



*Illustrations by Tsleil-Waututh artists Olivia George and Candace Thomas. Additional vectors from Vecteezy.com.*

# Technical Report

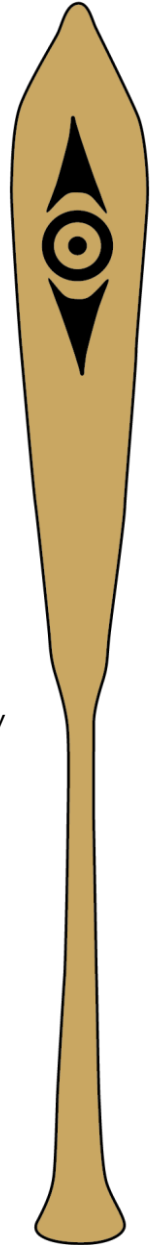
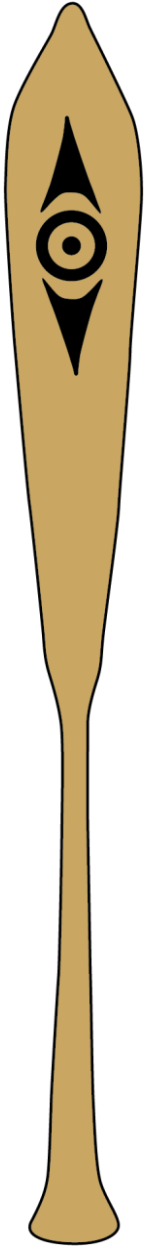
## səlilwət Water Quality Report Series

### Contaminant Heat Maps



**Tsleil-Waututh Nation**  
səlilwətəl





This Report supplements the [Burrard Inlet Water Quality Objectives](#), [Burrard Inlet Action Plan](#) and Cumulative Effects Management Initiative.

Citation:

Tsleil-Waututh Nation. 2026. səliłwət water quality report series:  
Contaminant heat maps. Tsleil-Waututh Nation Technical Report.

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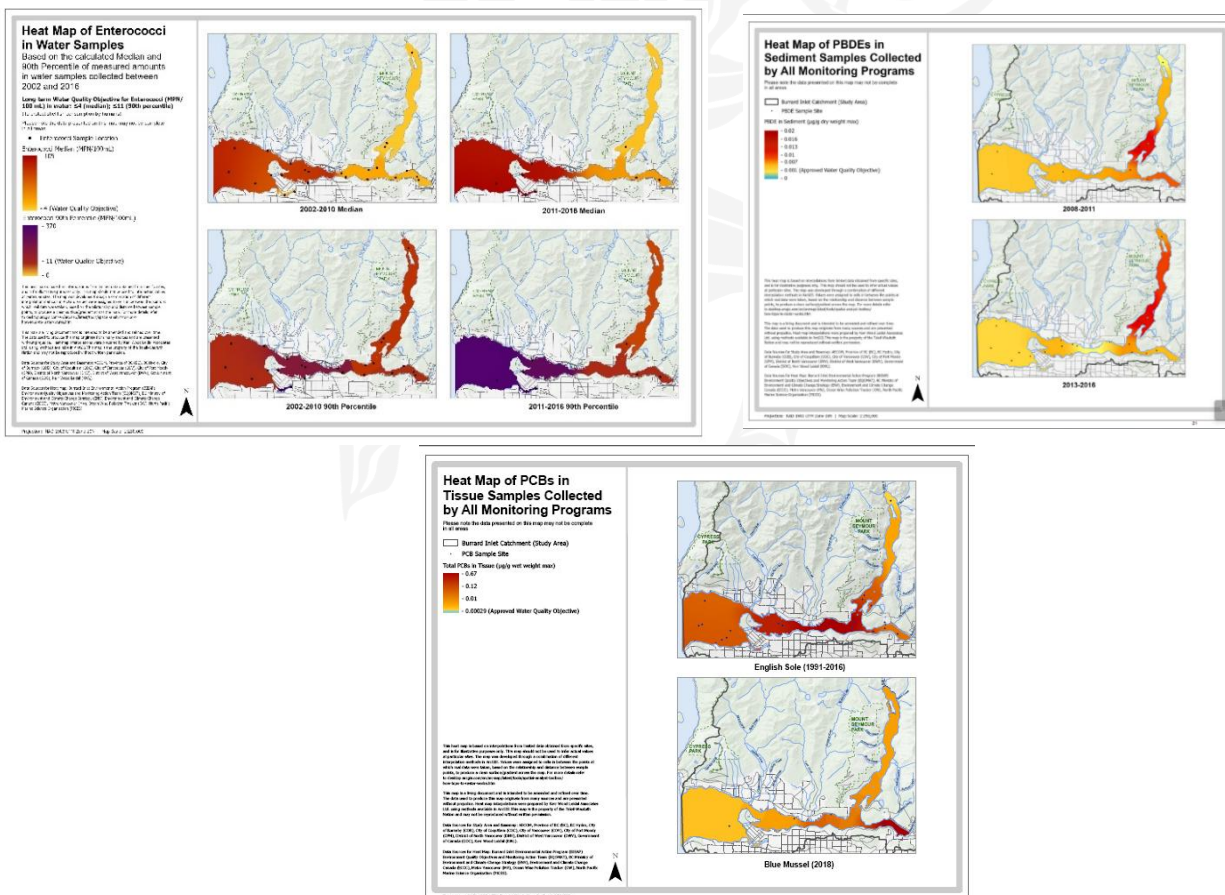
Tsleil-Waututh Nation  
PEOPLE OF THE INLET



## SUMMARY

Tsleil-Waututh are the People of the Inlet. Tsleil-Waututh territory is centred on səliłwət, known today as Burrard Inlet. The rich waters, lands and resources of the territory supported many thousands of Tsleil-Waututh ancestors. The cumulative effects of colonial development, including contamination, infringe on Tsleil-Waututh's rights, title, and ability to use their lands, waters and resources. Contamination of səliłwət has a major impact on Tsleil-Waututh Nation (TWN) Aboriginal rights and interests, and ways of life, by reducing or eliminating opportunities to fish, harvest shellfish and practice culture.

We analyzed historical data, ranging between the early 1970s and 2020, about certain contaminants in marine water, sediment and animal tissue (fish and mussel) and compared these data against the Burrard Inlet Water Quality Objectives, which are a measure of how clean the water should be to protect Water Values, including seafood consumption, cultural practices, recreation, and terrestrial and aquatic life. In this report, we display those data on maps to show the degree and extent of contamination compared to the Water Quality Objectives and to identify contaminant hotspots. Example heat maps are presented below for Enterococci (indicating fecal pollution) in marine water, PBDEs (flame retardants) in sediment, and PCBs in tissue. The WQO is set at yellow, with greater exceedances of the WQO represented as darker shades of red (purple in the most extreme cases).



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## ACRONYMS

BC	British Columbia
BDE	Brominated diphenyl ether
ENV	BC Ministry of Environment and Parks
GIS	Geographical information systems
PAH	Polycyclic aromatic hydrocarbon
PBDEs	Polybrominated diphenyl ethers
PCBs	Polychlorinated biphenyls
PCDDs	Polychlorinated dibenzodioxins or dioxins
PCDFs	Polychlorinated dibenzofurans or furans
TWN	Tsleil-Waututh Nation
WQO	Water Quality Objective

## INTRODUCTION

Tsleil-Waututh are the People of the Inlet and a distinct Coast Salish nation whose territory is centred on səlilwət, known today as Burrard Inlet. The rich waters, lands and resources of the territory supported many thousands of Tsleil-Waututh ancestors, who established legal obligations to protect, defend and steward the territory. The cumulative effects of colonial development, however, have gravely degraded the environmental integrity of the territory through impacts such as habitat loss, contamination and overfishing. In total, these impacts infringe on Tsleil-Waututh's rights, title, and ability to use their lands, waters and resources.

One of the major impacts on Tsleil-Waututh's ways of life has been contamination. Tsleil-Waututh Nation (TWN) considers the level of contamination in Burrard Inlet to have long surpassed acceptable levels; the cumulative impacts of contamination from urban and industrial development on water quality have impacted TWN's Aboriginal rights and interests, and ways of life, by reducing or eliminating opportunities to fish, harvest shellfish and practice culture.

In this document, heat maps illustrating the distribution of contaminant levels in sediment and tissue are presented in multi-year increments across all monitoring programs and years where data were present (data incorporated were from 1973 to 2020). These heat maps are based on data compilation and analyses undertaken as part of the project led by TWN, in collaboration with the Province of BC, to update the [Burrard Inlet Water Quality Objectives](#) (WQOs; ENV and TWN 2026).

Improving the water quality in Burrard Inlet through the implementation 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.



More than 700 contaminants have been recorded in Burrard Inlet (Rao 2022). The heat maps in this report only represent a fraction of those contaminants, and only within limited time periods. Heat maps for the following contaminants are included in this report:

Marine water:

- Microbiological indicators: Enterococci, *Escherichia coli*, Fecal coliforms

Marine sediment:

- Metals: arsenic, cadmium, copper, lead, mercury, nickel, zinc
- Persistent organic pollutants: polybrominated diphenyl ethers (PBDEs<sup>1</sup>, a type of flame retardant), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)
- Polycyclic aromatic hydrocarbons: acenaphthene, anthracene, benzo(a)pyrene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene

Marine animal tissue:

Shellfish (blue mussel tissue)

- Metals: arsenic, cadmium, copper, lead, mercury, nickel, zinc
- Persistent organic pollutants: PBDEs, PCBs, PCDDs, and PCDFs
- Polycyclic aromatic hydrocarbons: acenaphthene, anthracene, benzo(a)pyrene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene

Finfish (English Sole tissue)

- Metals: arsenic, cadmium, copper, lead, mercury, nickel, zinc
- Persistent organic pollutants: PBDEs, PCBs, PCDDs, and PCDFs
- Polycyclic aromatic hydrocarbons: acenaphthene, anthracene, benzo(a)pyrene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene

## METHODS AND LIMITATIONS

Please note that these maps are intended for the purposes of policy and policy implementation, to guide decision-making about priority areas for water quality improvements. These maps are not to be used to determine whether particular activities such as fish or shellfish consumption, or primary or secondary contact, can or cannot be undertaken.

The heat maps were developed using spatial interpolation in ArcGIS, primarily applying the *Spline with Barriers* geoprocessing tool. Values were assigned to cells in between the points at

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<sup>1</sup> The total concentration of PBDEs was calculated as the sum of measured homologue or congener levels, which were inconsistent between years and programs, leading to slight variations (Braig et al. 2021). In all cases the six most prevalent congeners (BDE-209, 47, 99, 49, 207, 17) were measured and past studies indicate that these congeners account for over 70% of the total PBDE concentrations in Burrard Inlet sediment (Morales-Caselles et al. 2017).



which real data were collected, based on the relationship and distance between sample points, to produce a continuous and smooth surface gradient across the map. No minimum number of points was required for this analysis. The boundary of the Inlet's ocean water was the limit for the interpolation, so the shape of the coastline was considered when interpolating the surface. Each available point was used to develop the continuous surface. Where there were fewer points available, the result was a less smooth surface. By using a Spline approach to interpolation, the resulting surface passed exactly through the available input points, while maintaining as much smoothness as possible across the entire surface. For more details, refer to ESRI (n.d.).

The maps incorporate different recent datasets, depending on the data variable. Marine water, marine sediment and tissue samples were collected by Environment and Climate Change Canada, BC Ministry of Environment and Parks, Metro Vancouver, and Ocean Wise. Fish data include samples from English Sole (*Parophrys vetulus*). Shellfish data include samples from blue mussels (*Mytilus sp.*). As was done with the analytical statistics for the [contaminant technical reports](#) produced while updating the Water Quality Objectives (ENV 2026), values below detection were excluded from the analysis because detection limits are highly variable.

The map colour gradients are set with yellow at the lower WQO value and red at the upper WQO value (if one exists). When there is a single WQO value, the map is set with yellow at that objective value. Areas where chemical concentrations exceed, or have been interpolated to exceed, the WQO are orange to red; areas where chemical concentrations are below the WQO are green to blue.

For individual contaminant maps, time increments for map displays have been set at 5 years, which enabled the most consistent data display, given the time gaps in the datasets. The date range for the complete dataset was 1973 to 2020; however, data were not available for all contaminants in all years, or in all matrices.

It is important to recognize that while the data may suggest that contaminant levels in parts of Burrard Inlet may have differed between year increments, differences in sampling frequency and method detection limits do not allow for direct comparisons. Instead, the heat maps may be used to illustrate the best understanding of potential areas where contaminant levels have been high relative to the rest of Burrard Inlet during a particular time window.

The heat maps are based on interpolations from limited data obtained from specific sites, and are for illustrative purposes only. The maps should not be used to infer actual values at particular sites.

These maps are living documents and are intended to be amended and refined over time. The data used to produce the maps originate from many sources and are presented without prejudice. Sources are listed on each map. These heat maps were commissioned by TWN. Heat



map interpolations were prepared by Kerr Wood Leidal Associates Ltd. using methods available in ArcGIS. Cartography was completed by Inlailawatash Limited Partnership.

## KEY FINDINGS

Significant findings from these heat maps include the following, with focus on more recent years; however, these are not to be considered comprehensive analyses:

- Hot spots exist, or have existed, for:
  - o Arsenic in finfish and shellfish tissue throughout Burrard Inlet
  - o Enterococci in water throughout western Burrard Inlet, with levels of concern for shellfish consumption throughout Burrard Inlet
  - o *E. coli* maximum levels in water throughout Burrard Inlet except northern Indian Arm
  - o Fecal coliform in water in the Inner Harbour and False Creek
  - o Lead in fish tissue throughout the Inlet, and in shellfish tissue in Indian Arm
  - o PBDEs and PCDDs & PCDFs in sediment in Indian Arm
  - o PBDE congeners 47, 99 and 100 in English Sole tissue in the Inner and Central Harbours
  - o PCBs in sediment in False Creek, Inner Harbour and at the First Narrows
  - o PCBs in shellfish tissue in Port Moody Arm, and fish tissue throughout the Inlet
  - o PCDDs & PCDFs in sediment throughout the Inlet, but particularly in Port Moody Arm and Indian Arm
  - o PCDDs, PCDFs and dioxin-like PCBs in tissue throughout eastern Burrard Inlet
- Microbiological indicators are at levels of concern throughout Burrard Inlet
- Metals in sediment have been recorded at levels of concern in several areas, based on the most recent data used for this analysis:
  - o Copper has been recorded at levels of concern in the Outer and Inner Harbour, and areas of Port Moody Arm and Indian Arm
  - o Lead has been at levels of concern in False Creek
  - o Mercury has been at levels of concern in multiple sub-basins
  - o Nickel has been at levels of concern in the Outer Harbour
  - o Zinc levels have been close to the WQOs near the outfalls around the Second Narrows
- Metals in tissue have been at levels of concern, particularly in Indian Arm, based on the most recent data used for this analysis:
  - o Arsenic has been recorded above the WQO at all locations in fish and shellfish.
  - o Mercury has been recorded at levels close to the WQO in Indian Arm.
  - o Lead has been at levels of concern in fish east of the First Narrows, and Indian Arm; and in shellfish in Indian Arm
- Persistent organic pollutants have been recorded at levels of concern in sediment and tissue throughout the Inlet, including in more remote areas of Indian Arm, based on the most recent data used for this analysis:



- The flame retardants PBDEs in sediment have been at levels of concern throughout the Inlet, particularly in Indian Arm. In tissue, PBDEs have been at levels of particular concern in the Inner Harbour.
- PCBs in sediment have been at levels of concern throughout the Inlet, particularly near the First Narrows, in the Inner Harbour and in False Creek, but also in Port Moody Arm and Indian Arm.
- Dioxins and furans have been at levels of concern throughout the Inlet, with greater concentrations in eastern Burrard Inlet.
- Certain polycyclic aromatic hydrocarbons (PAHs) have been recorded at levels of concern in sediment.
  - Particular areas of concern include the waters around Stanley Park, Port Moody Arm, Inner Harbour, Central Harbour, False Creek and southern Indian Arm.

For more information, including detailed information about the contaminants and datasets analyzed, and parameter-specific analyses of the data used to produce these heat maps, please refer to the Burrard Inlet Water Quality Objectives policy report and technical reports at: <https://www2.gov.bc.ca/gov/content?id=98C16ACBCFC4430B8D7A67FD9CB80EE7>

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<https://www2.gov.bc.ca/gov/content?id=98C16ACBCFC4430B8D7A67FD9CB80EE7>  
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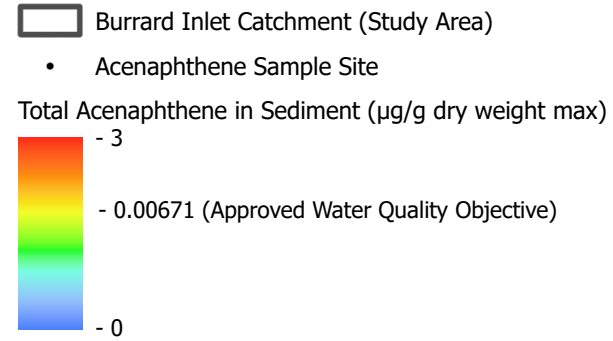
Morales-Caselles, C., Desforges, J.-P. W., Dangerfield, N., & Ross, P. S. 2017. A Risk-Based Characterization of Sediment Contamination by Legacy and Emergent Contaminants of Concern in Coastal British Columbia, Canada. Archives of Environmental Contamination and Toxicology, 73(2): 270–284.

