7 µg/g dw (WLRS 2025).

Cadmium concentrations may be naturally elevated in shellfish in the Pacific Northwest (Bendell 2009), therefore a tissue-based Cd WQO was derived to protect human health. The limited data available suggest that the average Canadian consumer is not at risk; however, Cd levels in fish and shellfish may be of higher concern for Indigenous persons who regularly consume wild marine foods. The WQO is set at the screening level of 0.03 µg/g ww to protect toddlers of a subsistence fishing population. Screening levels for adults of a subsistence fishing population and a recreational fishing population are less stringent at 0.07 µg/g ww and 0.1 µg/g ww, respectively. Additional data are required to properly assess Cd concentrations in fish and shellfish tissue in səliłwət/Burrard Inlet.

While Cd levels in səliłwət/Burrard Inlet water were only infrequently of concern in the Outer Harbour and False Creek prior to 2014, levels of Cd in sediment remain a concern for chronic effects, particularly in the eastern sub-basins. While current Cd levels in fish and shellfish tissue are not of concern to those who consume small amounts of seafood from səliłwət/Burrard Inlet, they may be of concern to those who consume larger amounts of fish and shellfish, such as Indigenous communities. To continue to manage for low Cd levels that protect aquatic life and fish and shellfish consumption as important values in səliłwət/Burrard Inlet, the objectives for Cd in water, sediment and tissue were updated.

The Cd WQOs are listed in Table 6. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 5. Water quality objectives for cadmium in *səlilwət*/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	0.12 µg/L (mean) ¹					
Sediment	0.7 µg/g dry weight (max) ²					
Tissue	0.03 µg/g wet weight ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.3 Chromium

Chromium (Cr) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and discussed in LeNoble et al. (2026). Screening benchmarks for chromium forms are from the B.C. WQGs and the B.C. WWQGs - 1.5 µg/L (Cr[VI]), 52.3 µg/g dw (for Cr[III]), and 0.08 µg/g ww (for Cr[VI]) in water (WLRS 2026), sediment (WLRS 2025), and fish/shellfish tissue (WLRS 2023), respectively. Only total chromium results were available and were compared conservatively to the screening benchmark for Cr(VI) or Cr(III), as available.

Total chromium was detected in 407 marine water samples (37%) with concentrations ranging from 0.5 to 43.0 µg/L, of which 313 samples (28% of total) exceeded the screening benchmark of 1.5 µg/L for Cr (VI).

Chromium was detected in 924 sediment samples (> 99%), with concentrations between 1.3 and 310 µg/g. Chromium concentrations were above the screening benchmark of 52.3 µg/g for Cr(III) in 184 samples (20% of total).

Chromium was detected in 734 tissue samples (82%). Concentrations of chromium in fish or shellfish tissue ranged from 0.037 to 27.7 µg/g. Most (70%) samples had concentrations less than 1.3 µg/g. The lowest screening benchmark, protective of a toddler from a subsistence fishing population, for hexavalent chromium (Cr[VI], the most toxic form) is 0.08 µg/g (WLRS 2023). Chromium concentrations were above the screening benchmark in 94% of samples.

The Cr WQOs are listed in Table 6 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 6. Water quality objectives for chromium in *səlilwət*/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	Cr VI: 1.5 µg/L, Cr III: 56 µg/L (mean) ¹					
Sediment	52.3 µg/g dry weight (max) ²					
Tissue	Cr VI: 0.08 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.4 Copper

Copper (Cu) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and discussed in Rao et al. (2021a). Screening benchmarks of 0.3 µg/L and 1.3 µg/L, representing protection of 99% and 95% of aquatic species, respectively, were used to assess current conditions of Cu concentrations in the water column at the time of WQO development. Screening benchmarks for sediments were 18.7 µg/g dw (TEL) and 108 µg/g dw (PEL) from the B.C. WSQG (WLRS 2025). Tissue screening benchmarks to assess risk to human health were 15 µg/g ww for toddler subsistence fishers, 30 µg/g ww for adult subsistence fishers, and 59 µg/g ww for adult recreational fishers (derived from ENV and HLTH 2021).

The more recent water quality monitoring results show Cu concentrations are generally below 1.3 µg/L throughout *səlilwət*/Burrard Inlet while older measurements were much higher resulting from differences between the monitoring programs producing the data. The 1.3 µg/L level is consistent with the *Draft Recommended Environmental Quality Guidelines for the Protection of Southern Resident Killer Whales and their Prey* (ECCC 2021).

Total Cu concentrations in sediment exceeded the TEL (18.7 µg/g dw) at most sites. Some samples from the location Outer Harbour North and all samples from Port Moody Arm and Indian Arm South also exceeded the higher PEL benchmark of 108 µg/g dw. The highest average concentrations were found in Port Moody Arm, and the lowest concentrations in Indian Arm North.

Tissue Cu concentrations in English Sole and mussels were below the 15 µg/g ww screening benchmark at all sites.

The WQOs for Cu in the marine waters of *səlilwət*/Burrard Inlet are listed in Table 7 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 7. Water quality objectives for total copper in *səlilwət*/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	1.3 µg/L (mean) ¹					
Sediment	18.7 µg/g dry weight (max) ²					
Tissue	15 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.5 Lead

Lead (Pb) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and discussed in Rao et al. (2021b). The B.C. WQGs for the protection of marine aquatic life (mean of ≤2 µg/L and a maximum of 140 µg/L) were applied as screening benchmarks to analyze existing water quality data. The B.C. lower and upper WSQGs (30.2 µg/g and 112 µg/g, respectively) were used to assess sediment conditions. Human health screening benchmarks for toddler subsistence fishers (0.070 µg/g ww), adult subsistence fishers (0.16 µg/g ww), and adult recreational fishers (0.276 µg/g ww) (ENV and HLTH 2021) were used to assess the quality of fish and shellfish tissue.

Past monitoring results showed Pb concentrations in water frequently above 2 µg/L in the water column throughout *səlilwət*/Burrard Inlet. More recent results (2007 – 2016) were consistently below the screening benchmark of 2 µg/L at all sites.

Sediment Pb concentrations exceeded the lower screening benchmark of 30.2 µg/g at the locations Port Moody Arm and Indian Arm South, with the highest measurement of 67 µg/g taken at Indian Arm in 2011.

Fish tissue and shellfish data are limited. Fish muscle tissue met the screening levels, but it should be noted that data are very limited, and further monitoring should be conducted to confirm these results.

The WQOs for Pb in *səlilwət*/Burrard Inlet are listed in Table 8 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 8. Water quality objectives for total lead in *səlilwət*/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	2 µg/l (mean) ¹					
Sediment	30.2 µg/g dry weight (max) ²					
Tissue	0.16 µg/g wet weight (max) (short-term to 2025) ³					
	0.070 µg/g wet weight (max) (long-term by 2050) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.6 Manganese

Manganese (Mn) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and discussed in LeNoble et al. (2026). The current B.C. WWQG for Mn for protection of humans eating shellfish (30-d mean concentration of 100 µg/L) (WLRs 2025) was applied as a screening benchmark to assess current conditions of Mn concentrations in the water column.

A review of available monitoring data shows that most concentrations are consistently below 100 µg/L in all sub-basins. Manganese concentrations were above the screening benchmark in one sample (< 1% of total). An updated WQO of 22.6 µg/L is based on 10 years of existing monitoring data from Metro Vancouver's Burrard Inlet Ambient Monitoring Program. This water objective is set to maintain or improve existing levels of Mn in the water column. The Mn WQO is listed in Table 9 and applies to all sub-basins. It is set to protect human consumption of shellfish.

Table 9. Water quality objective for manganese in *səlilwət*/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	22.6 µg/L (mean) ¹					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

5.2.7 Mercury

Mercury (Hg) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and discussed in Rao and LeNoble (2022). The CCME benchmark of 0.016 µg/L for inorganic Hg (CCME 2003) was used as the screening benchmark for total Hg in water. This provides a more conservative screening benchmark given the inorganic fraction will always be less than or equal to the total fraction. Additionally, the B.C. WQG for Hg is based on methylmercury and data for methylmercury is lacking for *səlilwət*/Burrard Inlet. The B.C. WSQGs of 0.13 µg/g dw (TEL) and 0.70 µg/g dw (PEL) were used to assess sediment quality. Finally, human health screening levels were calculated for various consumers ranging from 0.035 µg/g ww (subsistence fisher – toddler) to 0.324 µg/g ww (recreational fisher – adult). The most protective screening benchmark, however, is the approved B.C. WQG of 0.033 µg methylmercury/g ww in the diet of wildlife (WLRs 2026).

Note that some screening benchmarks differ slightly from those reported in Rao and LeNoble (2022) due to updated toxicological information from Health Canada (2021).

The screening benchmark for Hg in water was generally met in the most recent monitoring results analyzed, with exceedances occurring in 2012 at locations Outer Harbour, Inner Harbour, Port Moody Arm, and Indian Arm South.

Sediment Hg levels exceeded the TEL screening benchmark (0.13 µg/g dw) in at least one sample at all stations except for Indian Arm North. This screening benchmark was also exceeded in every sample collected from both Port Moody Arm and Indian Arm South. The PEL benchmark of 0.7 µg/g dw was met in all samples collected.