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# Heat Map of Acenaphthene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

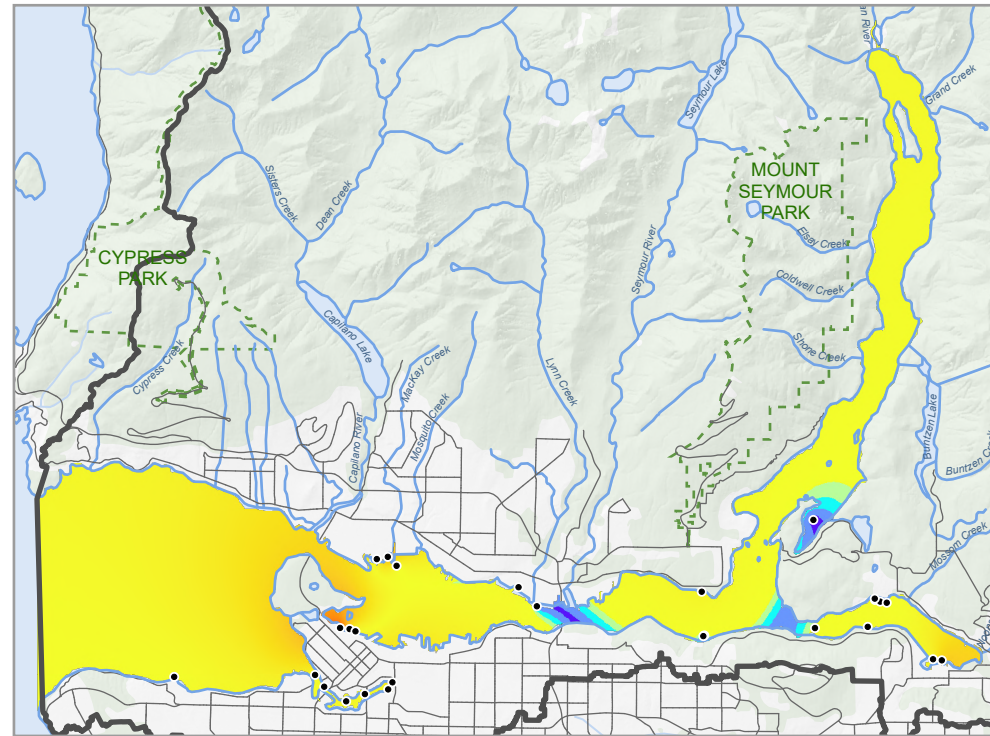


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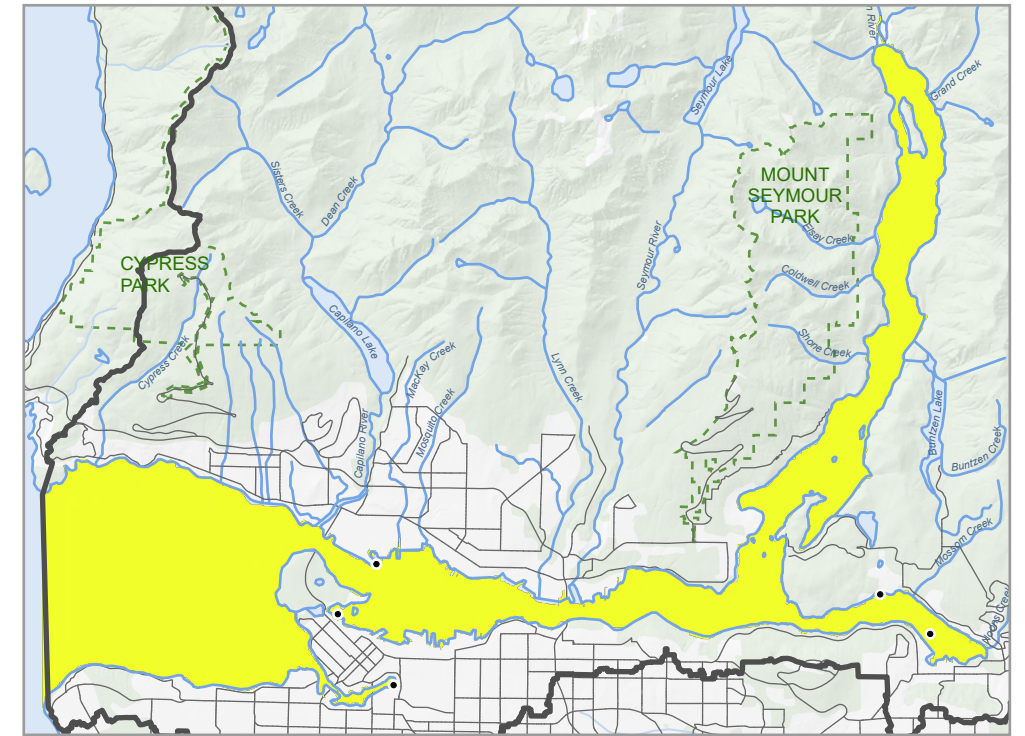
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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

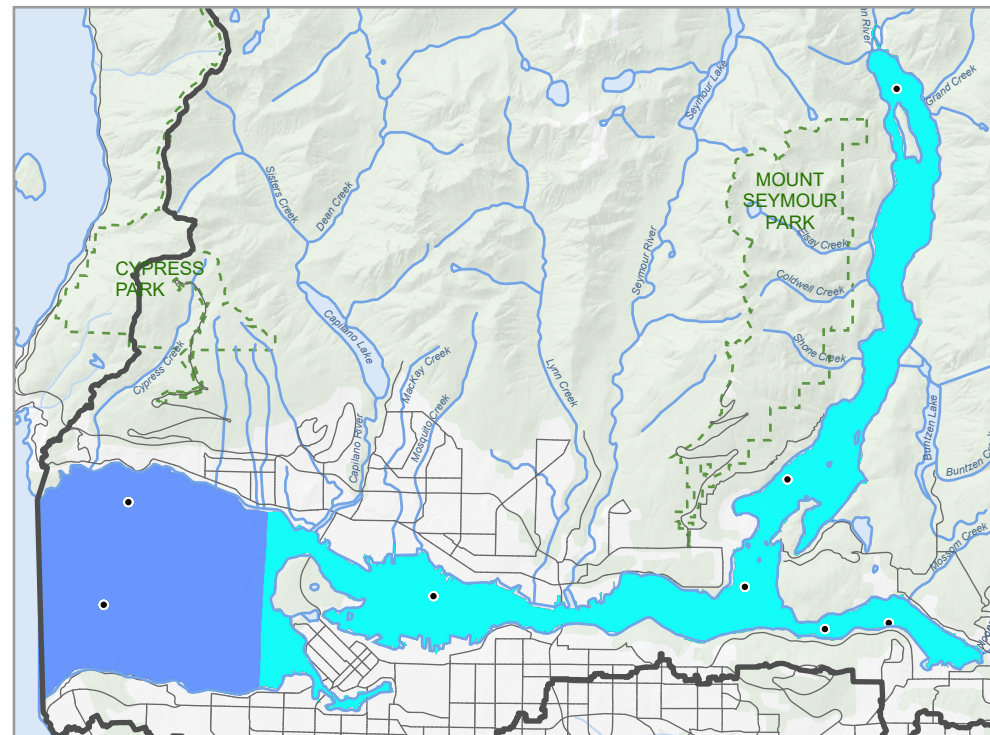
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



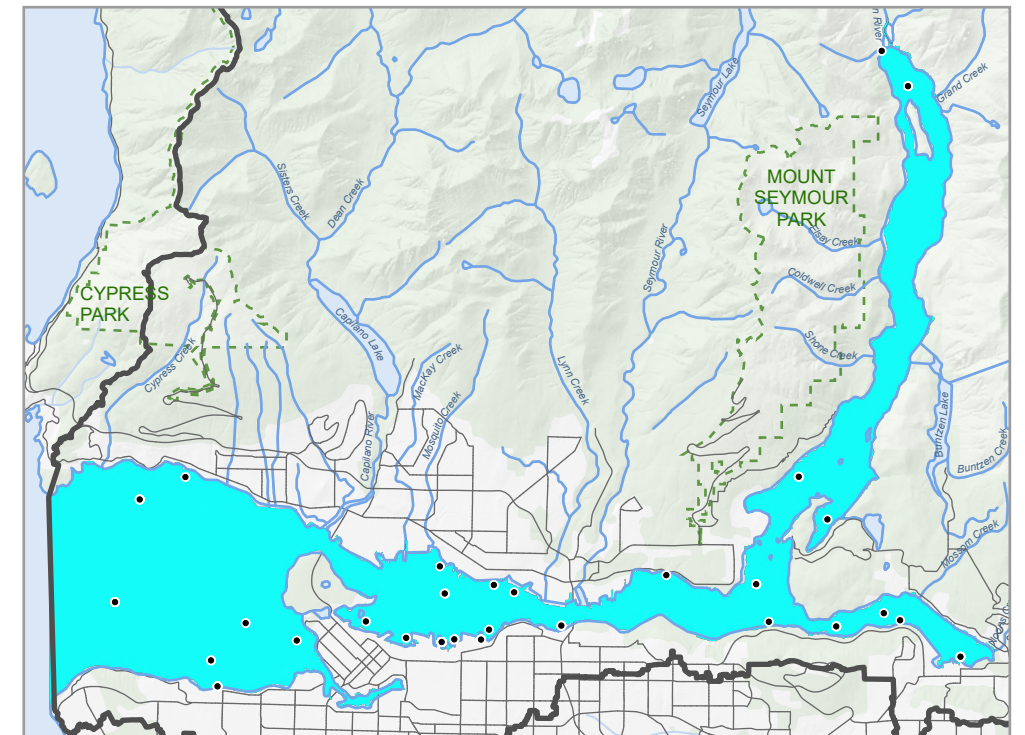
1991-1994



1999-2002



2008-2011



2013-2017

# Heat Map of Anthracene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Anthracene Sample Site

Total Anthracene in Sediment ( $\mu\text{g/g}$  dry weight max)

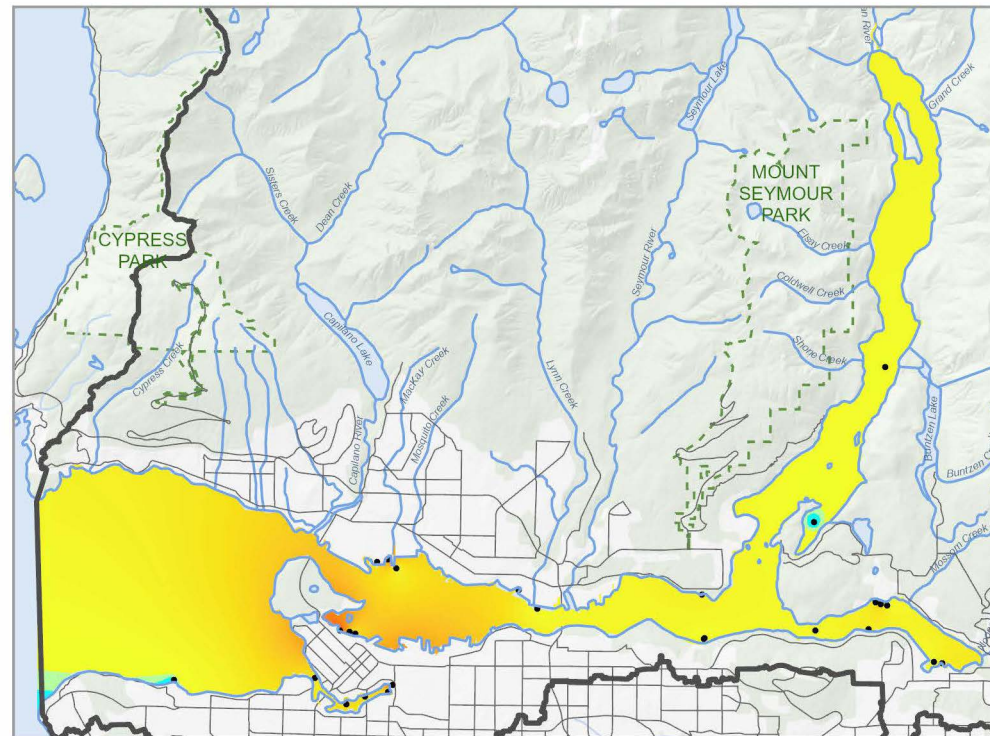


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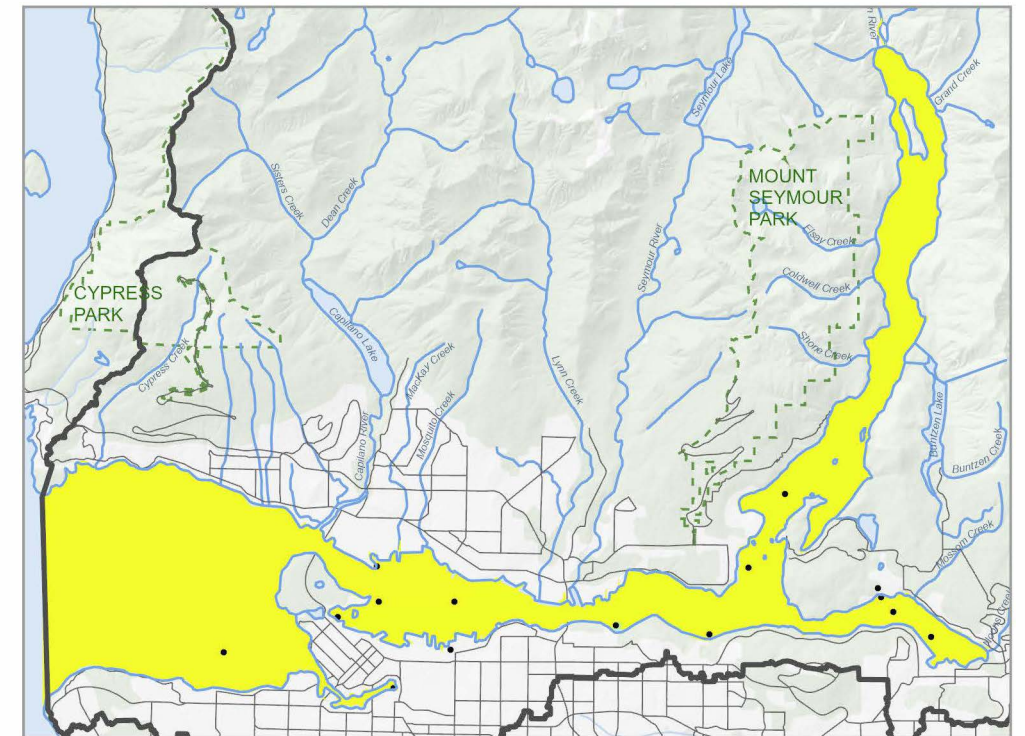
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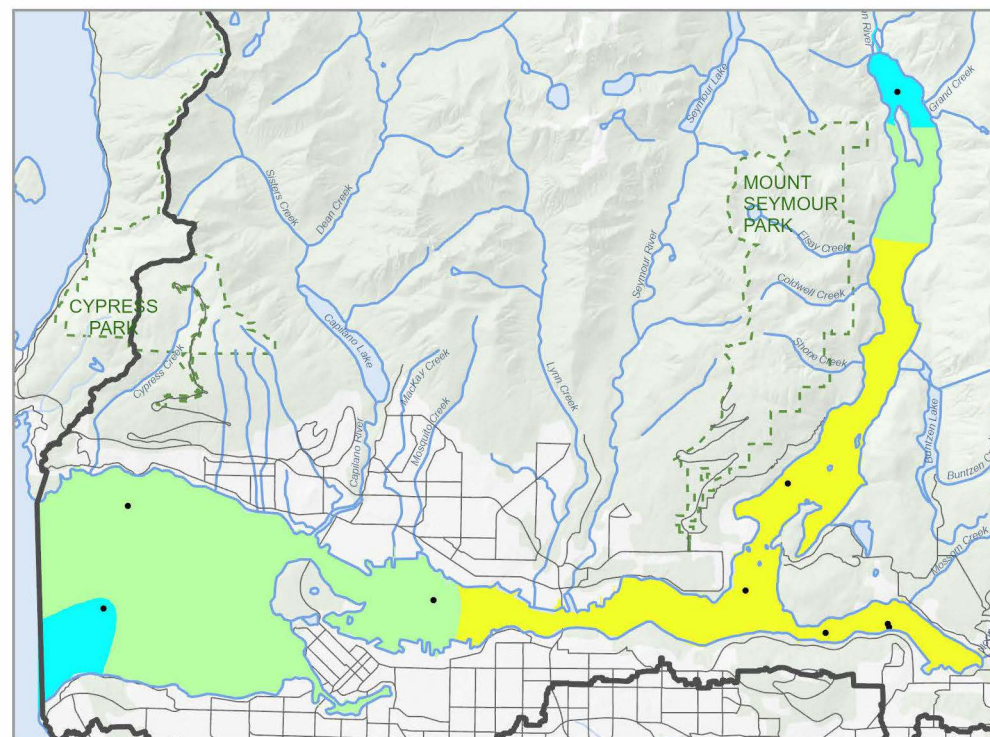
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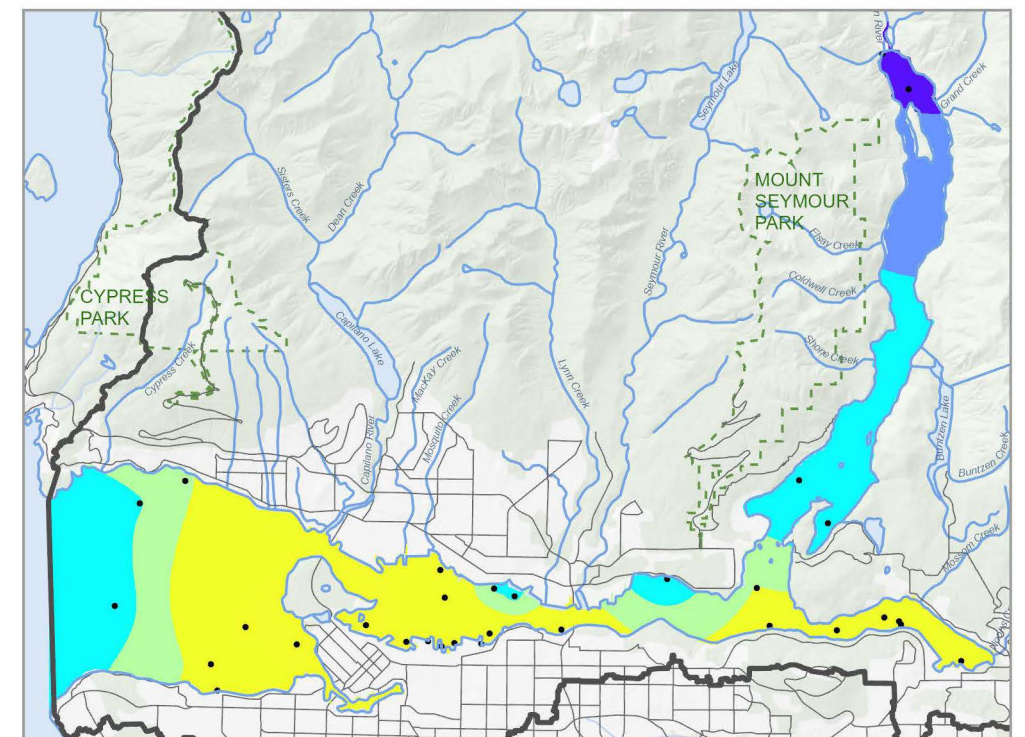
1991-1994



1999-2002



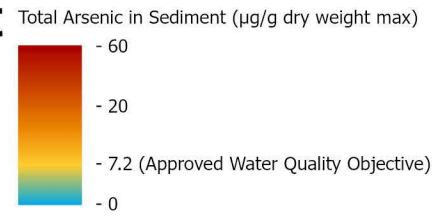
2008-2011



2013-2017

# Heat Map of Arsenic in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas



• Arsenic Sample Site  
 □ Burrard Inlet Catchment (Study Area)