The most recent tissue Hg data analyzed (2012) show that English sole whole-body and muscle samples met screening benchmarks, but liver tissue levels exceeded the toddler and wildlife benchmarks in some cases. Blue mussel tissue results (2015 and 2016) were all below all screening benchmarks. It should be noted that data are extremely limited, and more information would be required to properly assess conditions.

The Hg WQOs for səliłwət/Burrard Inlet are listed in Table 10. The water and sediment objectives are set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 10. Water quality objectives for total mercury in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	0.016 µg/L (mean) ¹					
Sediment	0.13 µg/g dry weight (max) ²					
Tissue	0.033 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.8 Nickel

Nickel (Ni) levels in səliłwət/Burrard Inlet were reviewed, assessed, and discussed in Rao et al. (2021c).

The B.C. WWQG was used as the screening benchmark for assessing water quality for the protection of aquatic life (8.3 µg/L). The most recent monitoring results (2007 – 2016) show Ni concentrations in water are below the aquatic life screening benchmark. Occasional single sample exceedances were observed at False Creek, Inner Harbour, Central Harbour, and Port Moody Arm. The water objective is based on current conditions at the time of WQO development (see Rao et al. 2021c). An updated WQO of 0.8 µg/L is based on 10 years of existing monitoring data from Metro Vancouver’s Burrard Inlet Ambient Monitoring Program. This water objective is set to maintain or improve existing levels of Ni in the water column.

The B.C. WSQGs were used as the screening benchmarks for assessing the risks of Ni in sediments to aquatic life: a lower WSQG of 30 µg/g dw (TEL) and an upper WSQG of 50 µg/g dw (PEL). Sediment Ni concentrations in sediment measured between 2008 and 2015 were variable between sites. Concentrations at Central Harbour and Indian Arm North were below the lower WSQG of 30 µg/g. At the Outer Harbour sites, concentrations were approaching the upper WSQG of 50 µg/g and occasionally exceeded the screening benchmark. Concentrations in the Inner Harbour and Port Moody Arm fluctuated around the lower WSQG level with a few exceedances.

Tissue screening levels for the protection of human health were calculated for toddler subsistence fishers (0.42 µg/g ww); adult subsistence fishers (0.83 µg/g ww), and adult recreational fishers (1.65 µg/g ww) (ENV and HLTH 2021). Nickel concentrations in English Sole were below the toddler subsistence fisher screening level at all sites. Mussel concentrations exceeded this screening benchmark in the Outer Harbour and Central Harbour; however, data are very limited, and further monitoring is required for proper assessment.

The WQOs for Ni in the marine waters of səliłwət/Burrard Inlet are listed in Table 11 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life. The sediment objective is based on the lower WSQG. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 11. Water quality objectives for total nickel in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	0.8 µg/L (mean) ¹					
Sediment	30 µg/g dry weight (max) ²					
Tissue	0.42 µg/g wet weight (max) ³					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

³ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.9 Selenium

Selenium (Se) levels in səliłwət/Burrard Inlet were reviewed, assessed, and discussed in LeNoble et al. (2026). Screening benchmark concentrations for selenium are 2 µg/L, 2 µg/g dw, and 0.21 µg/g ww in water (WLRS 2025), sediment (WLRS 2025), and fish/shellfish tissue (WLRS 2023), respectively.

Selenium was detected in 81 water samples (13%) with concentrations ranging from to 0.5 to 1.5 µg/L. There were no exceedances identified in water when compared to the marine water screening benchmark, so no WQO was defined for water.

Selenium was detected in 169 sediment samples (36%) with concentrations ranging from 0.1 µg/g to 5.2 µg/g. Selenium concentrations were above the screening benchmark of 2 µg/g in 44 samples (9% of total).

Selenium was detected in 103 tissue samples (90%) with concentrations ranging from to 0.2 to 4.6 µg/g. The screening benchmark of 0.21 µg/g was exceeded in 102 samples (99% of detects).

The Se WQOs are listed in Table 12 and apply to all sub-basins. The sediment objective is set to protect marine aquatic life. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 12. Water quality objectives for total selenium in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Sediment	2 µg/g dry weight (max) ¹					
Tissue	0.21 µg/g wet weight (max) ²					

¹ Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

² Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.2.10 Silver

Silver (Ag) levels in səliłwət/Burrard Inlet were reviewed, assessed, and discussed in LeNoble et al. (2026). The B.C. WQG and B.C. WSQG were applied as screening benchmark concentrations for silver and are 0.5 µg/L in marine water (WLRS 2026) and 1 µg/g in sediment (WLRS 2025).

Silver was detected in 40 marine water samples (5%) with concentrations ranging from 0.05 to 20.0 µg/L. Three samples (< 1% of total) had concentrations higher than the screening benchmark of 0.5 µg/L.

Silver was detected in 344 sediment samples (83%). Concentrations of silver ranged from 0.051 µg/g to 6.0 µg/g. Concentrations were higher than the screening benchmark of 1 µg/g in 15 samples (4% of total).

The Ag WQOs are listed in Table 13 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life.

Table 13. Water quality objectives for total silver in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	0.5 µg/L (mean) ¹					
Sediment	1 µg/g dry weight (max) ²					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

5.2.11 Thallium

Thallium (Th) levels in səliłwət/Burrard Inlet were reviewed, assessed, and discussed in LeNoble et al. (2026). The screening benchmark concentration for thallium in marine water is 0.27 µg/L (Washington State 2024).

Thallium was detected in two marine water samples which is < 1% of all the samples collected. One of the two samples above detection limit exceeded the screening benchmark of 0.27 µg/L.

The Th WQO is listed in Table 14 and applies to all sub-basins. The objective is set to protect marine aquatic life.

Table 14. Water quality objective for total thallium in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	0.27 µg/L (mean) ¹					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

5.2.12 Zinc

Zinc (Zn) levels in səliłwət/Burrard Inlet were reviewed, assessed, and discussed in Rao et al. (2021d). The current B.C. WQGs for Zn (10 µg/L mean and 55 µg/L maximum) were used to assess current conditions in the water column at the time of WQO development. The B.C. lower and upper WSQGs (124 µg/g and 271 µg/g, respectively) were used to assess sediment conditions. Tissue screening levels were calculated to assess risks to human health as described in ENV and HLTH (2021). Toddlers from a subsistence fishing population were identified as the most sensitive receptors (17 µg/g ww).

The most recent monitoring results showed average total Zn concentrations in water were generally below the chronic guideline level with individual samples occasionally above 10 µg/L. Older data show frequent exceedances of the acute WQG with concentrations up to 270 µg/L.

Monitoring results show Zn sediment concentrations were generally below the lower WSQG level, although exceedances are noted (e.g., Port Moody Arm).

Except for Metro Vancouver English Sole liver tissue samples, Zn levels in tissue were well below the screening benchmarks for adults from both recreational and subsistence fishing populations and rarely exceeded the screening benchmark for toddlers from a subsistence fishing population.

The WQOs for Zn are listed in Table 15 and apply to all sub-basins. The water and sediment objectives are set to protect marine aquatic life. The short-term maximum acute WQO is a level that is not to be exceeded at any time in order to protect the most sensitive species and life stages from severe effects, including lethality. Acute WQOs are intended to assess risks associated with infrequent exposure events such as spills. The tissue objective is set to protect consumption of shellfish and finfish by humans and applies to all tissue types.

Table 15. Water quality objectives for total zinc in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	10 µg/L (mean) ¹					
	55 µg/L (maximum) ²					
Sediment	124 µg/g dry weight (max) ³					
Tissue	17 µg/g wet weight (max) ⁴					

¹ Mean is based on at least five weekly samples over a 30-day period. Compare mean to WQO and no more than 20% of samples > WQO.

² Level not to be exceeded at any time.

³ Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

⁴ Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

5.3 Microbiological Indicators

Microbiological indicators are used to indicate the potential presence of pathogens and risks to human health. Waterborne pathogens are a common source of a wide variety of diseases which can infect humans either through skin contact or ingestion. Current analytical methods do not allow for fast or economical monitoring of all potential human pathogens. For this reason, indicator species or groups of species are commonly used as a surrogate for microbiological water quality to assess risks to human health. Microbiological indicator levels in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in LeNoble et al. (2021).

The updated WQOs for microbiological indicators reflect current B.C. and Health Canada guidelines for recreational water quality (ENV 2019, Health Canada 2012), and Canadian Shellfish Sanitation Program requirements for shellfish harvest areas (CFIA 2020). They apply year-round to protect shellfish harvesting, other cultural practices, and recreational use in consideration of current impacts and uses, anticipated availability of management options, and Tsleil-Waututh Nation’s səliłwət/Burrard Inlet recovery goals.

WQOs are included for fecal coliforms, *Escherichia coli* (*E. coli*), and enterococci. The addition of *E. coli* as an indicator recognizes that *E. coli* was selected as the preferred indicator by Metro Vancouver and health authorities for recreational water quality monitoring. Enterococci are included as the indicator recommended by both ENV and Health Canada for marine waters. An objective for fecal coliform has also been retained as a “legacy objective” and because of its continued use in some jurisdictions and monitoring programs, including the Canadian Shellfish Sanitation Program.

Microbiological indicator concentrations in all sub-basins, except for Indian Arm, frequently exceed levels to allow shellfish harvesting; shellfish harvesting in səliłwət/Burrard Inlet has been closed since 1972 due to contamination. Most results meet the primary recreational contact guidelines in all sub-basins except False Creek where the guidelines are exceeded throughout the area. For this reason, a phased approach was developed with short-term WQOs (Table 17) to be protective of secondary contact only for False Creek. In Indian Arm, the short-term objective aims to protect the food, social, and ceremonial shellfish harvest already occurring in a portion of this sub-basin and to possibly expand areas in Indian Arm available for harvest. This WQO also recognizes that Indian Arm could potentially be used to deurate bivalve shellfish harvested in other sub-basins prior to consumption. The WQO for False Creek recognizes that the current condition of False Creek at the time of WQO development does not meet conditions suitable for primary contact and that the current management objective of the City of Vancouver and Vancouver Coastal Health is to protect non-immersive (i.e., secondary contact) uses.

Table 16. Short-term (2021 – 2025) WQOs for microbiological indicators in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Fecal coliforms (MPN/100 mL)	Water (shellfish harvest)						≤14 (median); ≤10% of results >43
<i>E. coli</i> (CFU or MPN/100mL)	Water	≤1,000 (geo mean) ^{1,2}	≤200 (geo mean) ^{1,3} ; ≤400 (max) ^{3,4}				
Enterococci (MPN/100 mL)	Water (shellfish harvest)						≤4 (median); ≤11 (90 th percentile)
Enterococci (CFU or MPN/100 mL)	Water	≤175 (geo mean) ^{1,2}	≤35 (geo mean) ^{1,3} ; ≤70 (max) ^{3,4}				

¹ Geomean is based on at least 5 weekly samples over a 30-day period.

² To protect secondary contact activities only (Health Canada 2012).

³ To protect both primary and secondary contact activities (ENV 2019).

⁴ Single sample maximum allowable concentration.

The medium-term WQOs (Table 18) represent water quality suitable for shellfish harvesting in four of the six sub-basins—the Outer Harbour, Central Harbour, Port Moody Arm, and Indian Arm—and for primary contact activities in False Creek and the Inner Harbour. The selection of WQOs was informed by the range of microbiological indicator levels measured, the observed exceedances of shellfish harvesting benchmarks since 2007, and the frequency of microbiological indicator levels that are an order of magnitude or more above the shellfish harvesting benchmarks.

Table 17. Medium-term (2025 – 2050) WQOs for microbiological indicators in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Fecal coliforms (MPN/100 mL)	Water (shellfish harvest)		≤14 (median); ≤10% of results >43		≤14 (median); ≤10% of results >43		

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
<i>E. coli</i> (CFU or MPN/100mL)	Water	≤200 (geo mean) ^{1,3} ; ≤400 (max) ^{3,4}					
Enterococci (MPN/100 mL)	Water (shellfish harvest)		≤4 (median); ≤11 (90 th percentile)		≤4 (median); ≤11 (90 th percentile)		
Enterococci (CFU or MPN/100 mL)	Water	≤35 (geo mean) ^{1,3} ; ≤70 (max) ^{3,4}					

¹ Geomean is based on at least 5 weekly samples over a 30-day period.

²To protect secondary contact activities only (Health Canada 2012).

³To protect both primary and secondary contact activities (ENV 2019).

⁴Single sample maximum allowable concentration.

The long-term WQOs (Table 18) are based on a long-term recovery goal to reopen shellfish harvesting in all sub-basins of *səlilwət*/Burrard Inlet. Any future approvals of shellfish harvesting areas will be dependent on the success of measures taken to reduce microbiological pollution, among other criteria. The data assessment showed that screening benchmark exceedances occur more frequently in the winter when the region receives the most rainfall (LeNoble et al. 2021). This suggests that timelines for the elimination of combined sewer overflows (CSOs) and wet weather planning will be key components for achieving desired water quality improvements. The timeline for meeting the long-term WQOs was set to align with Metro Vancouver’s commitment to work with multiple municipalities to implement plans to prevent CSOs by 2050 in the Vancouver Sewage Area.

Attainment of these WQOs alone may not be sufficient to protect human health. Decisions on swimming and shellfish harvest area approvals are made by the relevant health authorities and the Canadian Shellfish Sanitation Program, respectively, considering microbiological indicator monitoring results, other potential pollutants, information on pollution sources, and other factors.

Pathogenic risk assessments may require additional monitoring beyond the microbiological indicators outlined in these WQOs; however, the WQOs consider the best available science and data for health outcomes and provide a relevant measure of microbiological water quality for the marine environment and water values in *səlilwət*/Burrard Inlet.

Table 18. Long-term (2050 – onwards) WQOs for microbiological indicators in *səlilwət*/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Fecal coliforms (MPN/100 mL)	Water	≤14 (median); ≤10% of results >43					
<i>E. coli</i> (CFU or MPN/100mL)	Water	≤200 (geo mean) ^{1,3} ; ≤400 (max) ^{3,4}					
Enterococci (MPN/100 mL)	Water (shellfish harvest) ⁵	≤4 (median); ≤11 (90 th percentile)					

¹ Geomean is based on at least 5 weekly samples over a 30-day period.

²To protect secondary contact activities only (Health Canada 2012).

⁴Single sample maximum allowable concentration.

⁵Note that these thresholds are lower than thresholds for recreation and cultural practices, and therefore also protect these values.

5.4 Microplastics

Microplastics (MPs) are plastic waste particles smaller than 5 mm and made of organic polymers derived from petroleum products, including polyvinylchloride, low density polyethylene, nylon, polystyrene,

polyethylene, and polypropylene. MP levels in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in Braig et al. (2019a).

Due to their small size, MP particles can be ingested by various marine organisms potentially causing both physical and chemical adverse effects. There are three mechanisms by which MPs can present significant risks to marine aquatic life:

- physical interactions, such as ingestion of plastics;
- indirect toxicity through release of toxic additives or bound chemicals; and
- as a vector for pathogenetic microorganisms and parasites.

Sources of MP pollution into səliłwət/Burrard Inlet include personal care products, marine coatings, plastic pellets, vehicle tires, road markings, fibres from synthetic textiles and plastic shoreline waste. Treatment at the Annacis Island wastewater treatment plant was found to remove approximately 92% of MP particles prior to discharge, with fibres being the dominant form of MP in the discharged effluent. In marine sediments, higher concentrations of MPs were associated with urban development, with fibres and fragments being the most dominant types. In səliłwət/Burrard Inlet mussels, fibres and fragments were also observed to be the most common MP types. MPs in səliłwət/Burrard Inlet were also found to provide sorption sites for lead, cadmium, copper, and zinc (Braig et al. 2019a).

Water quality benchmarks for the protection of marine life are not available for MPs, and the toxicological information currently available and the data specific to səliłwət/Burrard Inlet are limited. Therefore, the WQOs for MPs, listed in Table 19, are general in nature and may be updated once toxicological information and additional monitoring data become available. Monitoring of MPs in sediment, water, and tissue is recommended for səliłwət/Burrard Inlet, with year-round sampling to account for potential seasonal variability in MP abundance associated with variations in wastewater treatment plant discharges and plastic use. Until marine-relevant toxicity data are available, management priorities should be source control and monitoring, with the goal of reducing concentrations of MPs in water, sediment, and tissue over time.

Table 19. Water quality objectives for microplastics in səliłwət/Burrard Inlet.

Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Water	Short-term (to 2025): No increase over current levels Long-term (by 2050): Decreasing concentrations from current levels					
Sediment						
Tissue						

5.5 Nutrients

The screening benchmark concentration for total ammonia nitrogen in water ranges between 0.67 to 312 mg/L as N and the toxicity is dependent on modifying factors - salinity, temperature, and pH (WLRS 2025). The screening benchmark is for the protection of aquatic life. In many cases, toxicity modifying factors have not been measured alongside total ammonia nitrogen, leading to difficulty determining whether conditions that may be harmful to marine aquatic life were present.

Total ammonia nitrogen was detected in 731 marine water samples (69%) with concentrations ranging from 5 to 300 mg/L as N. Although 94% of the total ammonia nitrogen samples were not accompanied by measurements of the toxicity modifying factors, total ammonia nitrogen was detected in 61 samples that were accompanied by measurements of toxicity modifying factors with the calculated condition specific benchmarks ranging from 23 to 200 mg/L as N.

For total ammonia nitrogen, the updated WQO is based on a criteria table from the B.C. WQGs that requires measurement of toxicity modifying factors (salinity, pH, and temperature) to calculate a condition specific benchmark. The salinity of deeper water is usually 29-30 ppt, while the surface salinity can vary from 20-25 ppt during the winter local runoff period and to less than 10 ppt during the summer when Fraser River runoff is the major dilution factor to Burrard Inlet. The most saline surface waters in Burrard Inlet occur between the First and Second Narrows due to turbulent mixing associated with estuarine and tidal flows through the shallow areas (Nijman and Swain 1990). If data has not been collected for toxicity modifying factors, the updated objective for total ammonia nitrogen is the lowest calculated screening benchmark among the dataset (23 mg/L as N).