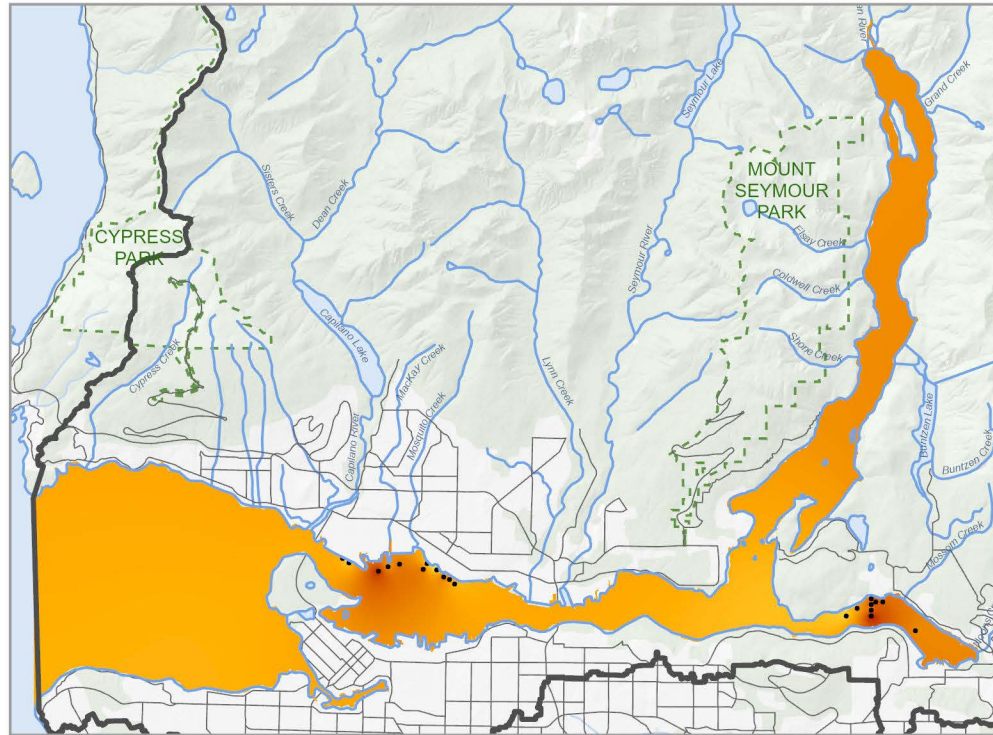
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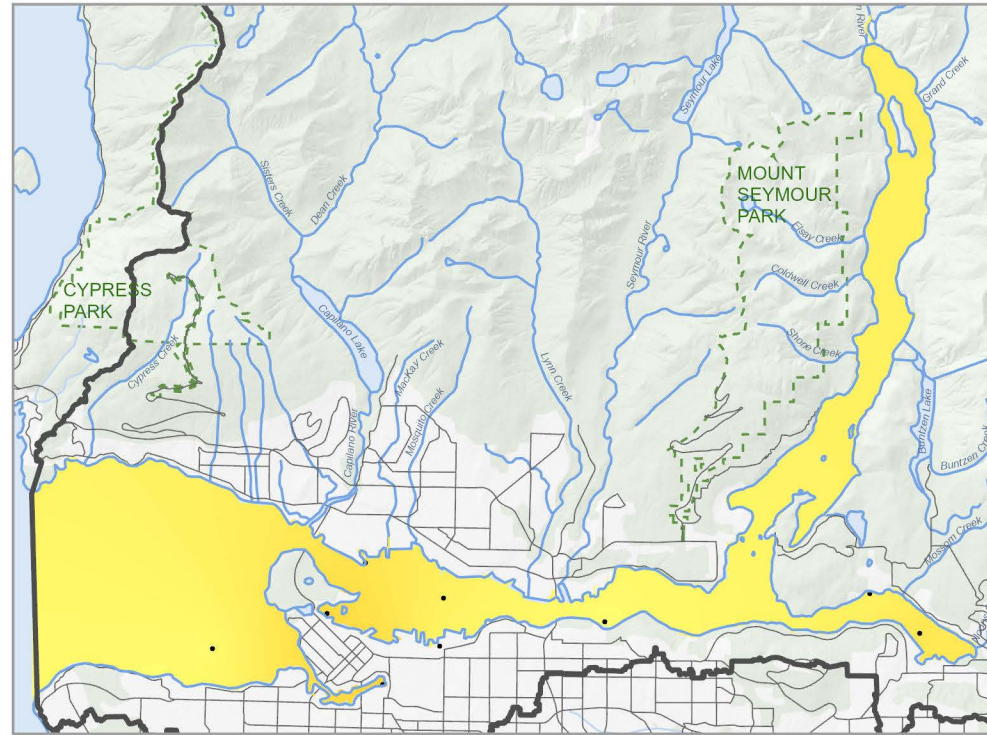
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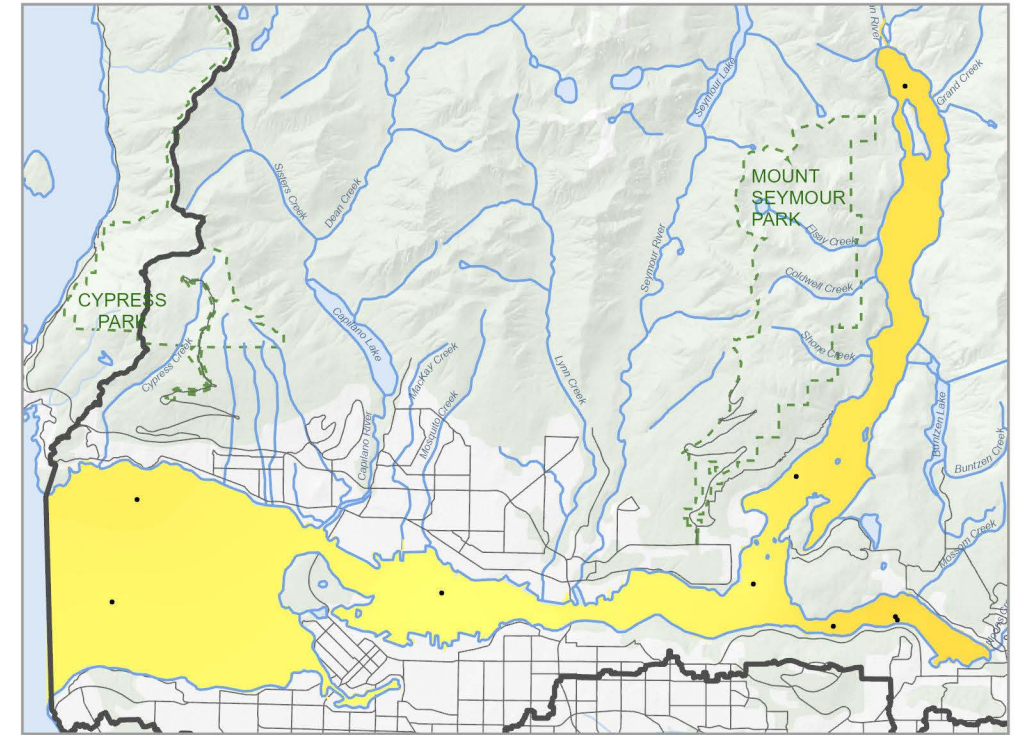
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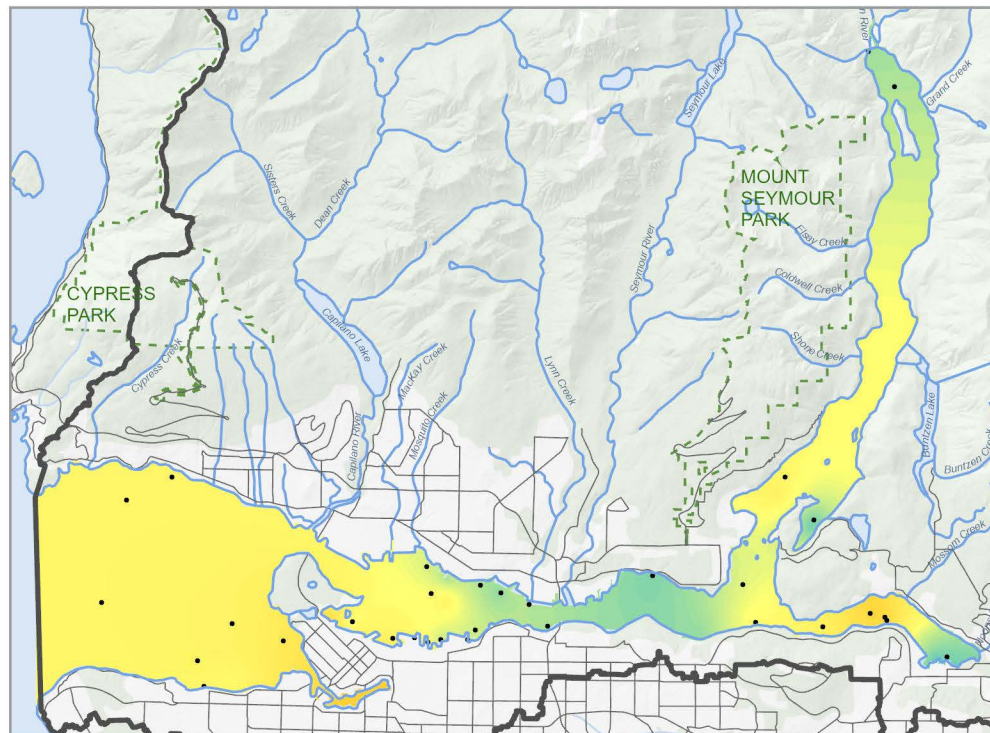
1985-1989



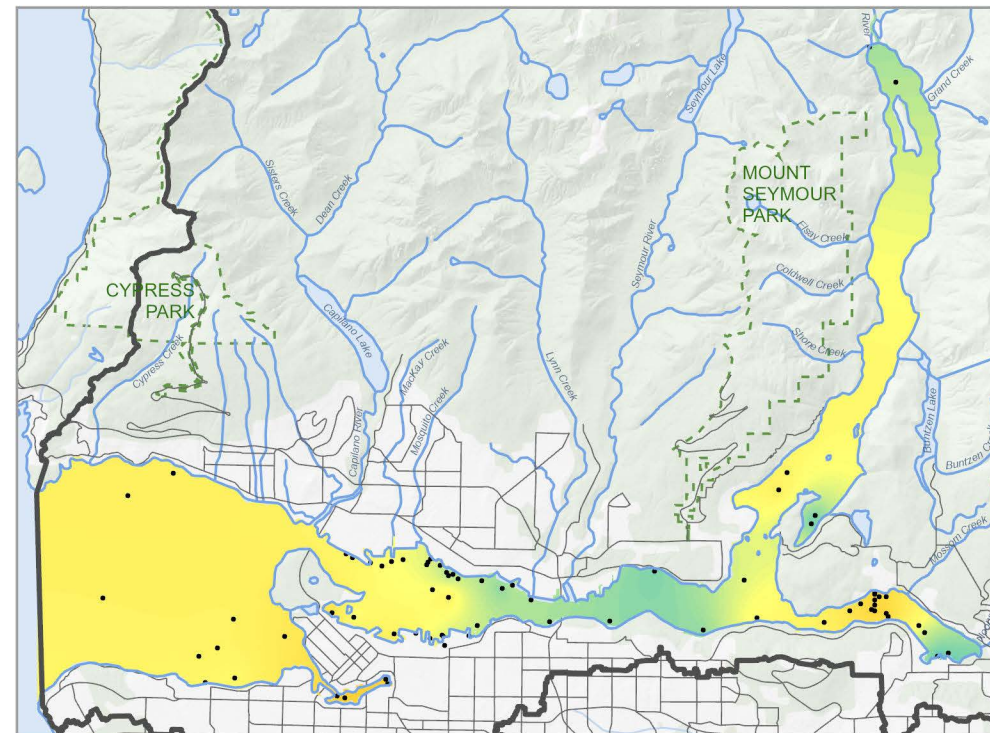
2000-2002



2008-2012



2013-2016



2017-2020

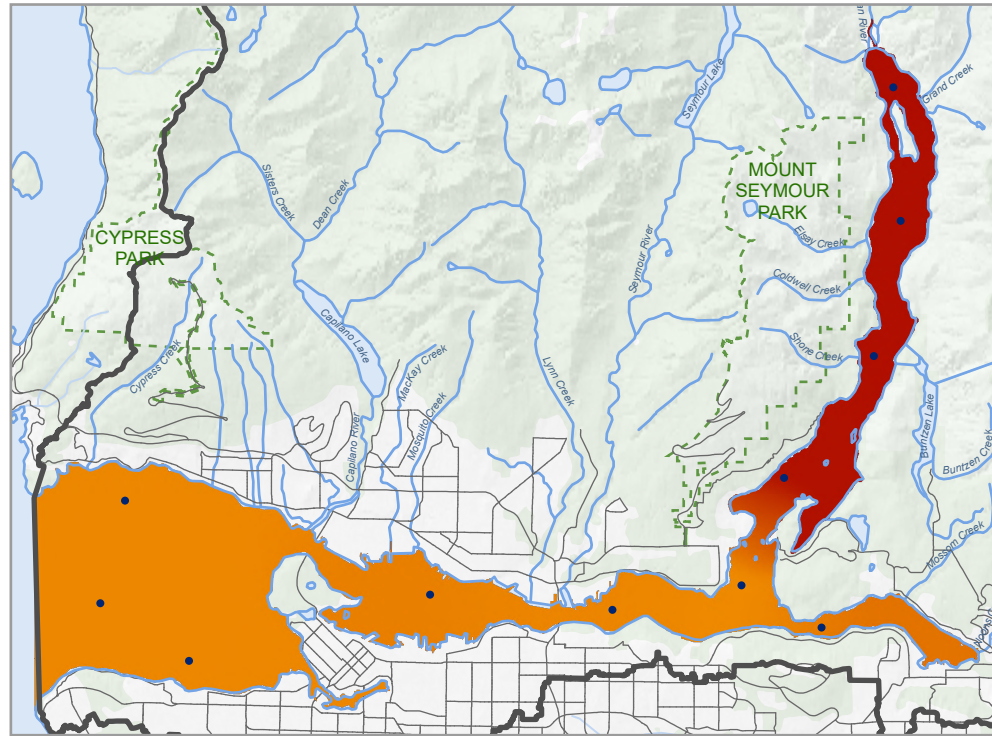
# Heat Map of Arsenic in Tissue Samples Collected by All Monitoring Programs

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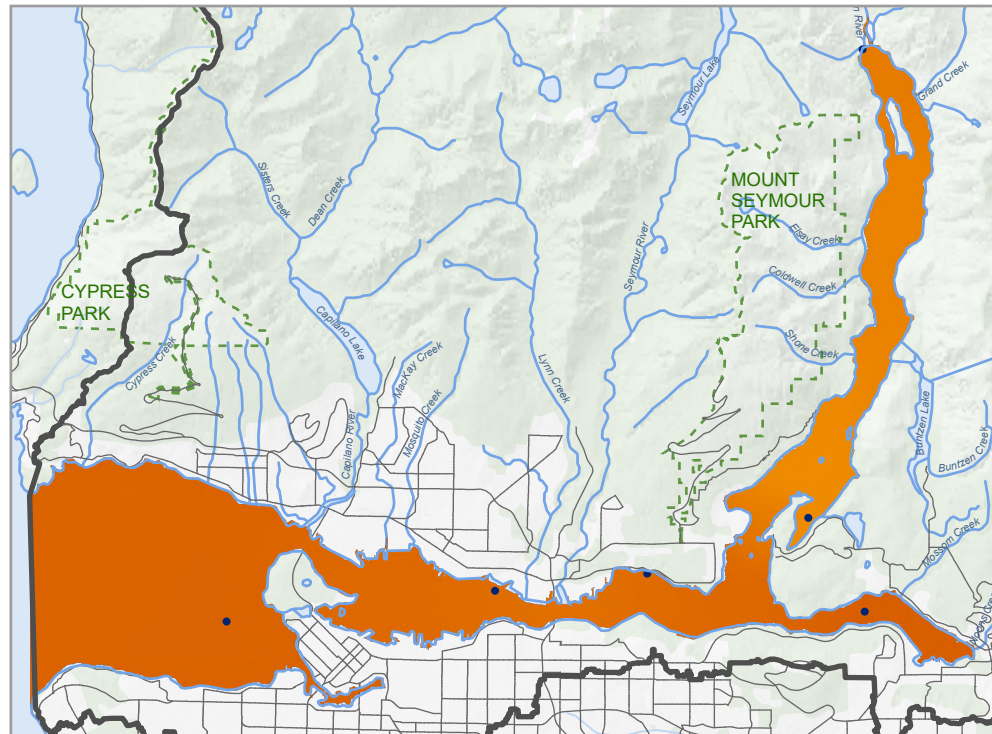
 Burrard Inlet Catchment (Study Area)

• Arsenic Sample Site

Total Arsenic in Tissue ( $\mu\text{g/g}$  wet weight max)



**English Sole (2007-2012)**



**Blue Mussel (2018-2019)**

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



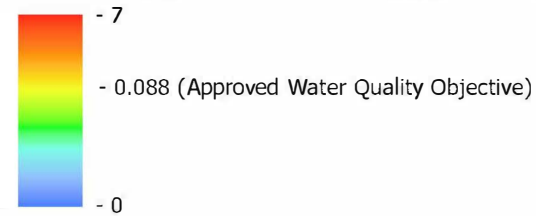
# Heat Map of Benzo(a)pyrene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Benzo(a)pyrene Sample Site

Total Benzo(a)pyrene in Sediment ( $\mu\text{g/g}$  dry weight max)

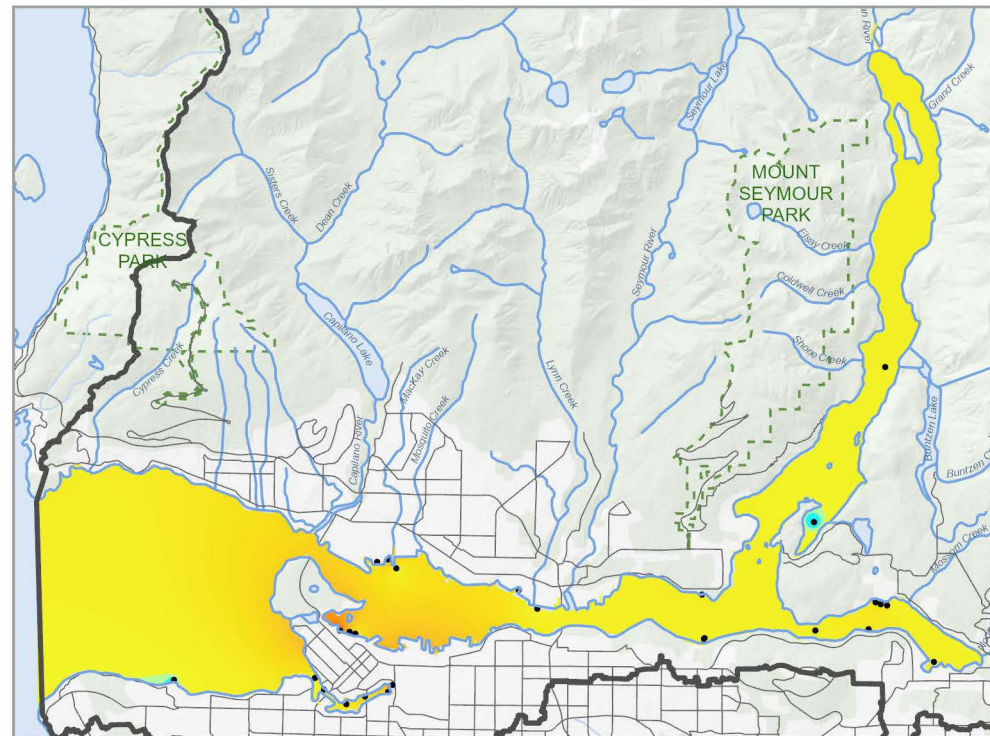


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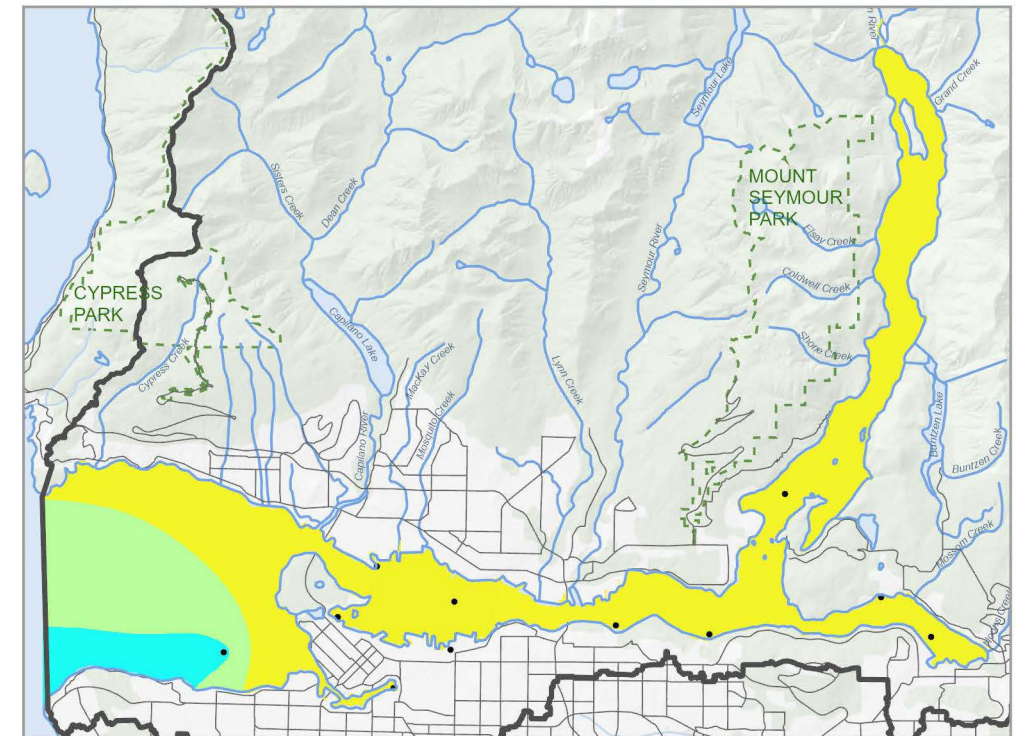
This map is a living document and is intended to be amended and refined over time. The data used to produce this map originate from many sources and are presented without prejudice. Heat map interpolations were prepared by Kerr Wood Leidal Associates Ltd. using methods available in ArcGIS. This map is the property of the Tseil-Waututh Nation and may not be reproduced without written permission.