The total ammonia WQO is listed in Table 20 and is set to protect marine aquatic life.

Table 20. Water quality objectives for ammonia in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total ammonia nitrogen	Water	See criteria table from the B.C. Water Quality Guidelines (mean). If toxicity modifying factors (salinity, pH, and temperature) were not measured, the objective is 23 mg/L as N (mean). ¹					

¹ Mean is based on at least 5 weekly samples over a 30-day period.

5.6 Oil and Grease

Oily substances may be of natural origin (e.g., seepage from natural deposits, decomposition of some materials), or human-made (e.g., industrial wastes, road run-off, etc.) (Health Canada 2022). Human-made contamination is of greatest concern, and very small quantities of oily substances can contaminate seafood, pose risks for primary contact activities such as cultural and recreational practices, cause lethal and sublethal effects on aquatic life and wildlife, make water aesthetically unattractive, create odours, form films, foul equipment, and result in beach advisories or closures. The water quality objective for oil and grease is listed in Table 21 and is set to protect marine aquatic life.

Table 21. Water quality objective for oil and grease in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Oil and grease	Water	Should not be present					

5.7 Persistent Organic Pollutants

5.7.1 Polybrominated Diphenyl Ethers

Levels of polybrominated diphenyl ethers (PBDEs) in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in Braig et al. (2021a), including a description of the screening benchmarks used to assess current conditions at the time of WQO development. PBDEs are a class of anthropogenic organobromine compounds used as flame retardant additives in various materials such as plastics and rubber. They are persistent, bioaccumulative, and toxic to both humans and aquatic life. PBDEs can undergo long-range global atmospheric transport and biomagnify in the food chain, affecting aquatic life and apex predators. Wastewater treatment plant effluent and combined sewer overflows are also potential sources of PBDEs to səliłwət/Burrard Inlet.

səliłwət/Burrard Inlet data showed that BDE-47 (tetra-BDE), BDE-99 (penta-BDE), BDE-100 (penta-BDE), and BDE-209 (deca-BDE) were the dominant congeners in sediment samples. Total PBDE concentrations

were above the B.C. WSQG of 1 ng/g dw in most samples with the highest concentrations found in the Inner Harbour, Outer Harbour, and Port Moody Arm.

In fish tissue, BDE-47, BDE-99, and BDE-100 were the congeners found in the highest concentrations. Concentrations of total tetra- and penta-BDEs were above the homologue-specific benchmarks in most samples. In both fish and mussel tissue samples, tetra-BDEs were found at the highest concentrations. PBDE levels in English Sole were highest at the Outer Harbour and Inner Harbour sites, with some elevated concentrations in the Port Moody area. For mussel tissue, PBDE levels were highest in the Outer Harbour, Central Harbour, and Inner Harbour sites, but at least one order of magnitude lower than in fish tissue samples. Mussel tissue samples were below the screening benchmarks for all homologue groups.

The PBDE WQOs for the marine waters of səliłwət/Burrard Inlet are listed in Table 22, based on the most sensitive screening benchmark for each homologue group. Objectives for the water column are for the protection of marine aquatic life. The sediment objective represents the concentration that will protect higher trophic level aquatic life (e.g., killer whales) from the adverse effects of PBDEs. The most sensitive value for tissue varied based on the homologue group: fish tissue for tri-BDE and penta-BDE, tissue screening value for humans for BDE-47, and wildlife diet for tetra-BDE, hexa-BDE, hepta-BDE, octa-BDE, nona-BDE, and deca-BDE. The objectives protective of fish tissue specify the concentrations in whole-body fish tissue (wet weight) which is not expected to cause adverse effects to the fish. The objectives protective of wildlife diet specify the PBDE concentrations in whole food (wet weight) which is not expected to cause adverse effects to wildlife.

The human health screening levels represent the potential risk to human health and apply to all tissue types (e.g., fish muscle, bivalves, crustaceans). The screening levels shown in Table 22 are for the most sensitive receptors, namely toddlers from a subsistence fishing population. Screening levels for adult consumers are provided in Braig et al. (2021a, Appendix A). WQOs for tissue, protective of fish, wildlife and human consumption of seafood, are presented in detail in Braig et al. (2021a). In addition to these numerical objectives, a general objective for decreasing PBDE concentrations in all media is included.

Table 22. Polybrominated diphenyl ether (PBDE) WQOs in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
PBDEs (all)	All	Decreasing concentrations from current levels					
PBDEs (total)	Sediment	1 ng/g dry weight (max)					
Tri-BDE (total)	Water	46 ng/L (mean) ¹					
	Tissue	120 ng/g wet weight (max)					
Tetra-BDE (total)	Water	24 ng/L (mean) ¹					
	Tissue	44 ng/g wet weight (max)					
Tetra-BDE-47	Tissue	4 ng/g wet weight (max)					
Penta-BDE (total)	Water	0.2 ng/L (mean) ¹					
	Tissue	1 ng/g wet weight (max)					
Hexa-BDE (total)	Water	120 ng/L (mean) ¹					
	Tissue	4 ng/g wet weight (max)					
Hepta-BDE (total)	Water	17 ng/L (mean) ¹					
	Tissue	64 ng/g wet weight (max)					
Octa-BDE (total)	Water	17 ng/L (mean) ¹					
	Tissue	63 ng/g wet weight (max)					

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Nona-BDE (total)	Tissue	78 ng/g wet weight (max)					
Deca-BDE (total)	Tissue	9 ng/g wet weight (max)					

¹Mean is based on at least five weekly samples over a 30-day period.

5.8 PCBs, PCDDs, and PCDFs

The persistent organic pollutants polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs or dioxins), and polychlorinated dibenzofurans (PCDFs or furans) were reviewed, assessed, and fully discussed in Sanchez et al. (2022b).

PCBs, PCDDs and PCDFs are three structurally related classes of persistent organic pollutants that are almost exclusively derived from anthropogenic activities, bioaccumulate in the marine food web, and are toxic to wildlife and humans (CCME 2001). PCBs have been identified as the contaminant of greatest concern for Southern Resident Killer Whales. PCDDs and PCDFs are endocrine disruptors, and the most toxic congener, 2,3,7,8-tetrachlorodibenzo-*para*-dioxin (2,3,7,8-TCDD), is carcinogenic.

Although banned for decades, PCBs, PCDDs, and PCDFs continue to persist in the environment. Current sources include leaching from improper waste disposal and aging equipment, long-range atmospheric transport, combined sewer overflows, and urban runoff. Due to their hydrophobicity, they tend to settle into sediments and can accumulate in fish and mammals. Humans are exposed through diet, with a disproportional risk to Indigenous peoples, relative to other populations, due to subsistence fishing (Sanchez et al. 2022b).

PCB, PCDD and PCDF levels exceeded sediment and tissue screening benchmarks throughout *səlilwət*/Burrard Inlet. Note that some screening benchmarks differ slightly from those reported in Sanchez et al. (2022b) due to updated toxicological information from Health Canada (2021). WQOs for PCBs, PCDDs, and PCDFs in water may be updated once more information becomes available; the current WQOs will be useful for characterizing waste discharges and assessing contaminated sites. Sediment and tissue WQOs are intended to protect aquatic life, including apex predators. The tissue objectives are also considered protective of Indigenous consumers of seafood.

The WQOs for PCBs, PCDDs and PCDFs are listed in Table 23. The WQOs for water are established based on current laboratory method detection limits and may be updated as analytical sensitivity improves. In addition to the numerical WQOs listed, an overall narrative WQO of decreasing concentrations of PCBs, PCDDs, and PCDFs over time is included.

Table 23. PCBs, PCDDs, and PCDFs WQOs in *səlilwət*/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total PCBs	Water	6.2 x 10 ⁻⁴ ng/L (max) ¹					
2,3,7,8-TCDD ²		5.1 x 10 ⁻⁶ ng/L (max) ³					
Total PCBs	Sediment	3.7 x 10 ⁻⁶ µg/g (dry weight) (max) ^{4,5}					
Total PCDDs and PCDFs		8.5 x 10 ⁻⁷ µg/g (dry weight) (max) ^{4,5}					
Total PCBs	Tissue	3.47 x 10 ⁻⁴ µg/g (wet weight) (max) ^{4,6}					
Total PCDDs, PCDFs, and Dioxin-like PCBs		8.0 x 10 ⁻⁸ µg/g (wet weight) (max) ^{6,7}					
PCBs, PCDDs, and PCDFs	All	Decreasing concentrations from current levels					

¹See Sanchez et al. (2022b) for details.

²2,3,7,8-tetrachlorodibenzo-*p*-dioxin, the most toxic of the PCDDs and PCDFs.

³Adopted from US EPA (2002).

⁴Adopted from WLRS (2026 and 2023).

⁵Based on at least 1 composite sample consisting of at least 3 replicates. Compare maximum to WQO.

⁶Applies to all tissue types. Based on a minimum of one composite sample, comprising no fewer than five fish, five crabs, or twenty-five bivalves. Compare maximum to WQO.

⁷PCDDs, PCDFs, and dioxin-like PCBs are assessed by converting their concentrations to units of 2,3,7,8-TCDD toxic equivalence using toxic equivalency factors applied to human health (see Sanchez et al. 2022b).

5.8.1 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbon (PAH) levels in *səlilwət*/Burrard Inlet were reviewed, assessed, and fully discussed in Braig et al. (2021b), including a description of the screening benchmarks used to assess current conditions at the time of WQO development. PAHs are a large and diverse group of substances consisting of hydrogen, carbon, and two or more aromatic rings. They are grouped into low molecular weight PAHs (≤ 3 aromatic rings) and high molecular weight PAHs (≥ 4 aromatic rings). Low molecular weight PAHs are more water soluble than high molecular weight PAHs and are generally more bioavailable. This variation in structure results in diverse physical and chemical properties, which in turn determine the fate and effects of PAHs in marine systems.

PAHs are formed in petroleum and coal deposits, and from the incomplete combustion of organic matter, such as forest fires, vehicle exhaust, and industrial emissions. Most PAHs are classified as persistent organic pollutants and can cause carcinogenic and non-carcinogenic effects in biological systems. Limited studies on the health effects in humans suggest that fish and shellfish consumption may pose health risks including endocrine disruption, cancer, and decreased birth rates.

Recent monitoring results indicate PAH levels in *səlilwət*/Burrard Inlet are a concern with respect to aquatic life and human health. In 2001, limited water column measurements showed occasional exceedances of the benzo(a)pyrene and chrysene screening benchmarks in Port Moody Arm and False Creek. More recent monitoring results to 2015 were below detection limits.

Sediment PAH concentrations exceeded screening benchmark levels in all sub-basins for all PAHs except total benzofluoranthenes. Concentrations at monitoring sites in the Inner Harbour, Outer Harbour, and Port Moody Arm frequently exceeded the screening benchmarks for priority PAH compounds. The north Indian Arm site had the lowest PAH concentrations, possibly because it is geographically removed from many PAH sources. Tissue PAH concentrations were below the screening levels; however, data are very limited, and further information is required for proper assessment.

PAH objectives for *səlilwət*/Burrard Inlet are listed in Table 24. The water and sediment objectives are set to protect marine aquatic life. The tissue objectives are set to protect consumption of shellfish and finfish by individuals from a subsistence fishing population. Note that some screening benchmarks differ slightly from those reported in Braig et al. (2021b) due to updated toxicological information from Health Canada (2021). The benzo(a)pyrene WQO allows for evaluation of exposure to mixtures of carcinogenic PAHs by totaling their measured concentrations adjusted according to their toxic equivalency factors (Health Canada 2021) as listed in Table 25. For example:

In a fish or shellfish tissue sample with the following PAH concentrations:

- Benzo(a)pyrene concentration – 1 $\mu\text{g/g}$
- Benzo(k)fluoranthene – 4 $\mu\text{g/g}$
- Chrysene – 5 $\mu\text{g/g}$
- Phenanthrene – 6 $\mu\text{g/g}$

the benzo(a)pyrene toxic equivalency concentration would be:

$$1 + (4 \times 0.1) + (5 \times 0.01) + (6 \times 0.001) = 1.456 \mu\text{g/g}$$

which exceeds the benzo(a)pyrene WQO in tissue (see ENV and HLTH (2021) for details).

In addition to these numeric WQOs, an overall objective of decreasing PAH concentrations in all media is included.

Table 24. Polycyclic aromatic hydrocarbon (PAH) WQOs in səlilwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Acenaphthene	Water	6 µg/L (mean) ¹					
	Sediment	6.71 ng/g dry weight (max) ²					
Anthracene	Sediment	46.9 ng/g dry weight (max) ²					
Benzo(a)pyrene ³	Water	0.01 µg/L (mean) ¹					
	Sediment	88 ng/g dry weight (max) ²					
	Tissue	0.0025 µg/g wet weight (max) ⁴					
Benzofluoranthene ⁵	Sediment	2.3 µg/g dry weight (max) ²					
Chrysene	Water	0.1 µg/L (mean) ¹					
	Sediment	108 ng/g dry weight (max) ²					
Fluoranthene	Sediment	113 ng/g dry weight (max) ²					
Fluorene	Water	12 µg/L (mean) ¹					
	Sediment	21.2 ng/g dry weight (max) ²					
Naphthalene	Water	1 µg/L (mean) ¹					
	Sediment	34.6 ng/g dry weight (max) ²					
2-methylnaphthalene	Sediment	20 ng/g dry weight (max) ²					
Phenanthrene	Sediment	86.7 ng/g dry weight (max) ²					
Pyrene	Sediment	153 ng/g dry weight (max) ²					

¹ Mean is based on at least 5 weekly samples over a 30-day period.

² Based on a minimum of 1 composite sample composed of at least 3 replicates. Compare maximum to WQO.

³The benzo(a)pyrene WQO provides a WQO to evaluate exposures to mixtures of carcinogenic PAHs by totaling their measured concentrations adjusted according to their potency equivalence factors (Health Canada 2021). See text and Table 25 for details.

⁴ Based on a composite sample consisting of at least 5 individual fish or 25 bivalves. Compare maximum to WQO.

⁵ This objective applies to the sum of all benzofluoranthenes. Concentrations are expressed in terms of sediment containing 1% organic carbon. Adjustments to guidelines are required for sediment with different organic carbon content.

Table 25. Benzo(a)pyrene toxic equivalency factors for carcinogenic PAHs.

Carcinogenic PAH	Toxic Equivalence Factor
Anthracene	0.1
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(g,h,i)perylene	0.01
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenzo(a,h)anthracene	1
Fluoranthene	0.001
Indeno(1,2,3-c,d)pyrene	0.1
Phenanthrene	0.001

5.9 Pesticides

Pesticides in *səlilwət*/Burrard Inlet were reviewed, assessed, and fully discussed in Braig et al. (2024). There are many different types of pesticides, originally developed to target specific classes of biota. They are applied to forests, rangelands, wetlands, cultivated crops, cities, and towns. They often drift or translocate into non-target aquatic systems and may unintentionally impact non-target species.

Both legacy and current use pesticides (CUPs) were considered. Legacy pesticides are compounds that were once used but are now banned due to adverse effects to humans and the environment. Many legacy pesticides are highly persistent, however, and can bioaccumulate and biomagnify within biological systems, meaning that they continue to be contaminants of concern. In general, CUPs are more target-specific and less persistent, but some are more acutely toxic.

The screening benchmarks for pesticide levels in sediment and water are based on the B.C. WWQGs, the B.C. WSQG, the US EPA freshwater sediment screening benchmarks (US EPA 2006), and the Water Quality Standards for surface waters of the State of Washington (Washington State 2024). Screening benchmarks for the protection of human health are derived from ENV and HLTH (2021). Pesticide concentrations were screened against the most conservative tissue screening benchmark, i.e., for either a toddler from a subsistence fisher population (for non-carcinogens) or an adult subsistence fisher (for carcinogens).

Of the 18 pesticides analyzed in *səlilwət*/Burrard Inlet marine water samples, three were detected and none exceeded the screening benchmarks. Of the 59 analyzed in *səlilwət*/Burrard Inlet sediments, 23 were detected and six exceeded screening benchmarks. Of the 33 analyzed in fish and mussel tissue, 19 were detected and three exceeded screening benchmarks.

The objectives for water, sediment and tissue are listed in Table 26. The updated objectives for water, sediment and tissue were drawn from the most protective screening benchmarks. Additional details of the protected value are presented in Appendix A of Braig et al. (2024). Where there was no detection of a given pesticide, the updated objective is ‘do not detect, when using best available detection limits, and/or decrease from current levels’. In addition to these objectives, an overall objective is for decreasing concentrations in levels of legacy pesticides and CUPs in all media.

Table 26. Pesticide WQOs in *səlilwət*/Burrard Inlet.