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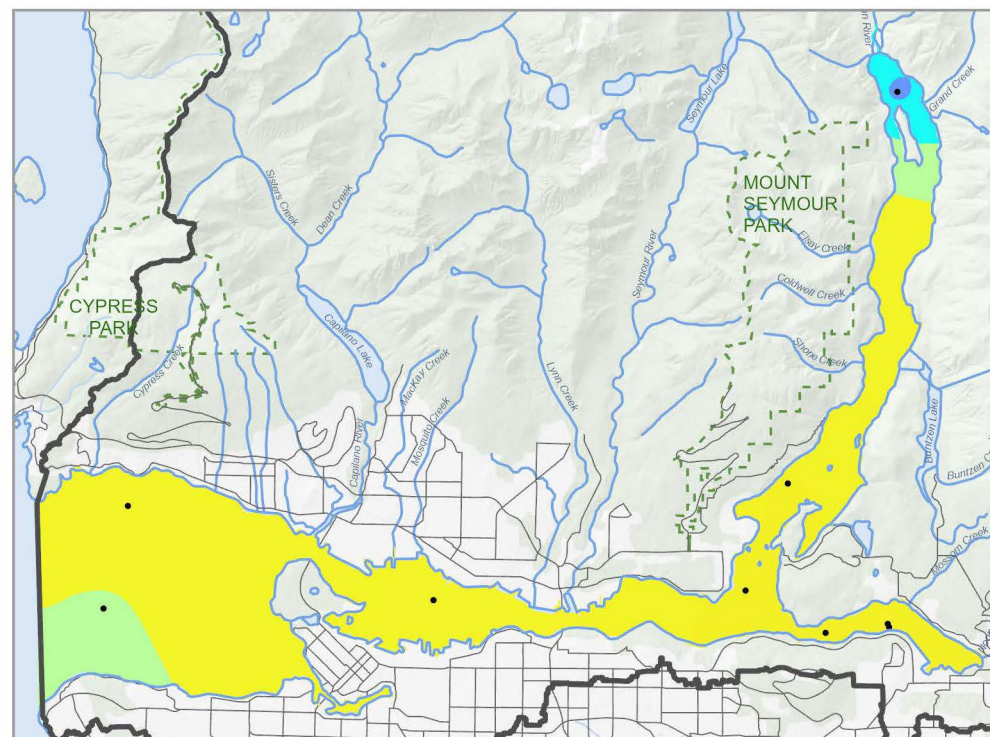
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



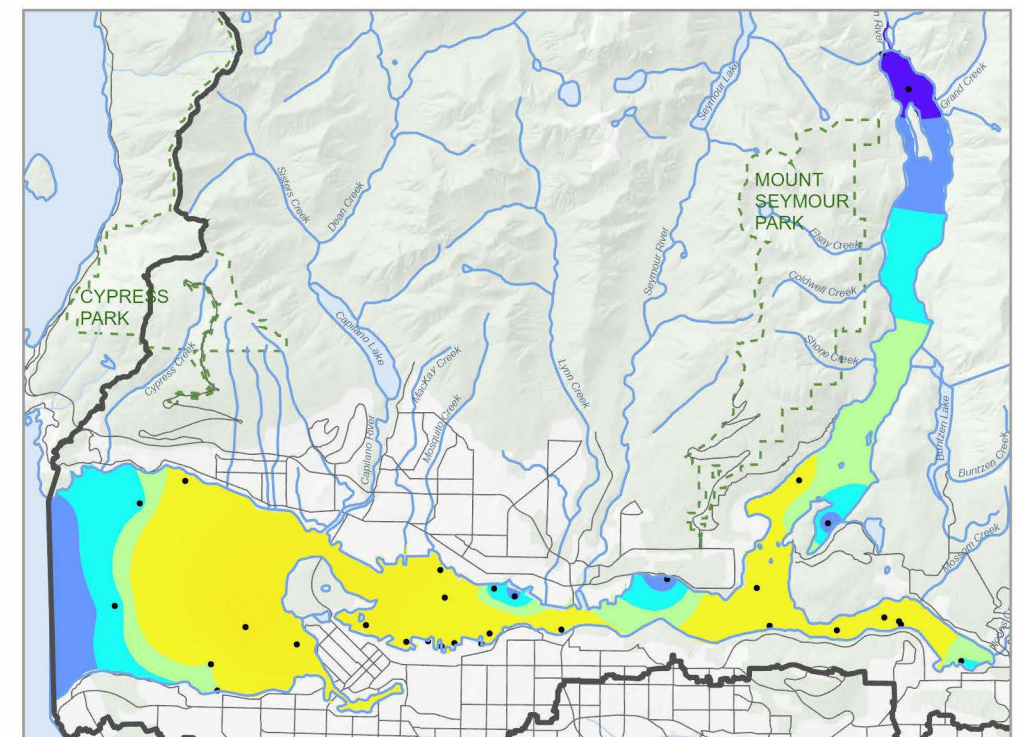
1991-1994



1999-2002



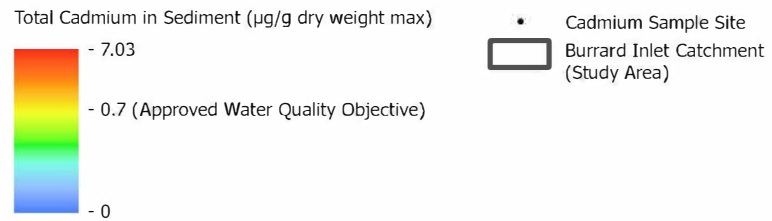
2008-2011



2013-2017

# Heat Map of Cadmium in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas



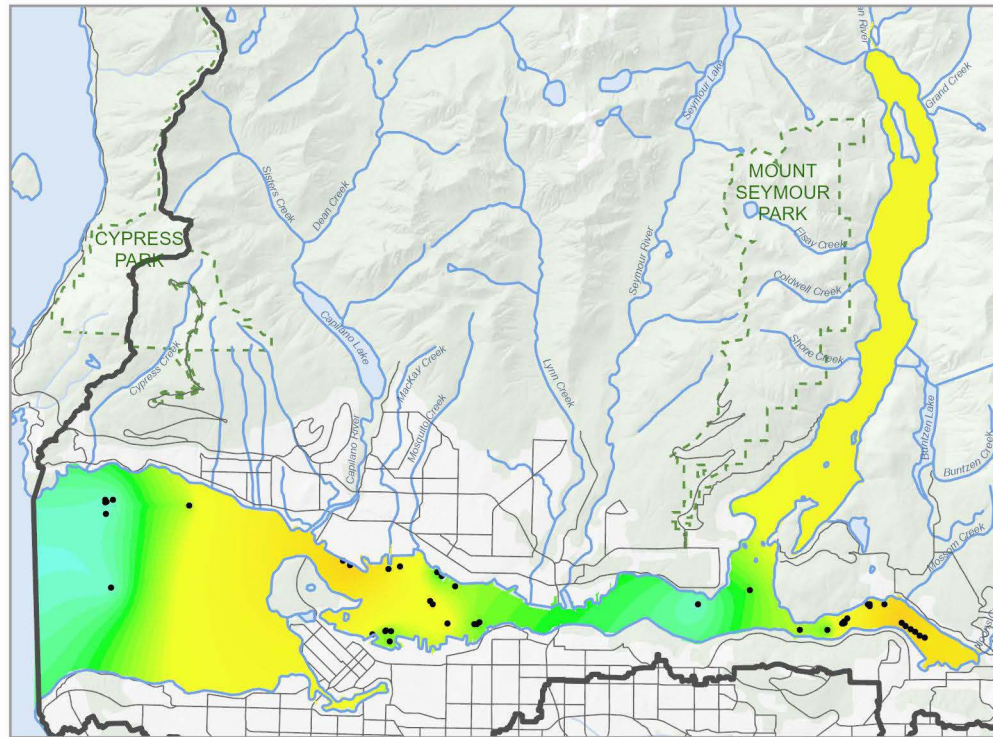
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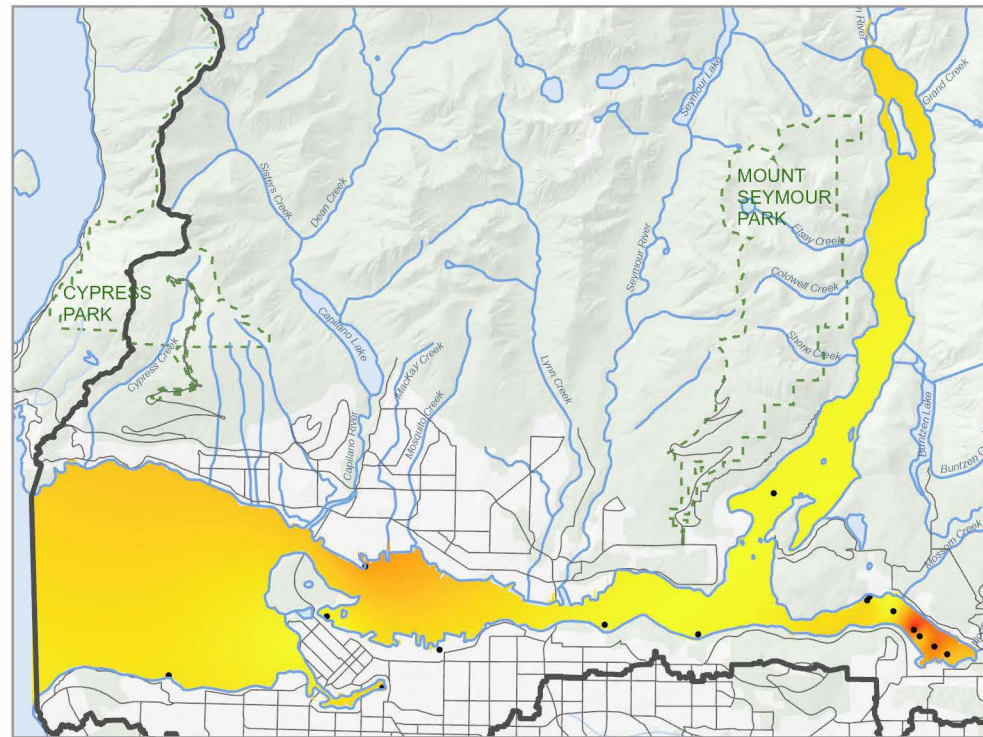
Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).

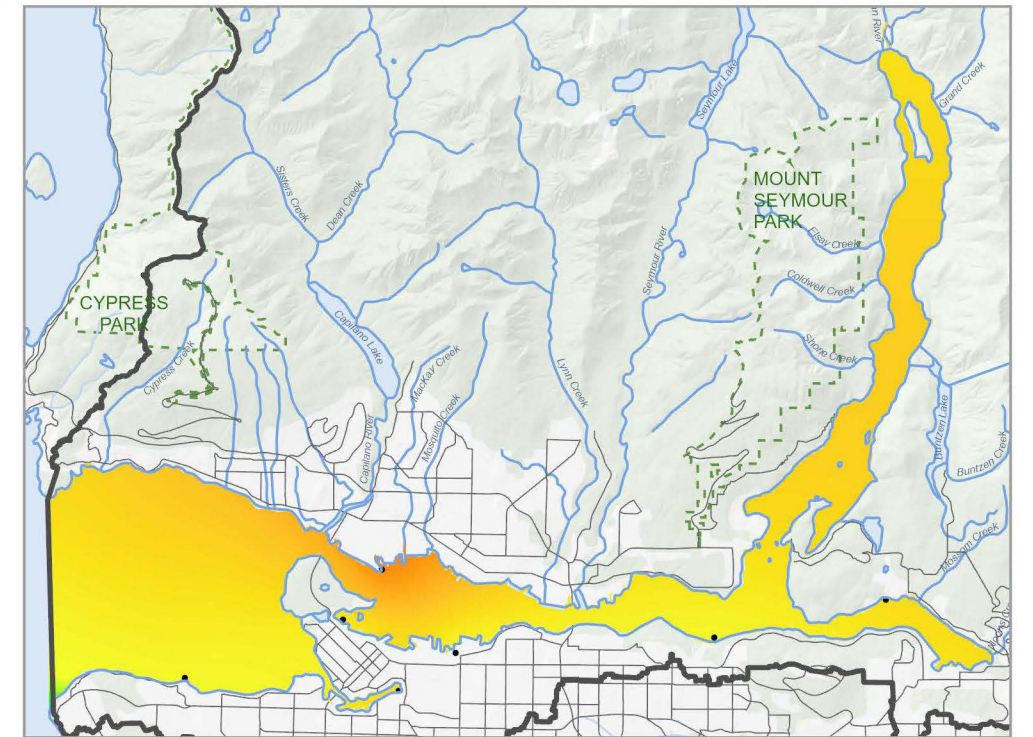
N



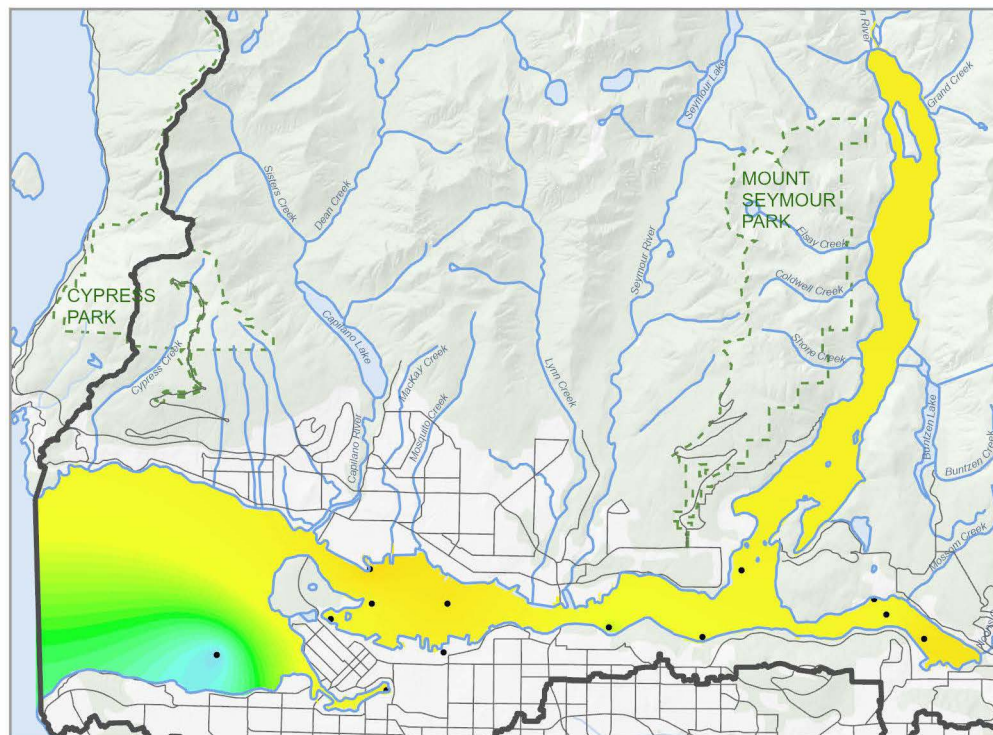
1985-1987



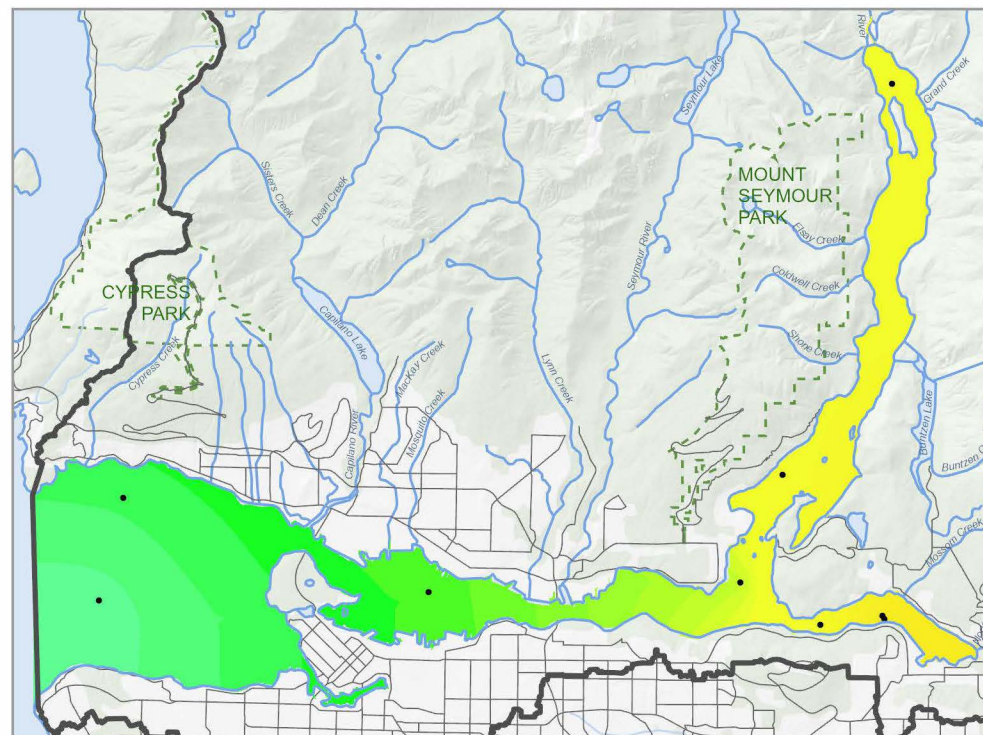
1988-1992



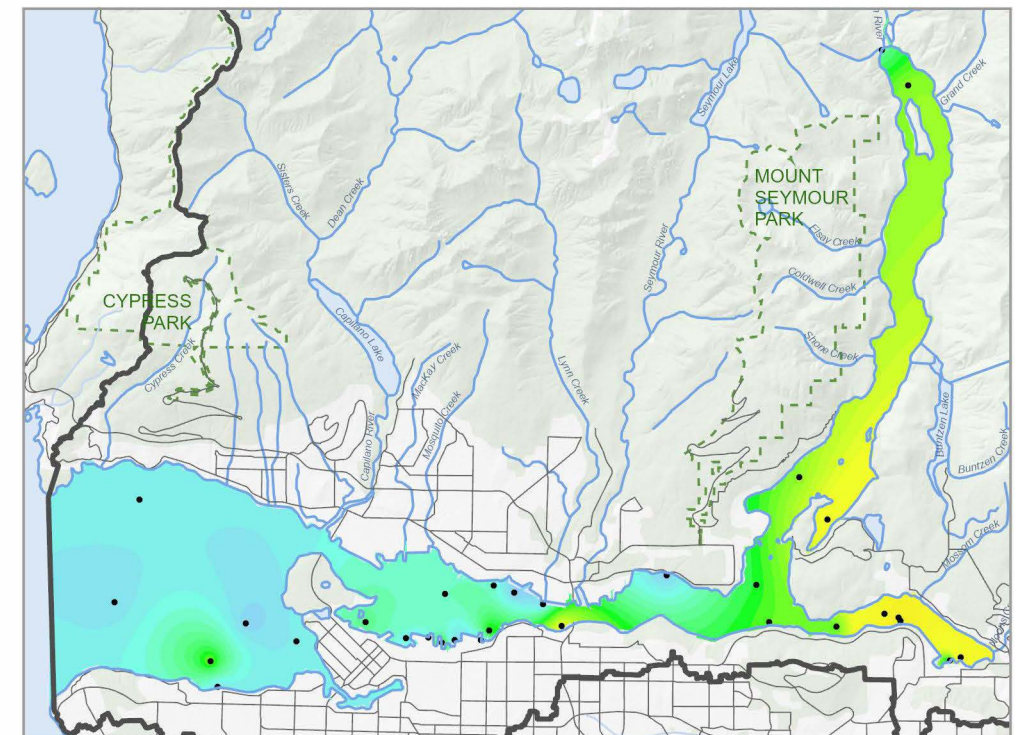
1993-1997



1998-2002



2008-2012



2013-2017

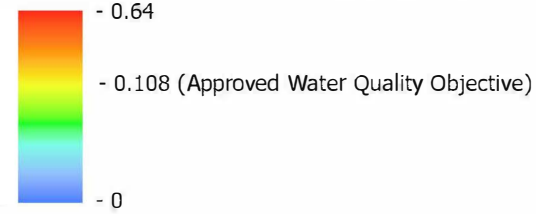
# Heat Map of Chrysene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Chrysene Sample Site

Total Chrysene in Sediment ( $\mu\text{g/g}$  dry weight max)