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
All pesticides	All	Decreasing concentrations from current levels					
Legacy Pesticides							
Aldicarb	Water	Not available					
	Sediment	Not available					
	Tissue	0.0351 µg/g wet weight (max)					
Aldrin	Water	0.0000077 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels ⁴					
Chlordane	Water	0.000093 µg/L (max)					
	Sediment	0.00226 µg/g dry weight (max)					
	Tissue	0.0026 µg/g wet weight (max)					
2,4,6-Trichlorophenol	Tissue	0.161 µg/g wet weight (max)					
2,4-Dichlorophenol	Tissue	3.47 µg/g wet weight (max)					
2,3,4,6-Tetrachlorophenol	Tissue	0.35 µg/g wet weight (max)					
Monochlorophenol	Water	0.1 µg/L (max)					
Total Dichlorophenols	Water	0.3 µg/L (max)					

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total Tetrachlorophenols	Water	1 µg/L (max)					
Total Trichlorophenols	Water	2 µg/L (max)					
DDE	Water	0.000018 µg/L (max)					
	Sediment	0.00207 µg/g dry weight (max)					
	Tissue	0.01 µg/g wet weight (max)					
DDT	Water	0.000025 µg/L (max)					
	Sediment	0.00119 µg/g dry weight (max)					
	Tissue	0.01 µg/g wet weight (max)					
DDD	Water	Not available					
	Sediment	0.00122 µg/g dry weight (max)					
	Tissue	0.014 µg/g wet weight(max)					
Diazinon	Water	0.03 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Dieldrin	Water	0.0000012 µg/L (max)					
	Sediment	0.00071 µg/g dry weight (max)					
	Tissue	0.00020 µg/g wet weight (max) ⁴					
Endosulfan	Water	0.0016 µg active ingredient/L (max)					
	Sediment	Not available					
	Tissue	0.21 µg/g wet weight (max)					
Endrin	Water	0.0023 µg/L (max)					
	Sediment	0.00267 µg/g dry weight (max)					
	Tissue	0.011 µg/g wet weight (max)					
Heptachlor	Water	0.0000059 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels ⁴					
Hexachlorobenzene	Water	0.000079 µg/L (max)					
	Sediment	0.0038 µg/g dry weight (max)					
	Tissue	0.002 µg/g wet weight (max)					
Methoxychlor	Water	0.02 µg/L (max)					
	Sediment	Not available					
	Tissue	0.17 µg/g wet weight (max)					
Mirex	Water	Not available					
	Sediment	Not available					
	Tissue	0.007 µg/g wet weight (max)					
Oxy-chlordane	Water	Not available					
	Sediment	Not available					
	Tissue	Do not detect ³ and/or decrease from current levels					
Toxaphene	Water	Not available					
	Sediment	0.0001 µg/g dry weight (max)					
	Tissue	Do not detect ³ and/or decrease from current levels					
Current Use Pesticides (CUPs)							
Atrazine	Water	1.8 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Carbaryl	Water	0.29 µg/L (max)					
	Sediment	Not available					

Parameter ¹	Medium ²	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
	Tissue	Do not detect ³ and/or decrease from current levels					
Chlorpyrifos	Water	0.002 µg/L (max)					
	Sediment	Do not detect ³ and/or decrease from current levels					
	Tissue	Do not detect ³ and/or decrease from current levels					
Lindane (<i>gamma</i> -hexachlorocyclohexane (γ-HCH))	Water	0.010 µg/L (max)					
	Sediment	0.00032 µg/g dry weight (max)					
	Tissue	0.00289 µg/g wet weight (max)					
Imidacloprid	Water	0.65 µg/L (max)					
	Sediment	Not available					
	Tissue	2.11 µg/g wet weight (max)					
Malathion	Water	0.1 µg/L (max)					
	Sediment	Not available					
	Tissue	Do not detect ³ and/or decrease from current levels					
Permethrin	Water	0.001 µg/L (max)					
	Sediment	Not available					
	Tissue	1.74 µg/g wet weight (max)					

¹ Any water sample to be analyzed for organic substances should not be filtered.

² For sediment guidelines that are expressed as µg/g, this is based on the sediment as a whole and does not require adjustment for organic carbon content. Adjustments to guidelines are only required when they are expressed in terms of the sediment containing 1% organic carbon. For sediments with organic carbon other than 1%, an adjustment in guidelines should be made by multiplying the guideline by the % organic carbon content of the sediment.

³ Any objective of 'do not detect' implies non-detection when using best available detection limits.

⁴ Aldrin, dieldrin, heptachlor, and heptachlor epoxide assessed together: add measured concentrations in tissue and compare to screening value.

5.10 Pharmaceuticals and Personal Care Products

Pharmaceuticals and personal care products (PPCPs) in *səlilwət*/Burrard Inlet were reviewed, assessed, and fully discussed in Braig et al. (2019b). PPCPs were grouped into the following classes:

- Analgesics
- Antimicrobials
- Antihypertensives
- Antihistamines
- Selective Serotonin Reuptake Inhibitors (SSRIs)
- Stimulants/recreational drugs/personal care products
- Hormones

Sources of PPCPs are entirely anthropogenic and usually released into the marine environment via sewage from municipal and regional sources – including but not limited to sewer overflows, wastewater discharges, and illegal sewage release from marine vessels. Aquaculture and agriculture waste and run-off and leachate from landfills are also sources, but not relevant to *səlilwət*/Burrard Inlet. The main source of PPCPs in *səlilwət*/Burrard Inlet is sewage discharges.

When PPCPs reach the receiving marine environment, photodegradation, biodegradation and other abiotic transformation processes, such as hydrolysis, occur and may reduce their concentrations. PPCPs can also be transported within the marine environment depending on their physicochemical properties and environmental factors (e.g., pH, temperature, and the amount of sunlight exposure).

Since PPCPs are active molecules with target receptors in most vertebrates, their presence in the environment is highly concerning. To date, PPCP concentrations measured in səlilwət/Burrard Inlet waters are below the acute and chronic toxicity thresholds found in the literature. These thresholds are derived from acute exposure experiments, however, and likely do not reflect environmentally relevant low dose chronic exposures or the potential for toxicity from complex mixtures of PPCPs through additive, synergistic and antagonistic interactions. Measured PPCPs concentrations in səlilwət/Burrard Inlet waters and sediments are listed in Table 27 and Table 28, respectively. Information on PPCPs in səlilwət/Burrard Inlet aquatic life was not available at the time of writing.

Water quality screening benchmarks for the protection of marine life were not found for the PPCPs detected in səlilwət/Burrard Inlet, and the toxicological information currently available is insufficient to establish specific numerical marine WQOs. Until marine-relevant toxicity data are available, management priorities should be source control and monitoring, with the goal of reducing concentrations of PPCPs in water, sediment, and tissue over time. Therefore, general WQOs for PPCPs have been set and are listed in Table 29.

Sampling for PPCPs in səlilwət/Burrard Inlet has been limited. Monitoring recommendations are provided in Braig et al. (2019b) to guide future monitoring efforts and inform the development of numerical PPCP WQOs for səlilwət/Burrard Inlet. Monitoring for PPCPs in səlilwət/Burrard Inlet should continue to support the assessment of spatial and temporal trends in both background and impacted sites, and to develop appropriate numerical WQOs for PPCPs.

Table 27. Minimum and maximum PPCP concentrations measured in səlilwət/Burrard Inlet.

Compound	Class	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Acetaminophen	Analgesic	0.143	0.182
Naproxen	Analgesic	0.00698	0.00929
Clarithromycin	Antimicrobial	0.0034	0.00574
Ciprofloxacin	Antimicrobial	<0.00565	0.00624
Erythromycin-H2O	Antimicrobial	0.000524	0.000608
Desmethyldiltiazem	Antihypertensive (metabolite)	0.000161	0.000214
Diltiazem	Antihypertensive	0.00059	0.000622
Diphenhydramine	Antihistamine	0.000657	0.000698
Benzoylcegonine	Recreational drug (metabolite)	0.00325	0.00331
Cocaine	Recreational drug	0.000785	0.000988
N,N-Diethyl-meta-toluamide (DEET)	Personal care product	0.00218	0.00381
Caffeine	Stimulant	0.0989	0.179
1,7-dimethylxanthine	Stimulant	<0.0565	0.0705

Table 28. Minimum and maximum PPCP concentrations measured in səlilwət/Burrard Inlet sediments.

Compound	Class	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Clarithromycin	Antimicrobial	1.36	1.58
Erythromycin-H2O	Antimicrobial	0.263	0.554
Miconazole	Antimicrobial	1.39	1.73
Norverapamil	Antihypertensive	0.134	0.269
Verapamil	Antihypertensive	0.136	0.201
Diphenhydramine	Antihistamine	0.942	1.76
N,N-Diethyl-meta-toluamide (DEET)	Personal Care Product	0.622	1.18
Triclocarban	Personal Care Product	9.06	15.6
Cocaine	Recreational Drug	<0.123	0.27

Compound	Class	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Amphetamine	Stimulant	2.86	2.99
Sertraline	SSRI	0.354	0.453

Table 29. Water quality objectives for PPCPs in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Pharmaceuticals and Personal Care Products	Water	Short-term (to 2025): No increase over current levels Long-term (by 2050): Decreasing concentrations from current levels					
	Sediment						
	Tissue						

5.11 Physical Parameters

Physical water quality parameters in səliłwət/Burrard Inlet were reviewed, assessed, and fully discussed in Björklund et al. (2024). The physical parameters assessed include temperature, salinity, dissolved oxygen (DO), pH, total suspended solids, and turbidity.

The most sensitive value to changes in physical parameters is aquatic life. Changes in temperature impact almost every physical property of seawater, and shifts can have detrimental effects on the growth and survival of aquatic species. Changes to salinity may impact the structure of communities and distribution of species. A decrease in dissolved oxygen can have both sublethal and lethal effects in a variety of organisms. Changes in pH can directly impact some organisms and have secondary effects on many others. Increased suspended solids concentrations and turbidity can reduce the primary production of phytoplankton, resulting in impacts to other organisms and their habitats.