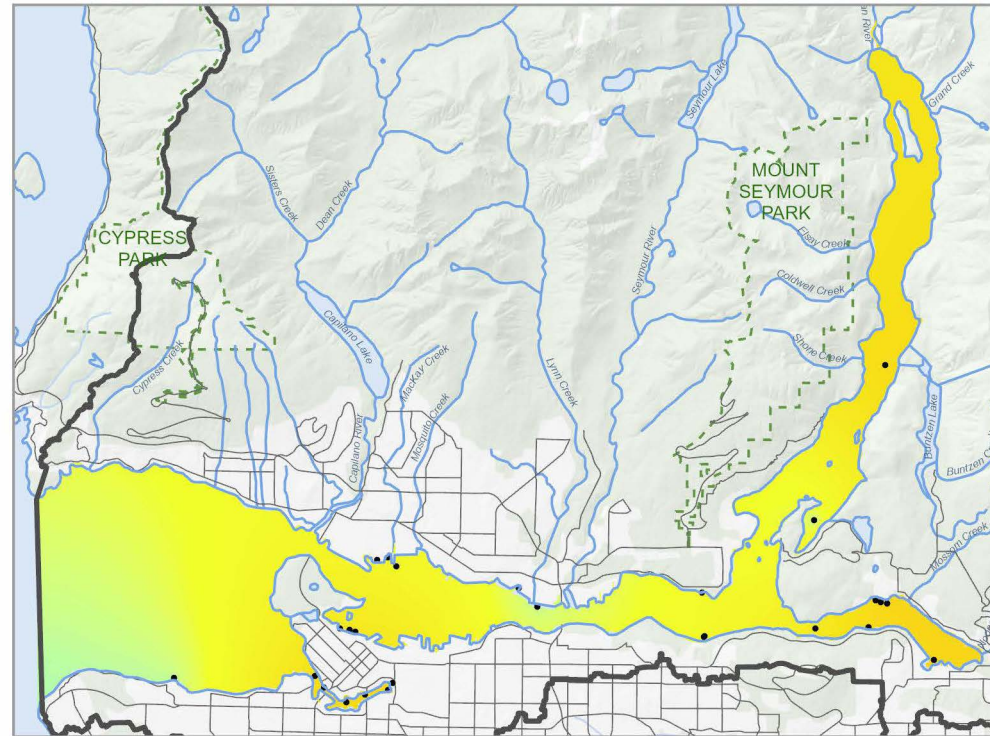


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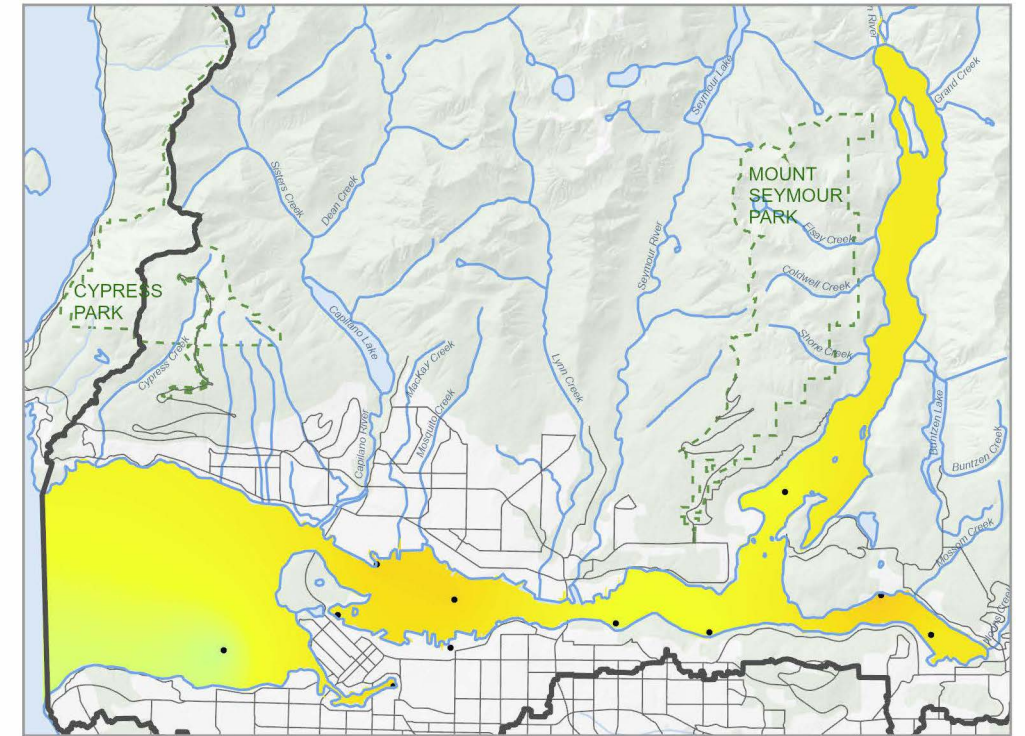
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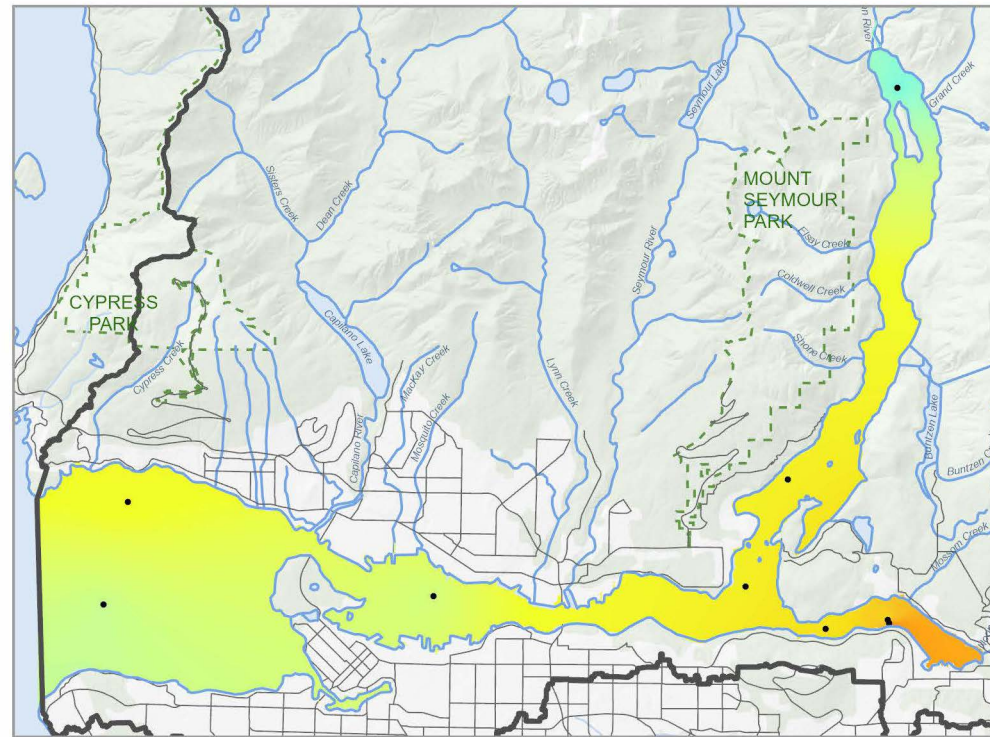
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



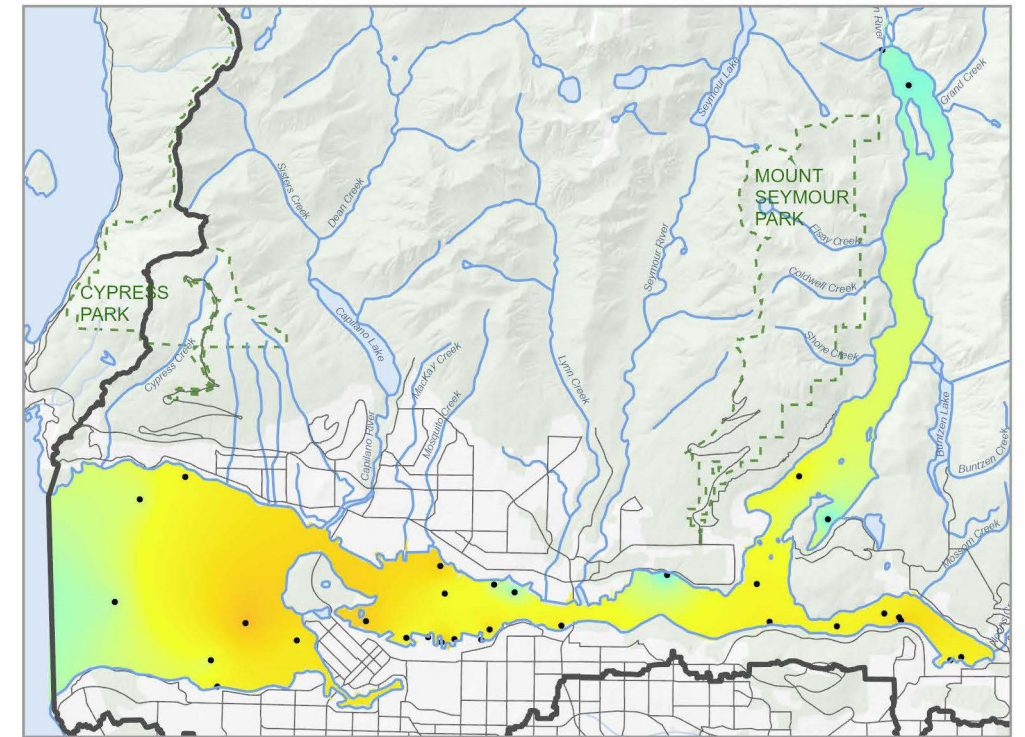
1991-1994



1999-2002



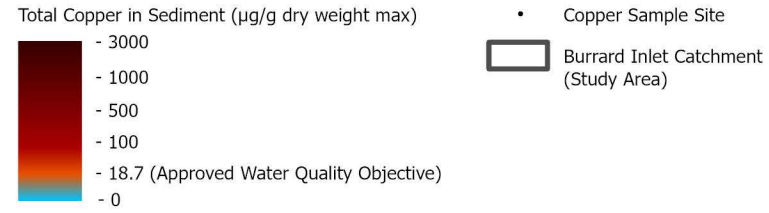
2008-2011



2013-2017

# Heat Map of Copper in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

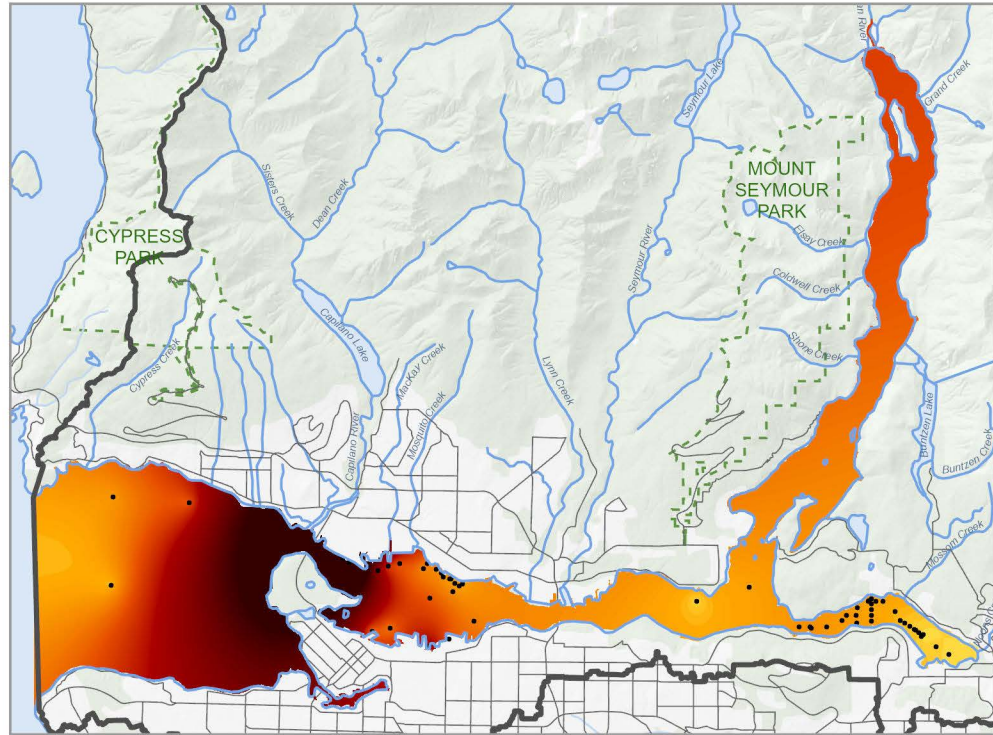


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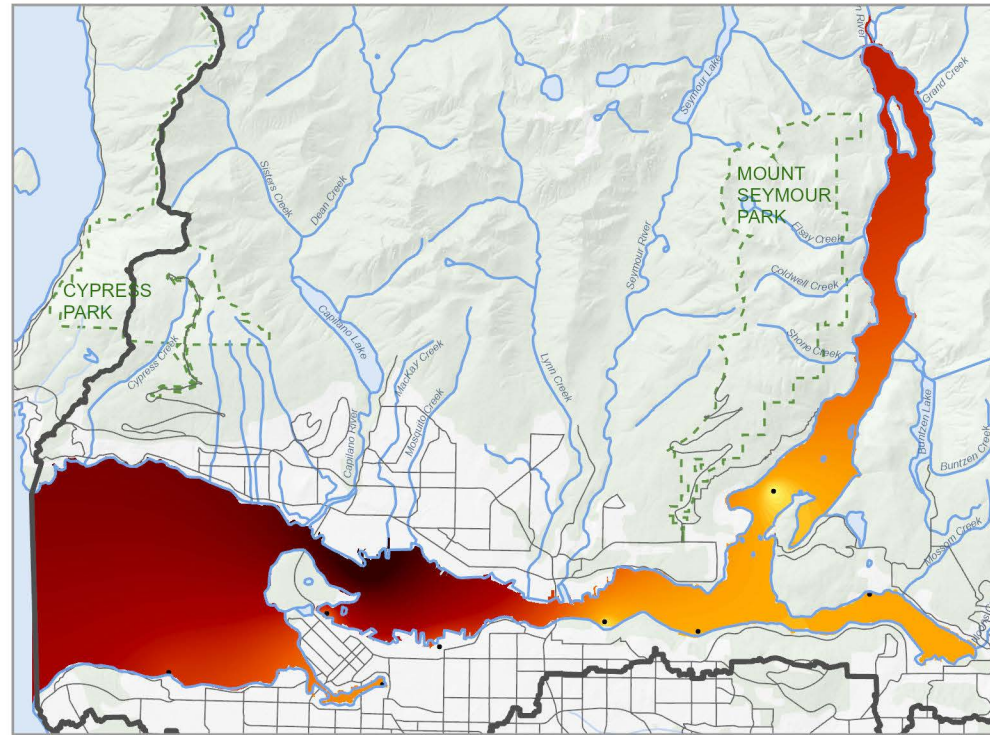
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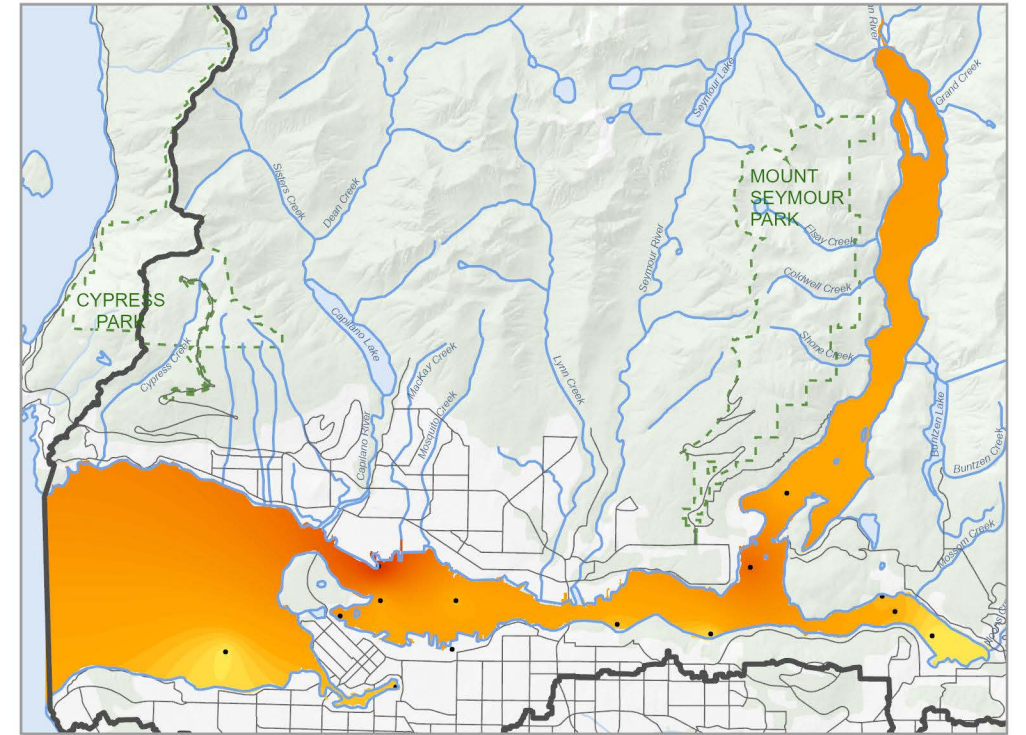
District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



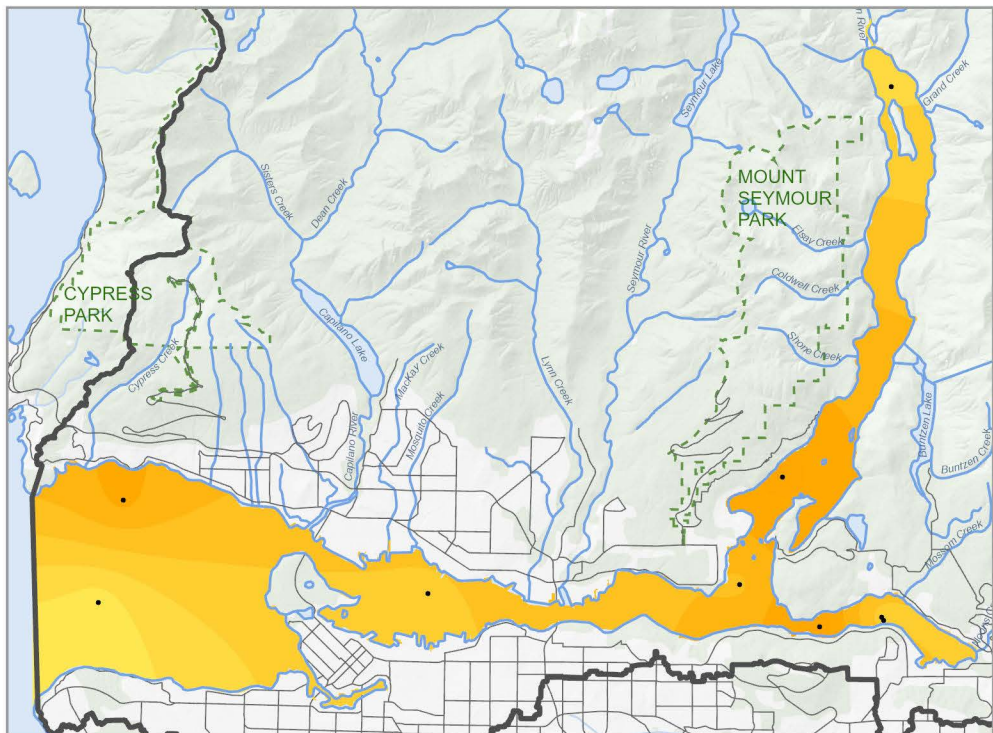
1985-1989



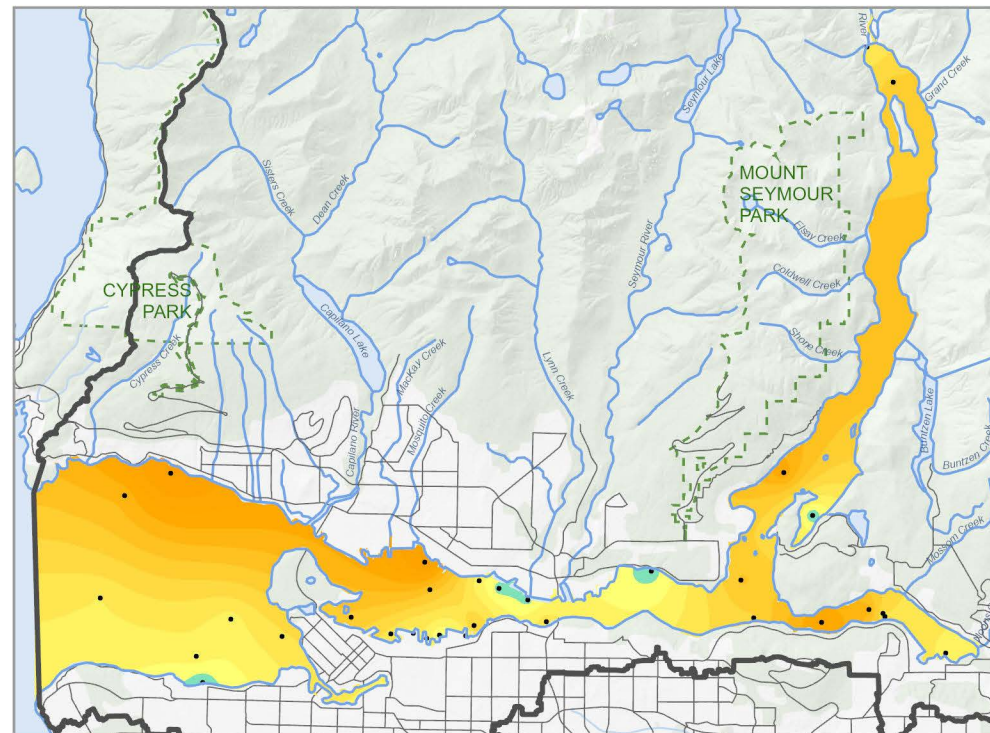
1990-1994



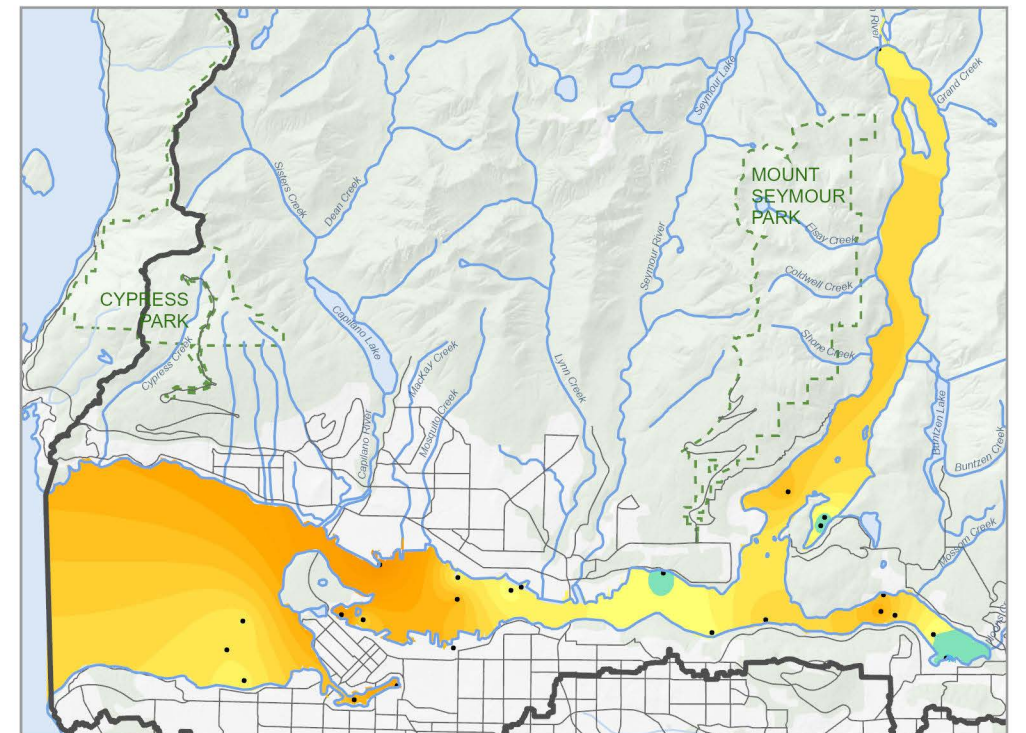
1999-2002



2008-2012



2013-2016



2017-2020

# Heat Map of Enterococci in Marine Water Samples

Based on the calculated Median and 90th Percentile of measured amounts in water samples collected between 2002 and 2016

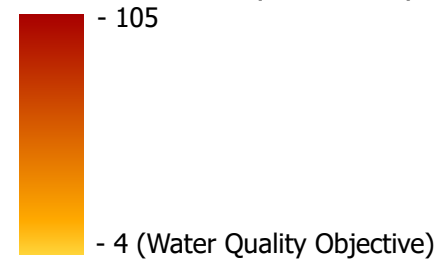
**Long-term Water Quality Objective for Enterococci (MPN/100 mL) in water:  $\leq 4$  (median);  $\leq 11$  (90th percentile)**

(To protect shellfish consumption by humans)

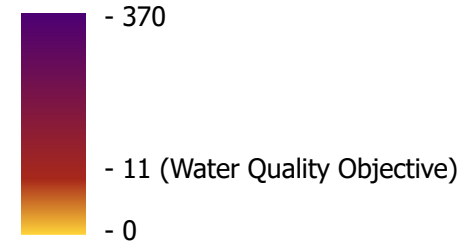
Please note the data presented on this map may not be complete in all areas

- Enterococci Sample Location

Enterococci Median (MPN/100mL)



Enterococci 90th Percentile (MPN/100mL)

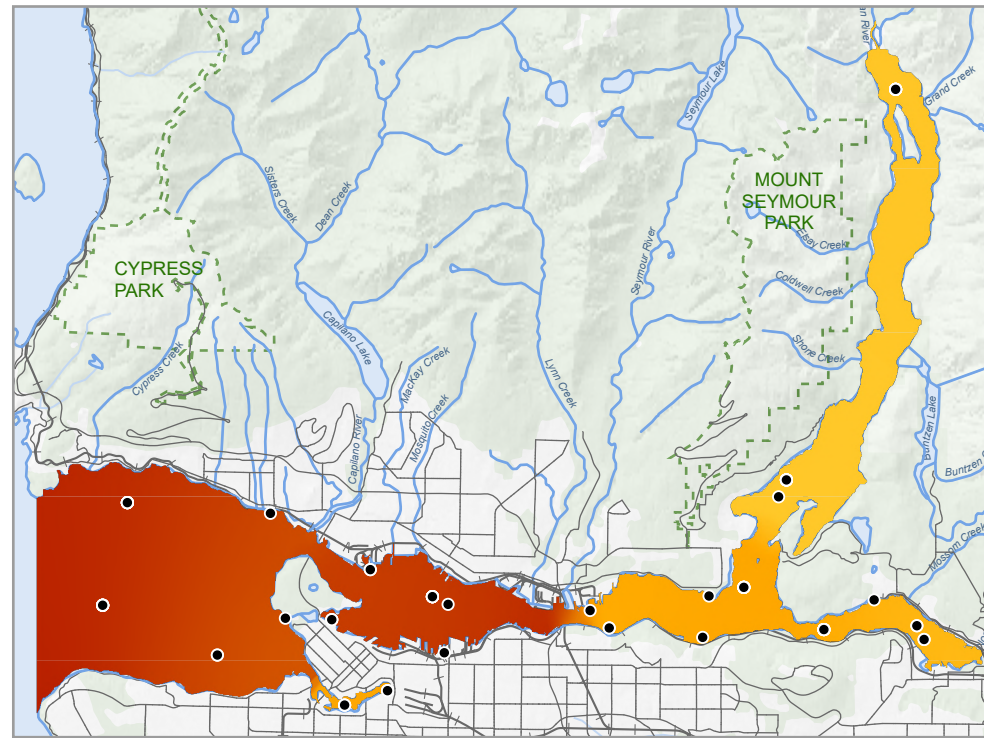


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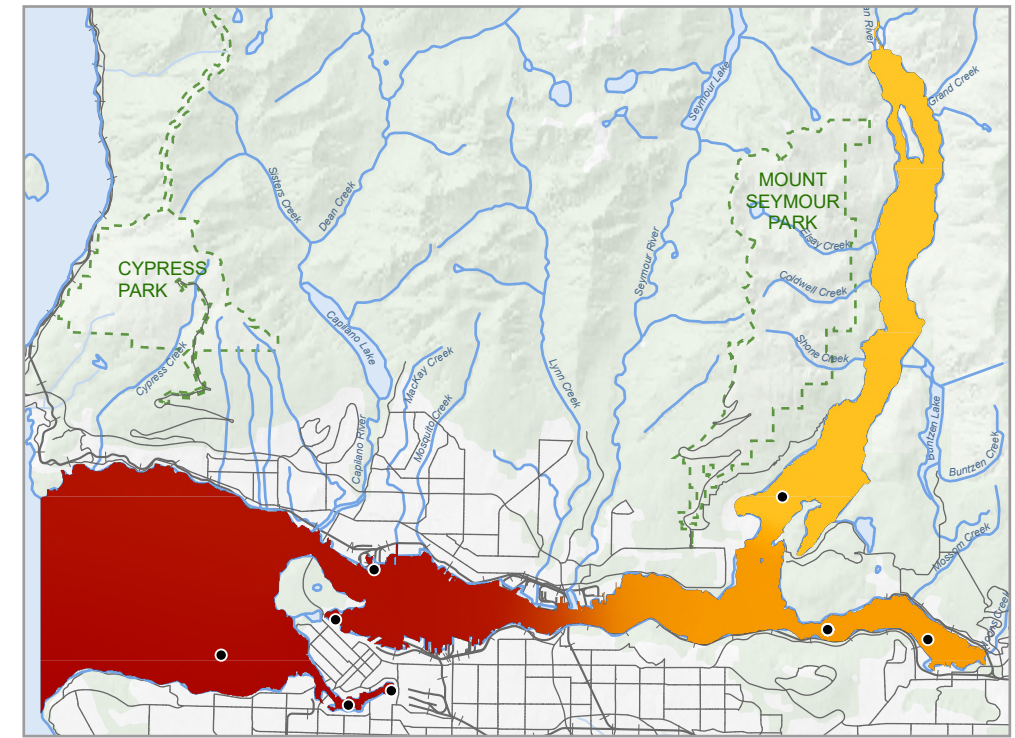
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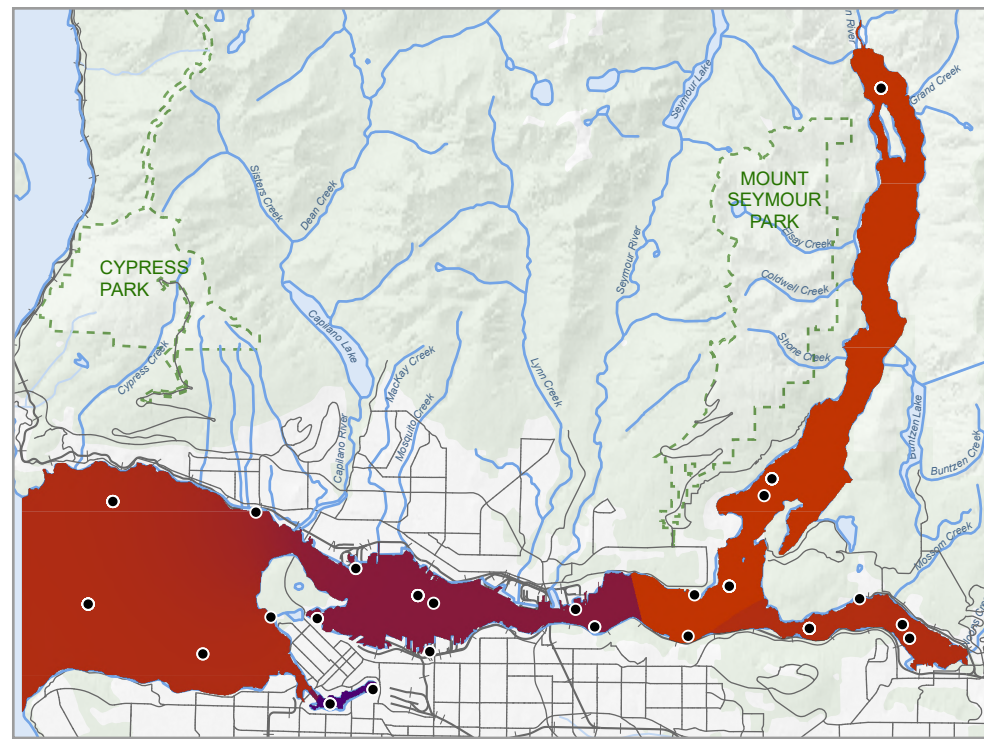
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



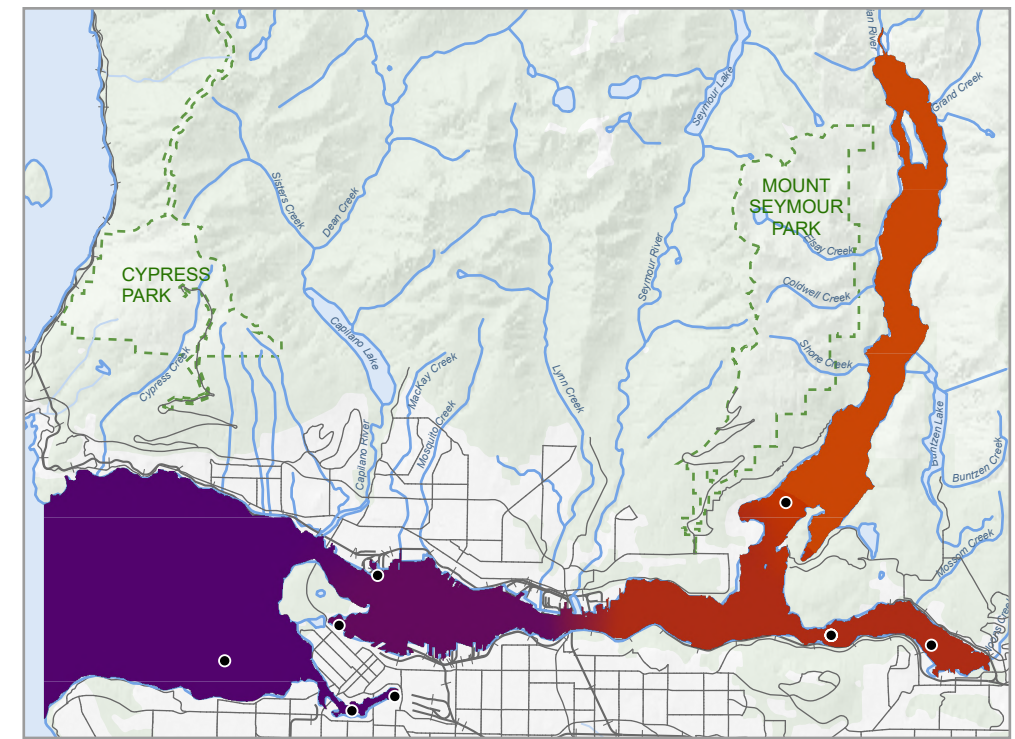
2002-2010 Median



2011-2016 Median



2002-2010 90th Percentile



2011-2016 90th Percentile

# Heat Map of Enterococci in Marine Water Samples

Based on the calculated Geometric (geo) Mean and Maximum of measured amounts in water samples collected between 2002 and 2016

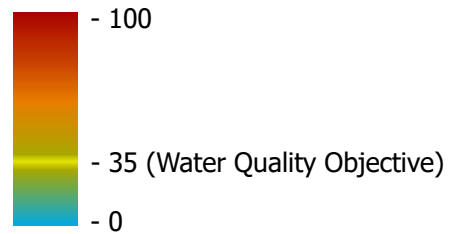
**Medium-term Water Quality Objective for Enterococci (MPN/100 mL) in water: ≤35 (geo mean); ≤70 (max)**

(To protect primary and secondary contact activities)

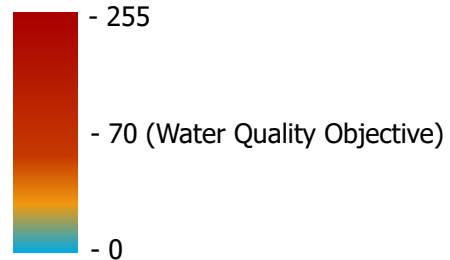
Please note the data presented on this map may not be complete in all areas

- Enterococci Sample Location

Enterococci Geometric Mean (MPN/100mL)



Enterococci Maximum (MPN/100mL)