While global climate change is the major anthropogenic factor influencing physical parameters in marine waters, local anthropogenic activities related to land use and development can also have an effect. Natural processes that affect levels of physical parameters in səliłwət/Burrard Inlet include water column stratification (salinity and temperature driven), freshwater inputs, winds, and tides and currents.

Sensor-based data were collected during cruises performed by TWN in 2018 – 2020, with technical and data management support from Ocean Networks Canada. Existing B.C. WQGs and Washington State Water Quality Standards for Surface Waters (Washington State 2024) for marine and/or estuarine aquatic life were used as screening benchmarks.

Water temperatures in səliłwət/Burrard Inlet are characterized by uniform temperatures throughout the water column in winter, and a stratified water column in all sub-basins in spring, summer, and fall, with the highest surface temperatures in Port Moody Arm and Indian Arm. The Outer Harbour is most influenced by the Fraser River, with more variable summer surface temperatures than other sub-basins. Historical data collected by Fisheries and Oceans Canada (DFO) (DFO 2009) shows that deep water temperatures in Indian Arm increased by 1.5 °C when comparing 1950s – 1970s levels to post-1980s levels. Compared to the Water Quality Standards for Surface Waters of the State of Washington (Washington State 2024), observed maximum water temperatures in səliłwət/Burrard Inlet reach “extraordinary” ($\leq 13^{\circ}\text{C}$) or “excellent” ($13\text{--}16^{\circ}\text{C}$) quality in all sub-basins in fall, winter, and spring. During summer, maximum surface temperatures in Indian Arm, Port Moody, and Outer Harbour fall into the most impaired temperature category and are classified as “fair” ($\geq 19^{\circ}\text{C}$), while surface temperatures in Central Harbour and Inner Harbour are of “good” quality ($16\text{--}19^{\circ}\text{C}$).

Salinity is measured as a ratio of measured conductivity to a standard potassium chloride solution conductivity and is therefore dimensionless (no units). The salinity in səliłwət/Burrard Inlet typically

ranges between 15 and 30, whereas the average global ocean salinity is 35. Salinity in səliłwət/Burrard Inlet is generally low and highly variable due to seasonal variations in precipitation and freshwater inputs. Surface salinities increase toward the seaward entrance due to exchange with water from the Strait of Georgia. The seasonal trends in the Outer Harbour are affected by the Fraser River, with lowest salinity observed during freshet. Salinity in the other sub-basins is more affected by local streams, with lower salinity in the fall, winter, and spring, and higher salinity in the summer due to reduced rainfall. The highest and most stable salinity is measured in the bottom layer in all sub-basins. Salinity monitoring in səliłwət/Burrard Inlet has not been designed to detect short-term changes and the existing data cannot be assessed using the short-term B.C. WWQGs. Historical salinity data collected by DFO in Indian Arm (DFO 2009) showed no overall trend or anomalies over the 1951 – 2000 timespan, suggesting that the chronic B.C. WWQGs of $\leq 10\%$ change from background was met.

səliłwət/Burrard Inlet has a relatively high DO content. Surface concentrations peak in the spring in all sub-basins, averaging 8.8 mg/L, and decline over the year, with the lowest concentrations usually found in the fall (mean of 5.7 mg/L). By depth, the lowest DO levels are found in the mid- and bottom-depth layers of Indian Arm and Outer Harbour. In these deepest basins, the DO was below the 5 mg/L minimum instantaneous benchmark for the protection of aquatic life. In deeper layers during spring and summer and in all layers during fall and winter, the average DO concentrations fell below the chronic DO benchmark of 8 mg/L in all sub-basins, with some exceptions. Low oxygen at depth has been observed in other inlets on the B.C. coast, particularly those with low-runoff inputs or where circulation was not sufficient to replace oxygen (ENV 1997).

Suspended solids and turbidity in səliłwət/Burrard Inlet are affected by the silty waters of the Fraser River, especially near the Inlet entrance and in the Outer Harbour. Suspended solids were not measured during cruises for physical parameters, but surface concentrations of suspended material from the Fraser River plume in səliłwət/Burrard Inlet have been estimated at ≤ 10 mg/L using satellite imagery. Turbidity data collected during TWN cruises showed levels are generally below 8 NTU, with site and seasonal averages ranging from 0.18 NTU to 3.94 NTU. Turbidity met the short-term B.C. WQG, with exceptions in Indian Arm in the fall and winter, and the Outer Harbour in the winter. Turbidity data from Indian Arm, Port Moody Arm, and the Outer Harbour show larger variations than the ± 2 NTU chronic benchmark on some occasions.

pH was not measured during the TWN cruises but was measured by DFO in the Outer Harbour in 2018 through 2020. Results were within the lower bound of the B.C.-based screening benchmark but were above the upper limit of 8.7 on occasion at all monitored locations.

The WQOs for dissolved oxygen, pH, salinity, temperature, total suspended solids, and turbidity across all sub-basins are listed in Table 30.

Table 30. Physical parameter WQOs in səliłwət/Burrard Inlet.

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Temperature	Water	No further increase in temperature; the natural temperature cycle ¹ characteristic of the site should not be altered in amplitude or frequency by human activities					
Salinity	Water	No change in concentration (NaCl or equivalent) from the expected natural level ¹ at that time and depth					
Dissolved Oxygen ²	Water	8 mg/L 30-day mean ³					
		5 mg/L instantaneous minimum					
pH	Water	7.7 to 8.8 ⁴					

Parameter	Medium	False Creek	Outer Harbour	Inner Harbour	Central Harbour	Port Moody Arm	Indian Arm
Total Suspended Solids	Water	No increase from the expected natural levels in the ambient background, defined by best available data ⁵ as 10 mg/L ⁶					
Turbidity	Water	No increase from the expected natural levels in the ambient background, defined by best available data ⁵ as < 1 NTU ⁶					

¹ Data are unavailable to conclusively define “natural” levels; until additional information becomes available, monitoring results can be compared to conditions as described in Björklund et al 2024.

² In cases where natural dissolved oxygen concentrations do not meet the criteria, no statistically significant reduction below natural levels should be applied.

³ Mean is based on at least 5 weekly samples over a 30-day period.

⁴ To be refined when data are available for additional sub-basins.

⁵ See Appendix B in Björklund et al 2024 for details on how background concentrations were determined. Although other datasets may exist, the datasets used for determining the background (i.e., data available in ENV’s database) were found to be the ‘best available data’ within the constraints of the project. As more data becomes available, the background concentration may be revisited.

⁶ For comparison to the background, a mean is based on at least 5 weekly samples over a 30-day period.

6. MONITORING RECOMMENDATIONS

səlilwətəl health, well-being, diet, cultural identity, and stewardship laws are closely tied to the health of səlilwət. When our lands and waters are healthy, our people are healthy.

- Tseil-Waututh Nation (2022)

The WQOs presented in this document establish benchmarks to assess water quality and determine if the identified water values are being protected. WQOs apply throughout səlilwət/Burrard Inlet in both the areas of particular concern and the ambient areas. WQOs should be used for evaluation of data in all water quality monitoring programs conducted in the Inlet. Sampling and monitoring recommendations for səlilwət/Burrard Inlet are outlined in monitoring guidance prepared by ENV and TWN (2026) - https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo-attainment-reports/biwqo_monitoring_guidance.pdf.

səlilwət/Burrard Inlet and its watershed are large and complicated with many influencing factors affecting the Inlet's health. Given the extensive list of parameters of concern (see Appendix 1), it is unlikely that any single monitoring program will assess all parameters at any given time. Cooperation and collaboration amongst interested groups are therefore key to assessing the whole health of səlilwət/Burrard Inlet with respect to the WQOs. TWN has convened the organizations currently conducting major water quality monitoring programs to identify opportunities to coordinate efforts and collectively design a comprehensive water quality monitoring program for səlilwət/Burrard Inlet. Other water quality monitoring programs for səlilwət/Burrard Inlet should review the results of this initiative, published by Tseil-Waututh Nation, to inform their efforts (TWN 2025a).

Monitoring efforts should be designed so that analytical results can be compared to the WQOs to assess attainment (i.e., are the WQOs being met?). Monitoring programs would benefit from the use of the WQOs as benchmarks as they contribute to a better understanding of current conditions, cumulative effects, and most importantly, trends in water quality. WQOs can be used as benchmarks in a variety of monitoring programs such as baseline monitoring, WQO attainment monitoring, and aquatic effects monitoring. The purpose of monitoring should be documented and clearly described to support the best interpretation of results when comparing them to WQOs.

As much as possible, the selection of monitoring sites should be consistent with past or collectively identified monitoring locations to build on the existing body of knowledge or be targeted to identify pollution sources so that they may be addressed. Data collection and analysis methods should be consistent with B.C. Government standards and protocols, appropriate for the purpose, and clearly

documented. Part of a successful monitoring program is the effectiveness of communicating the results and integrating information into decision-making processes. Ideally, monitoring data for səliłwət/Burrard Inlet is openly shared through a centralized publicly accessible web-based database, such as the Provincial database EnMoDS, so it is available to regulatory agencies, Indigenous Nations, municipalities, and the public in a timely manner. The technical reports referenced in this document provide useful information on the details of monitoring results and locations that can guide future monitoring programs.