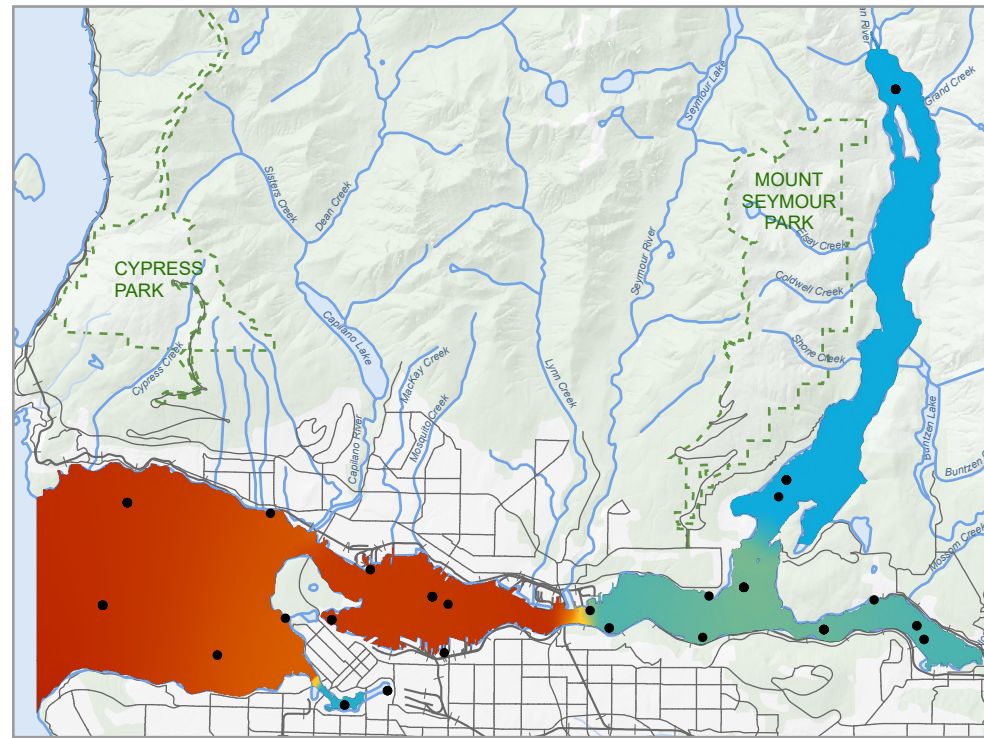


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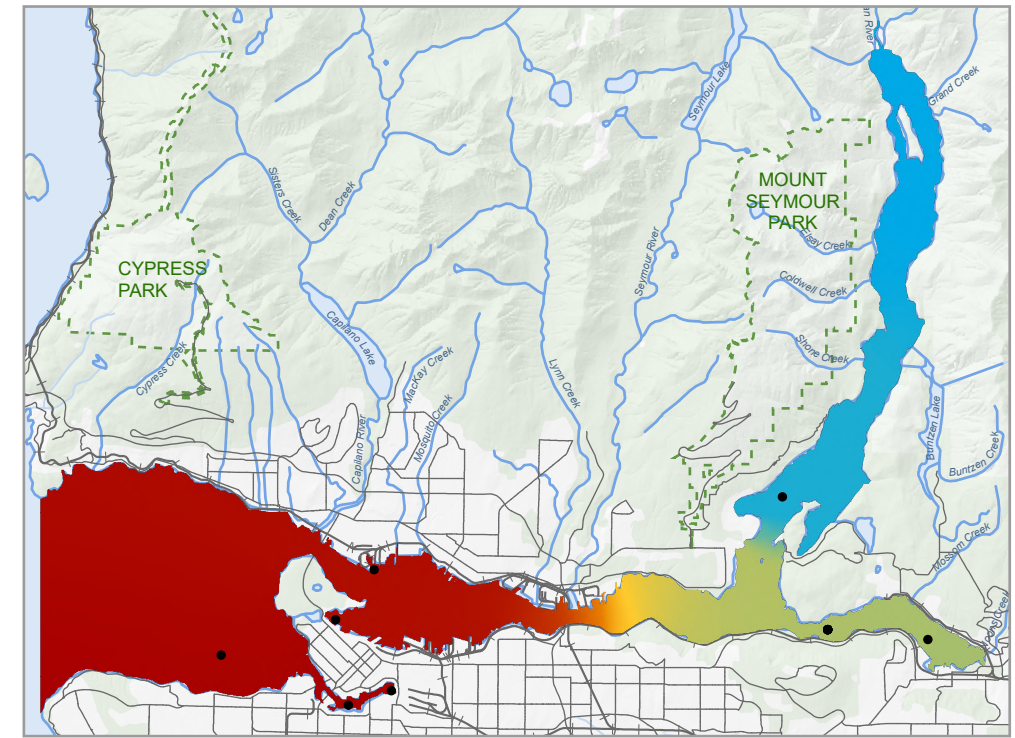
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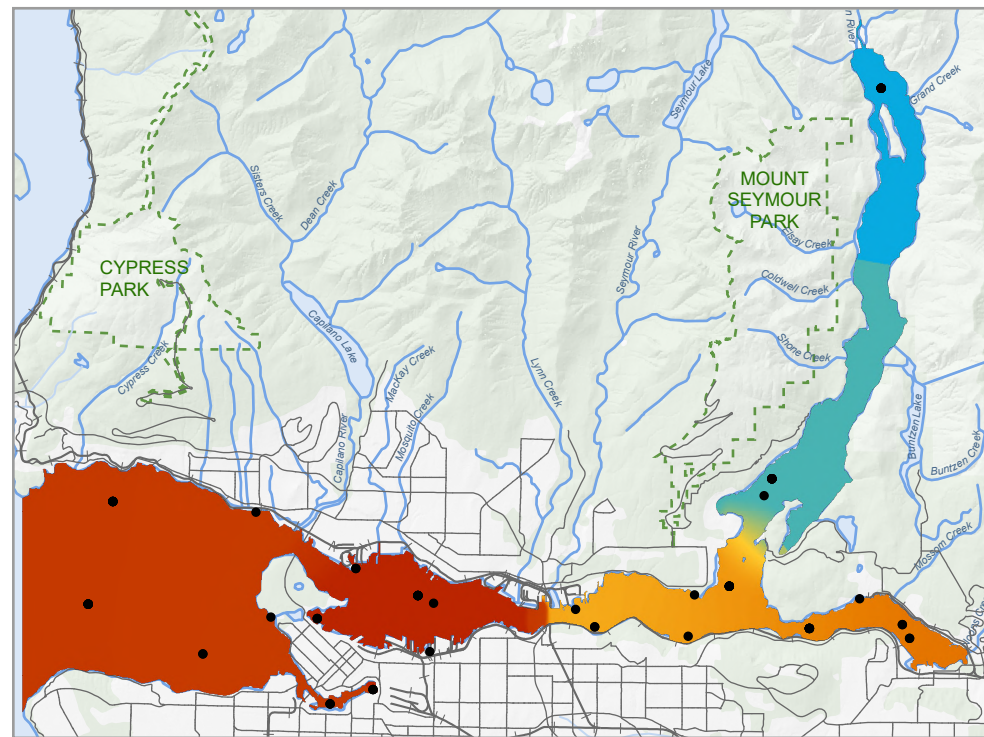
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



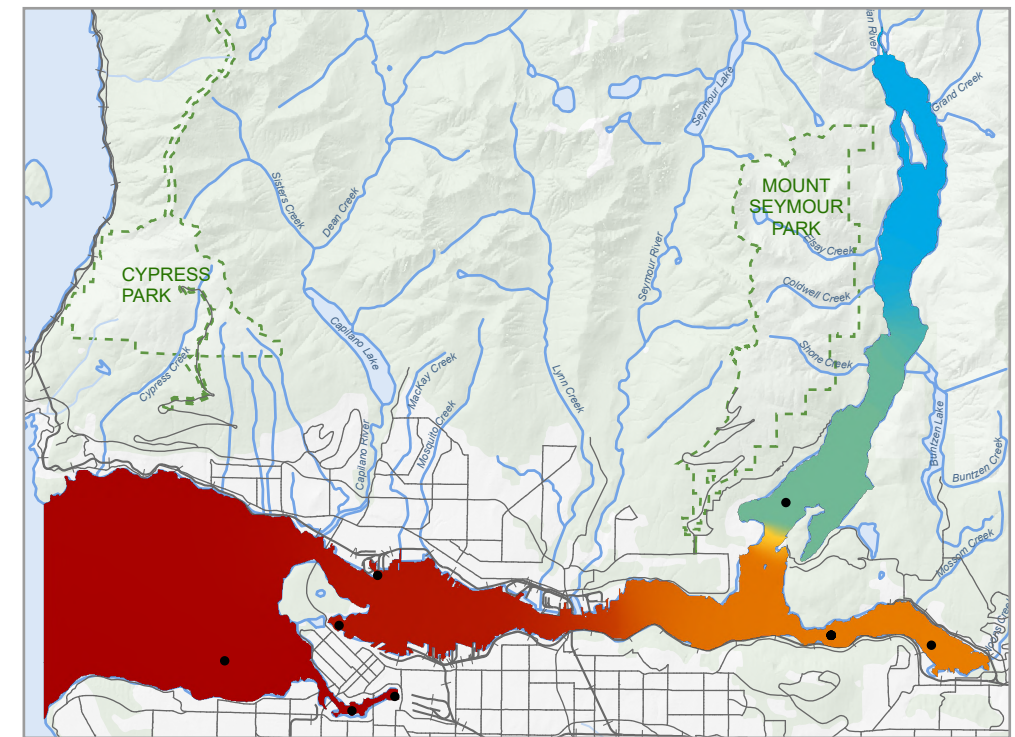
2002-2010 Geometric Mean



2011-2016 Geometric Mean



2002-2010 Maximum



2011-2016 Maximum

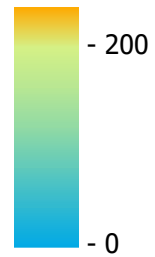
# Heat Map of *E. coli* in Marine Water Samples

Based on the calculated Geometric (geo) Mean and Maximum of measured amounts in water samples collected between 2007 and 2016

**Water Quality Objective for *E. coli* (CFU or MPN/100mL) in water: ≤200 (geo mean), ≤400 (max)**  
(To protect primary and secondary contact activities)

Please note the data presented on this map may not be complete in all areas

- *Escherichia Coli* Sample Location
- *E. Coli* Geometric Mean (MPN/100mL)



*E. Coli* Maximum (MPN/100mL)

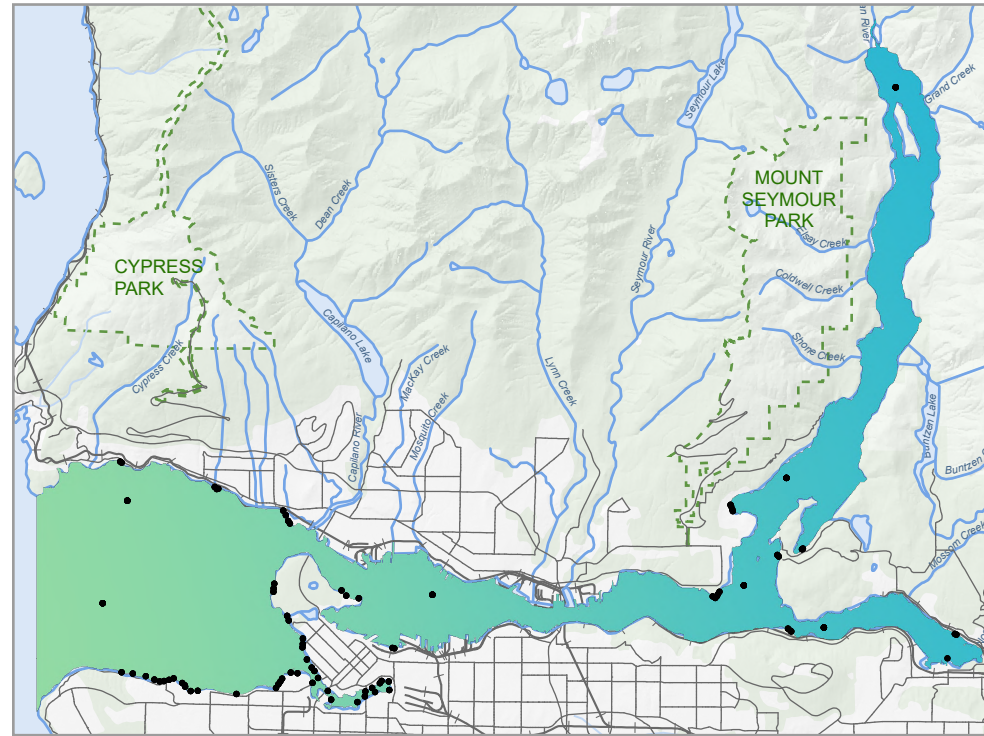


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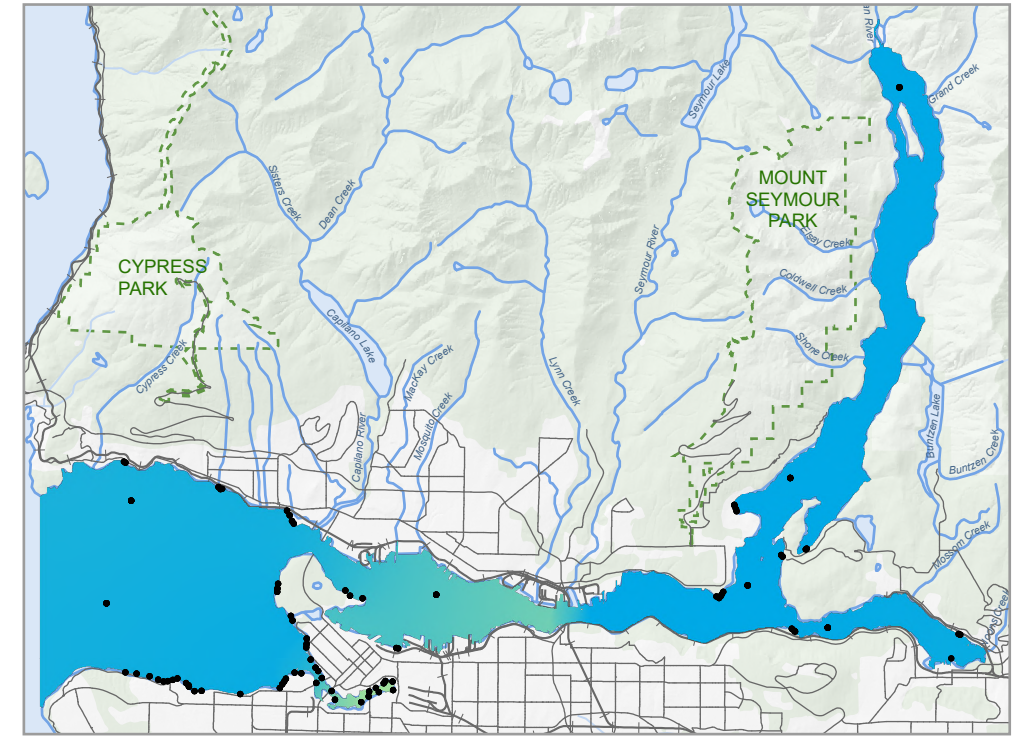
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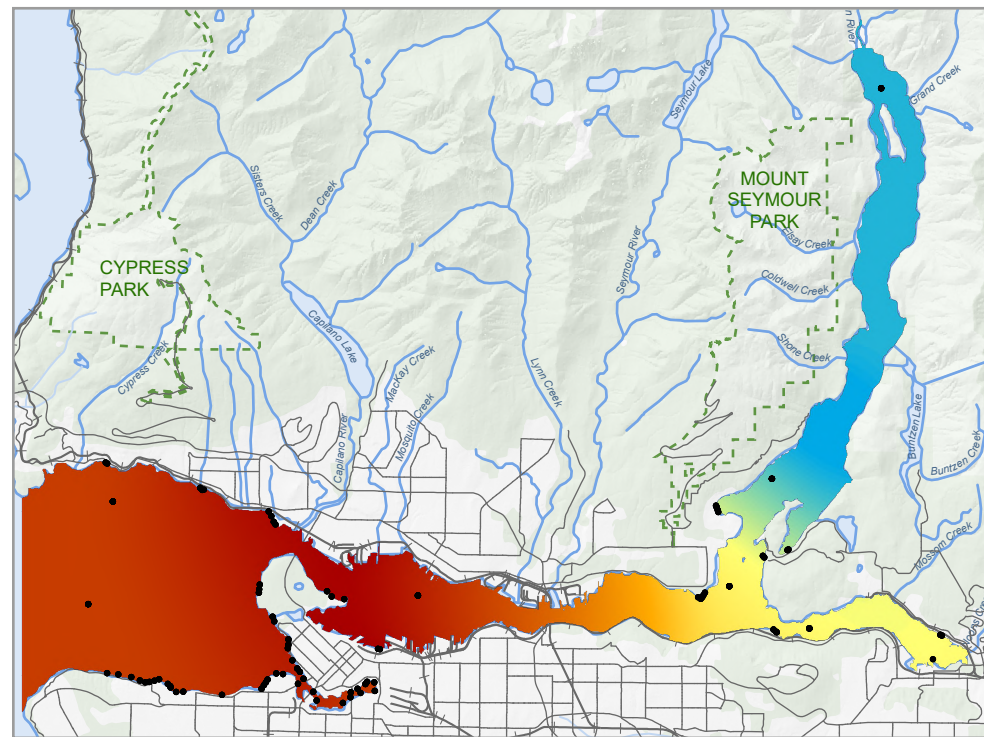
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



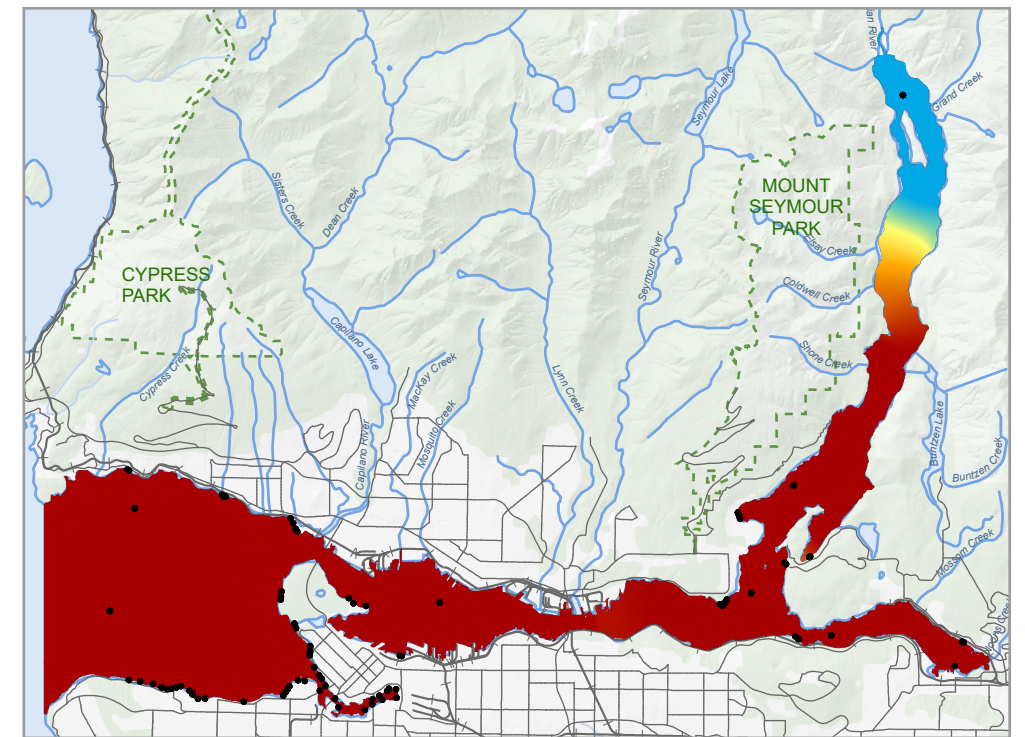
2007-2010 Geometric Mean



2011-2016 Geometric Mean



2007-2010 Maximum



2011-2016 Maximum

# Heat Map of Fecal Coliform in Marine Water Samples

Based on the calculated Median of measured amounts in water samples collected between 1973 and 2020

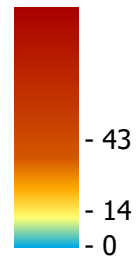
**Water Quality Objective for fecal coliform in water (MPN/100mL): ≤14 (median); ≤10% of results >43**

(To protect shellfish consumption by humans)

Please note the data presented on this map may not be complete in all areas

- Fecal Coliform Sample Location

Fecal Coliform Median (MPN/100 mL)

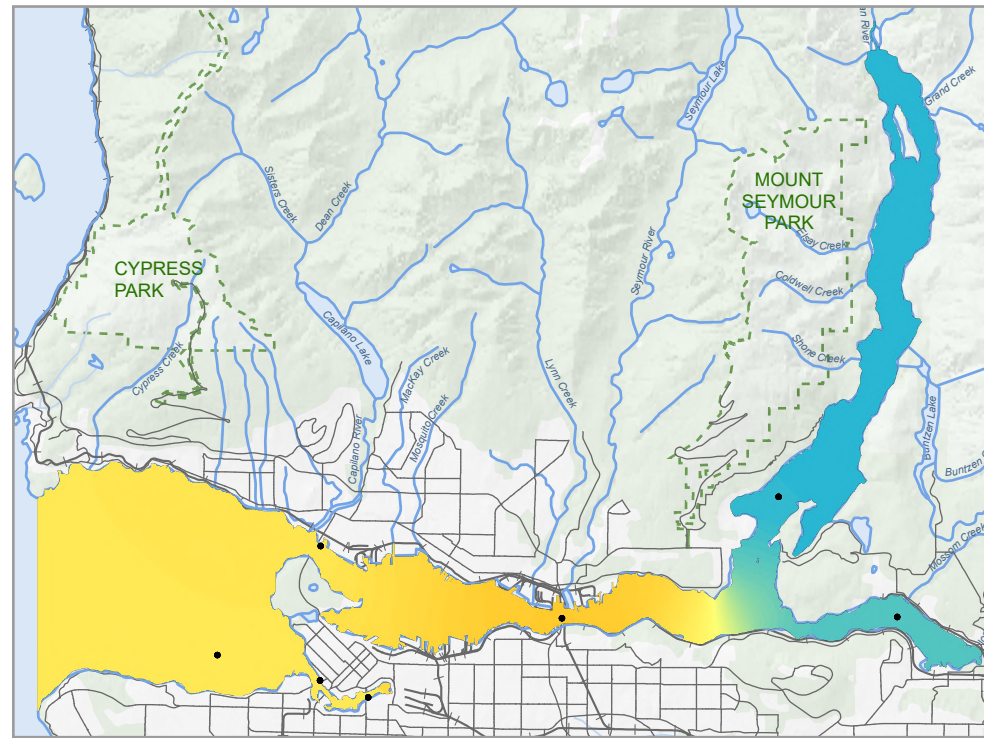


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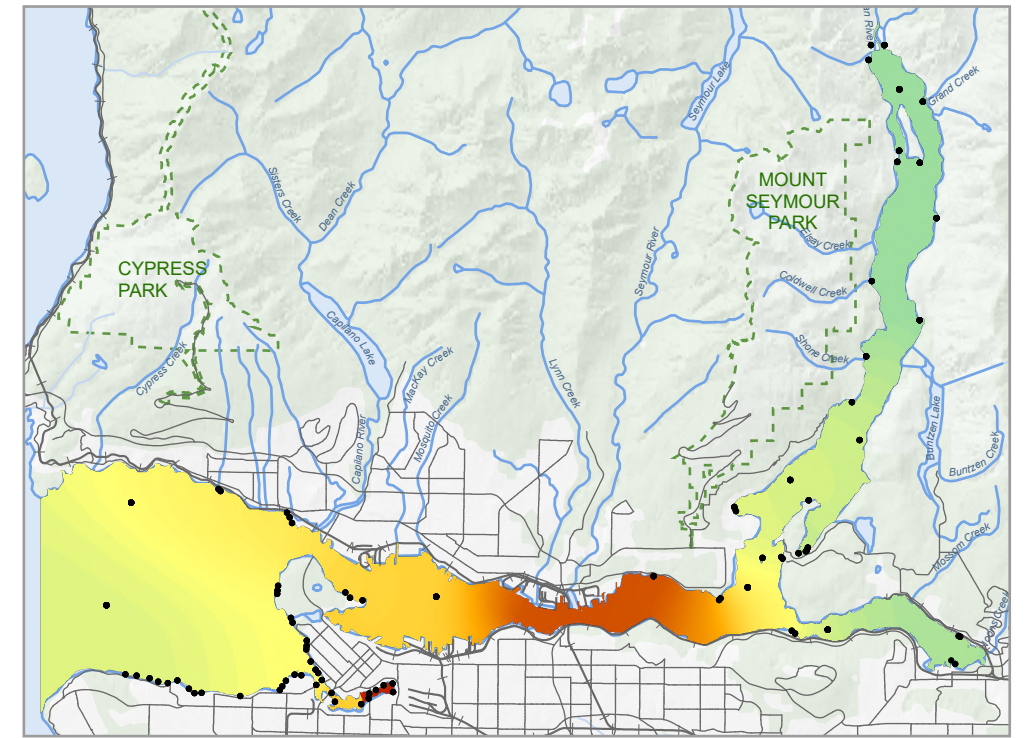
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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