Monitoring additional parameters of concern that have limited data is recommended where possible. These parameters are as follows:

Table 31. Parameters to monitor in səliłwət/Burrard Inlet to determine if a WQO is needed, if they are at levels of concern, and help identify potential sources

Parameter	Medium
1,2,4-trichlorobenzene	Water
1,2-dichlorobenzene	Water, sediment, tissue
17 α -ethinyloestradiol (EE2) plus other hormones/steroids	Water
Aluminum*	Water, sediment, tissue
Arsenic (speciated data)*	Water, sediment, tissue
Benzene, toluene, ethylbenzene, xylene, styrene (BTEXS)	Water
Biotoxins	Water and tissue
Chlorate and free chlorine	Water
Chlorine-produced oxidants (CPOs)	Water
Chromium (speciated data)	Water and tissue
Cobalt*	Water, sediment, tissue
Contaminants of emerging concern (CECs) - consider novel CECs in future monitoring	Water, sediment, tissue
Cotinine (metabolite of nicotine)	Water
Current use pesticides (CUPs) – consider additional CUPs in future monitoring. Consider glyphosate, s-metolachlor, and 2,4-D	Water, sediment, tissue
Cyanide (e.g., weak acid dissociable)	Water
Ethylene dichloride	Water, sediment, tissue
Ethylene glycol	Water
Hexachlorobutadiene (HCBD)	Sediment
Iron*	Water, sediment, tissue
Light extractable petroleum hydrocarbon (LEPH)	Water
Methyl tert-butyl ether (MTBE)	Water
Molybdenum**	Water, sediment, tissue
Monochlorobenzene	Water
Pharmaceuticals and personal care products (PPCPs) – consider additional PPCPs in future monitoring	Water, sediment, tissue
Polychlorinated Biphenyls (PCBs), Dioxins (PCDDs) and Furans (PCDFs) - incorporate analysis of dioxin-like PCBs into monitoring programs, along with analyses of other PCBs, PCDDs and PCDFs	Water, sediment, tissue
Selenium	Water
Sulphide (as unionized H ₂ S)	Water
Tin*	Water, sediment, tissue
Total extractable hydrocarbons (TEH)*.***	Water
Total Phenols	Water, tissue

Parameter	Medium
Volatile petroleum hydrocarbons (VPHs) and volatile hydrocarbons (nC6 - nC10) (VH6-10)	Water

* There is currently no benchmark for comparison for marine water. Continue to monitor these metals in Burrard Inlet as an applicable benchmark may be developed in the future.

** There is currently no reliable benchmark for comparison for marine water; however, there exists an interim working level of 23 µg/L from the Australia and New Zealand Environment and Conservation Council (ANZECC 2000, Commonwealth of Australia 2000), and some exceedances of this interim working level have been observed in Burrard Inlet.

*** Constituents should also be monitored (i.e., polycyclic aromatic hydrocarbons [PAHs] and total PAH).

7. MANAGEMENT RECOMMENDATIONS

Our health and survival are closely tied to the health of our waters, lands, and the air that we breathe. Guided by our sacred obligation to protect and be good stewards of the environment, our deep connection to Burrard Inlet and the surrounding lands, and our ancestral knowledge that has been passed on from generation-to-generation, we have governed and survived in this place for thousands of years.

- Tsleil-Waututh Nation (2020)

The supporting technical reports for the səliłwət/Burrard Inlet WQOs provide management recommendations related to the respective parameters. Several of these recommendations are useful across all parameters and those are provided below:

- Involvement with Tsleil-Waututh Nation’s ongoing work to restore the health of the Inlet through the continued implementation of the original and updated Burrard Inlet Action Plan (TWN 2017, TWN in prep).
- Update regulations, where needed, and work with industry and all levels of government to better implement existing regulations related to contaminant reduction, including via compliance and enforcement programs.
- Work towards reducing the frequency, duration, and magnitude of combined and sanitary sewer overflows through infrastructure improvements with the goal of phasing them out completely.
- Design and implement source controls and green stormwater infrastructure to reduce both point- and non-point source pollution.
- Improve wastewater management to further reduce inputs of nutrients, pathogens, and pharmaceuticals and personal care products.
- Implement existing Integrated Stormwater Management Plans.
- Implement municipal, regional, and provincial development standards or best management practices to protect watershed health, for example the Riparian Areas Protection Regulation.
- Further develop timely and publicly available reporting of monitoring results including data collected under waste discharge authorizations.
- Increase education, awareness, regulation, and public access to disposal facilities for proper disposal of hazardous materials such as paint and petroleum products.
- Limit or discontinue the use of harmful substances in consumer products including single-use plastics and chemicals that can harm aquatic life.
- Continue to remediate contaminated sites in the səliłwət/Burrard Inlet watershed.
- Initiate research and/or monitoring to address identified knowledge gaps in the understanding of water quality parameters and their management (see TWN 2025b).
- Update industrial and other authorized wastewater discharges, where needed, to reduce entry of contaminants into Burrard Inlet.

- Focus on the use of environmentally responsible materials and work to remove hazardous materials, e.g., creosote treated wood, from Burrard Inlet.
- Take proactive measures to eliminate or minimize the potential for accidents, malfunctions, spills, leaks and other contributions of petroleum hydrocarbons into səliłwət/Burrard Inlet.
- Establish an integrated working group to develop a collaborative approach to monitoring the water quality of səliłwət/Burrard Inlet (see TWN 2025a).

Note that this is not intended to be an exhaustive list of possible management recommendations, and these recommendations are not mutually exclusive. Readers should refer to the technical reports for more recommendations related to specific parameters.

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APPENDICES

Appendix 1. Parameters of concern for səlilwət/Burrard Inlet and accompanying technical reports.

Parameter	Reference
Contaminants of emerging concern (alkylphenols and their ethoxylates, bisphenols, phthalates, 6PPD and 6PPD-quinone, organotins, brominated flame retardants, perfluoroalkyl and polyfluoroalkyl substances)	Björklund, K., and LeNoble, J. 2024. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Contaminants of Emerging Concern Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Arsenic	Sanchez et al. 2022a. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Arsenic Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Cadmium	LeNoble, J., Lilley, P. and A. Rao. 2019. Water Quality Assessment and Updated Objectives for Burrard Inlet: Cadmium Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C. Rao, A.S. 2021. Addendum to cadmium technical report: updated tissue objective. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Copper	Rao, A.S., K. Björklund, J. LeNoble, and P. Lilley. 2021. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Copper Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Lead	Rao, A., J.L. LeNoble, and P. Lilley. 2021. Water quality assessment and proposed interim objectives for Burrard Inlet: Lead Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Mercury	Rao, A.S. and LeNoble, J. 2022. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Mercury Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Nickel	Rao, A., J.L. LeNoble, and P. Lilley. 2021. Water quality assessment and proposed interim objectives for Burrard Inlet: Nickel Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Zinc	Rao, A.S., J.L. LeNoble, H.C. Thompson, and P. Lilley. 2021. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Zinc Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Microbiological Indicators	LeNoble, J.L., P. Lilley, and A. Rao. 2021. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Microbiological Indicators Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Microplastics	Braig, S., K. Delisle, and M. Noël. 2019a. Water Quality Assessment and Updated Objectives for Burrard Inlet: Microplastics Technical Report.
PBDEs	Braig, S., Delisle, K., LeNoble, J., Björklund, K., Noël, M., Rao, A.S. and H.C. Thompson. 2021. Water quality assessment and proposed objectives for Burrard Inlet: polybrominated diphenyl ethers (PBDEs) technical report. Tsleil-Waututh Nation and Province of B.C.
Pesticides (current use and legacy)	Braig, S., LeNoble, J., and Delisle, K. 2024. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Pesticides Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Pharmaceuticals and Personal Care Products	Braig, S., K. Delisle, and M. Noël. 2019b. Water Quality Assessment and Updated Objectives for Burrard Inlet: Pharmaceuticals & Personal Care Products Technical Report.
Physical Parameters	Björklund, K., Braig, S, Rao, A.S. and Gabelhouse, K. 2024. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Physical Parameters Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Polycyclic Aromatic Hydrocarbons	Braig, S., Delisle, K, Noël, M., LeNoble, J., Thompson, H.C. and A.S. Rao. 2021. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Polycyclic Aromatic Hydrocarbons (PAHs) Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Polychlorinated Biphenyls, Dioxins and Furans	Sanchez et al. 2022b. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Polychlorinated Biphenyls (PCBs), Dioxins (PCDDs) and Furans (PCDFs) Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.

Parameter	Reference
Remaining Marine Parameters	LeNoble, J., Björklund, K., Rao, A.S., Gabelhouse, K., and M. Sanchez. 2026. Water quality assessment and proposed objectives for Burrard Inlet: additional marine water quality parameters technical report. Prepared for Tsleil-Waututh Nation and the Province of B.C.
Freshwater tributaries	Rao, A.S., LeNoble, J., Braig, S and Björklund, K. in prep. xatəmət ct tə səllwət / Water Quality Assessment and Proposed Objectives for səllwət (Burrard Inlet): Freshwater Tributaries Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.