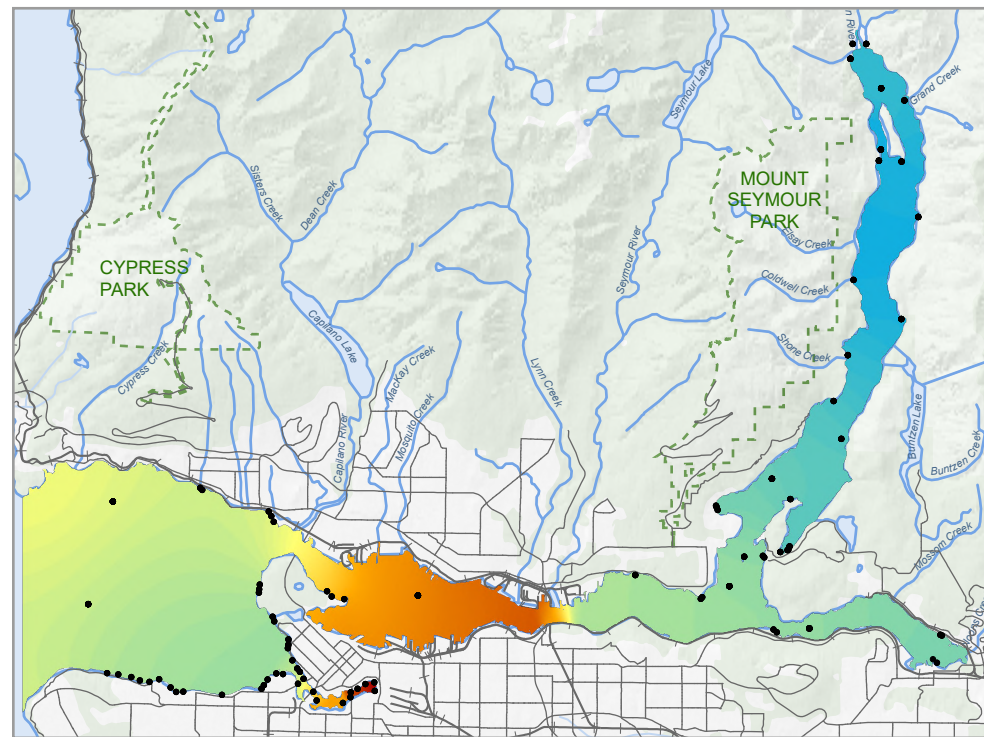
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



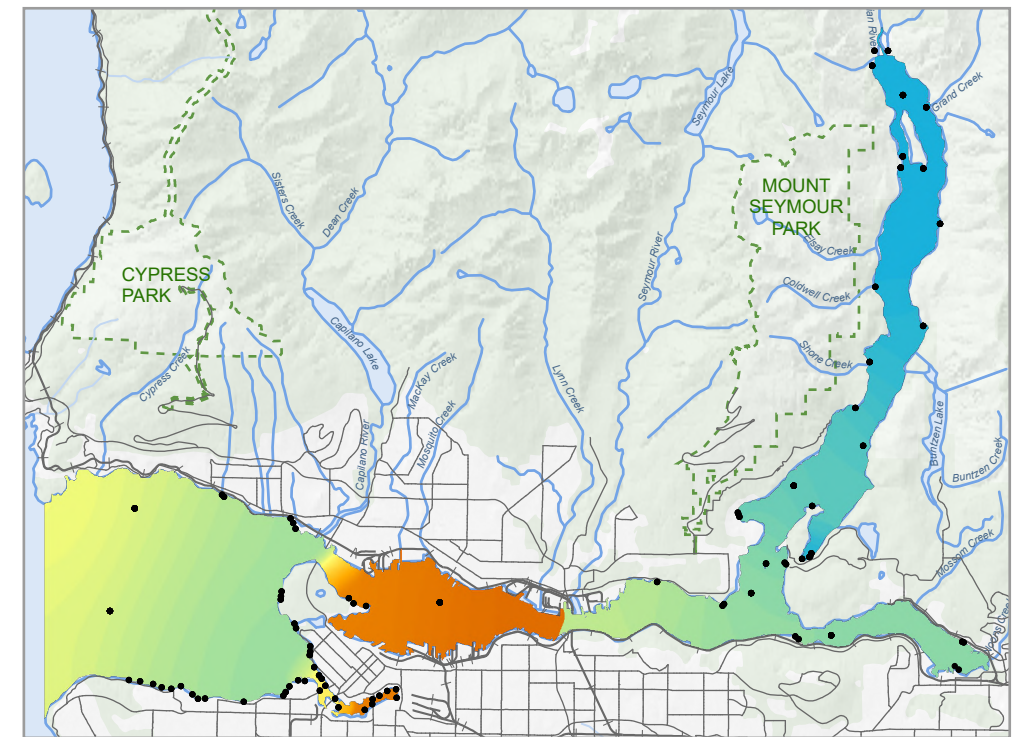
1973-1978



2000-2002



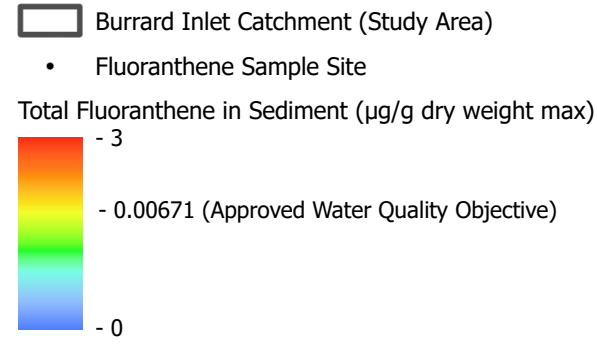
2008-2012



2017-2020

# Heat Map of Fluoranthene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas



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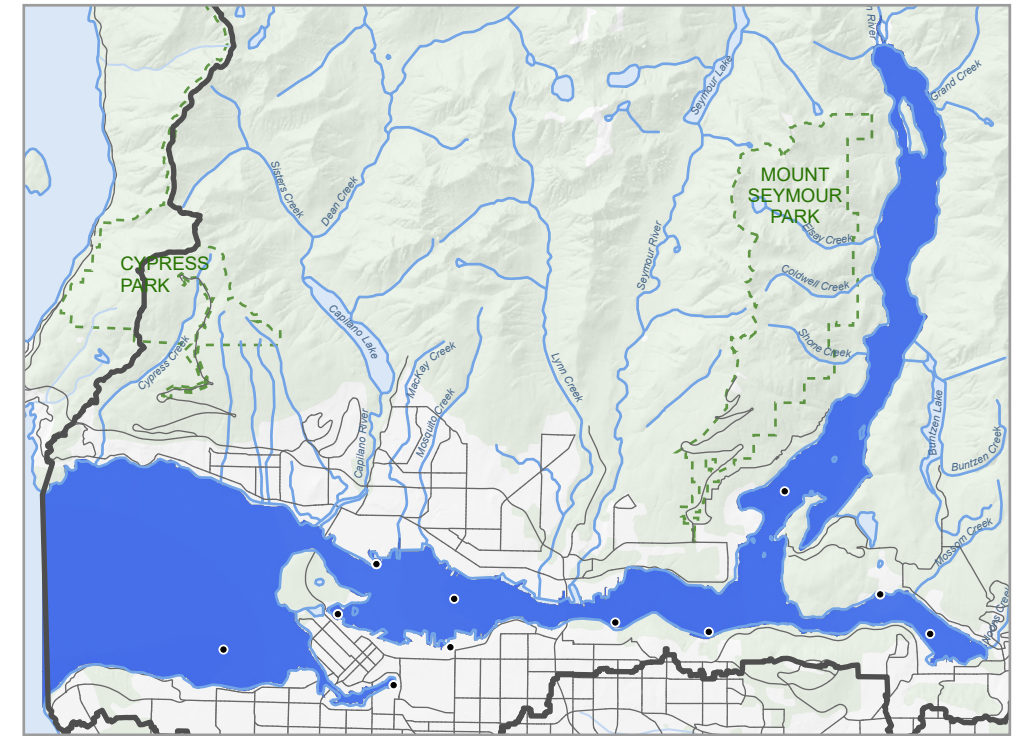
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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



1991-1994



1999-2002



2008-2011



2013-2017

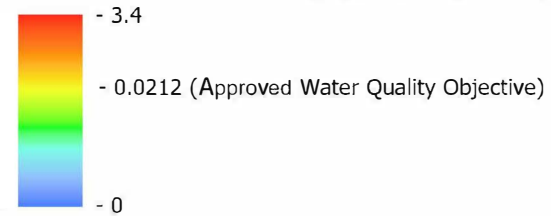
# Heat Map of Fluorene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Fluorene Sample Site

Total Fluorene in Sediment ( $\mu\text{g/g}$  dry weight max)

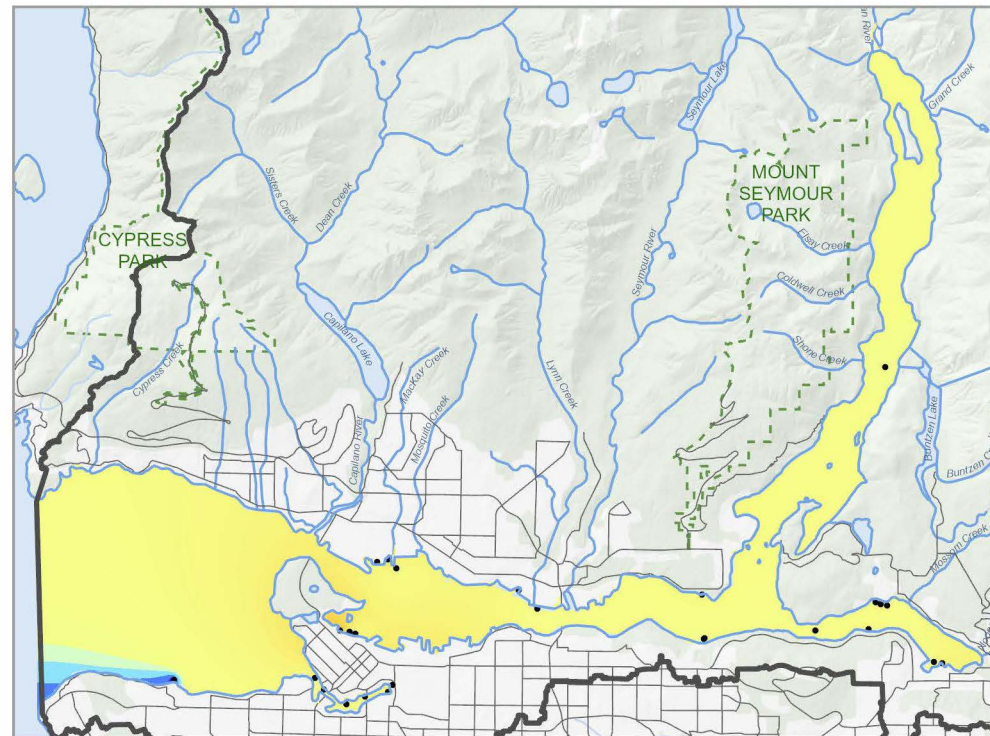


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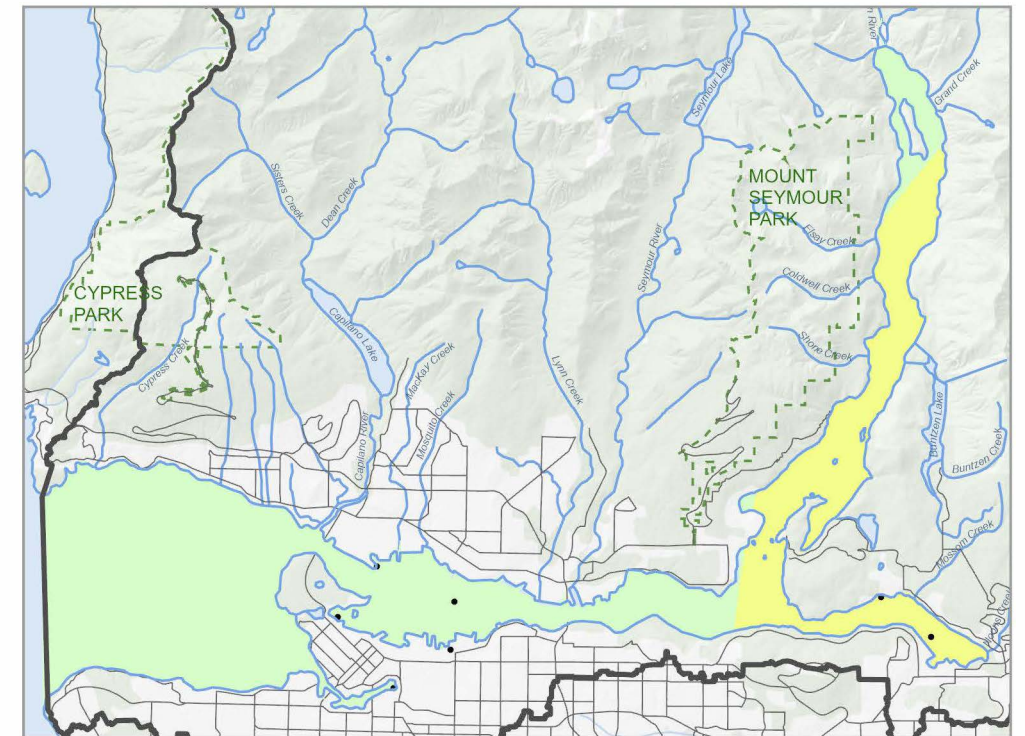
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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



1991-1994



1999-2002



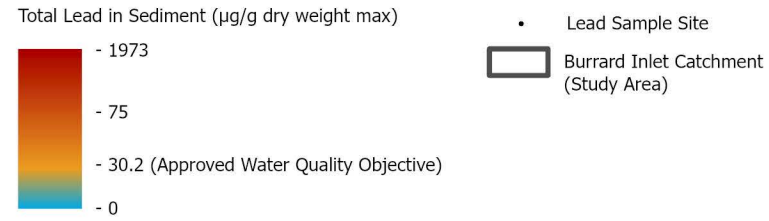
2008-2011



2013-2017

# Heat Map of Lead in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

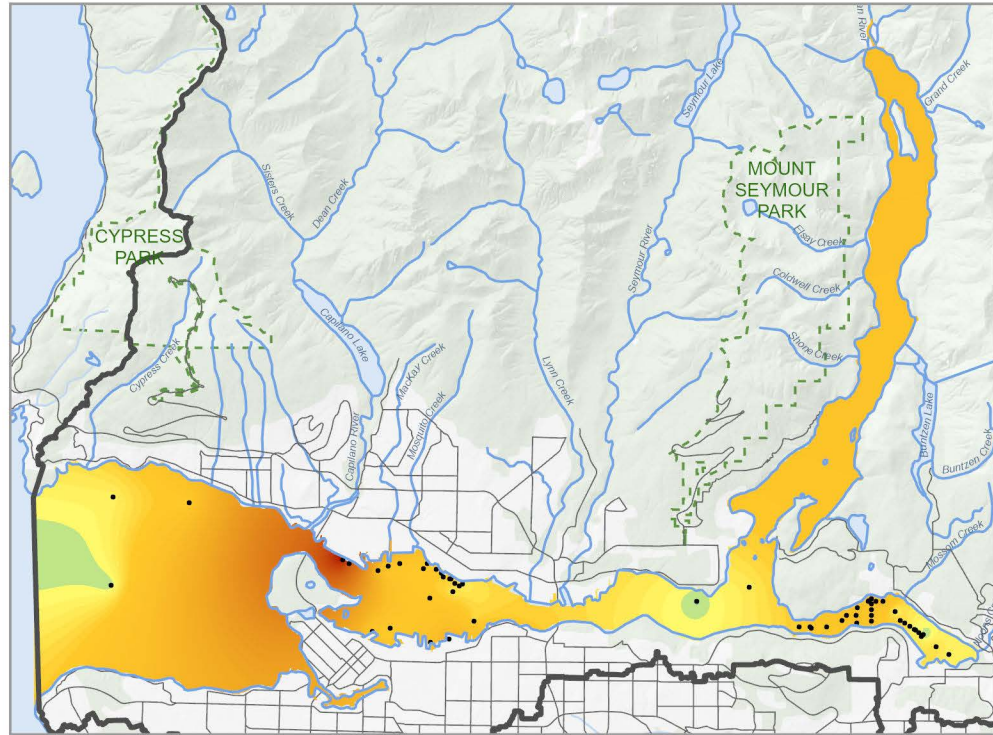


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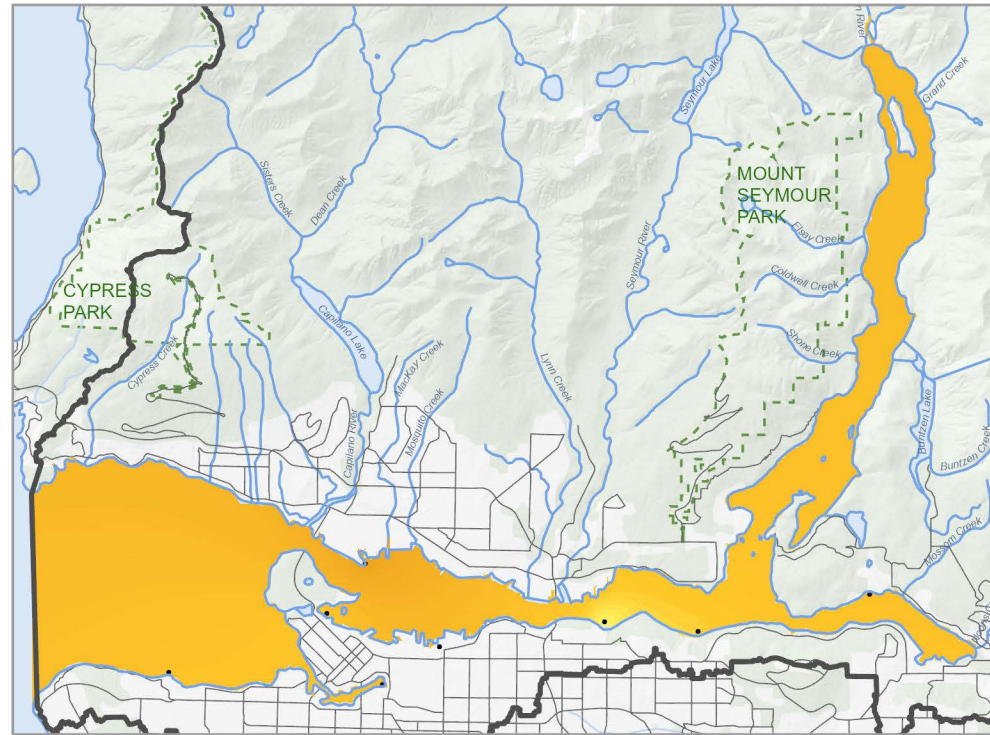
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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

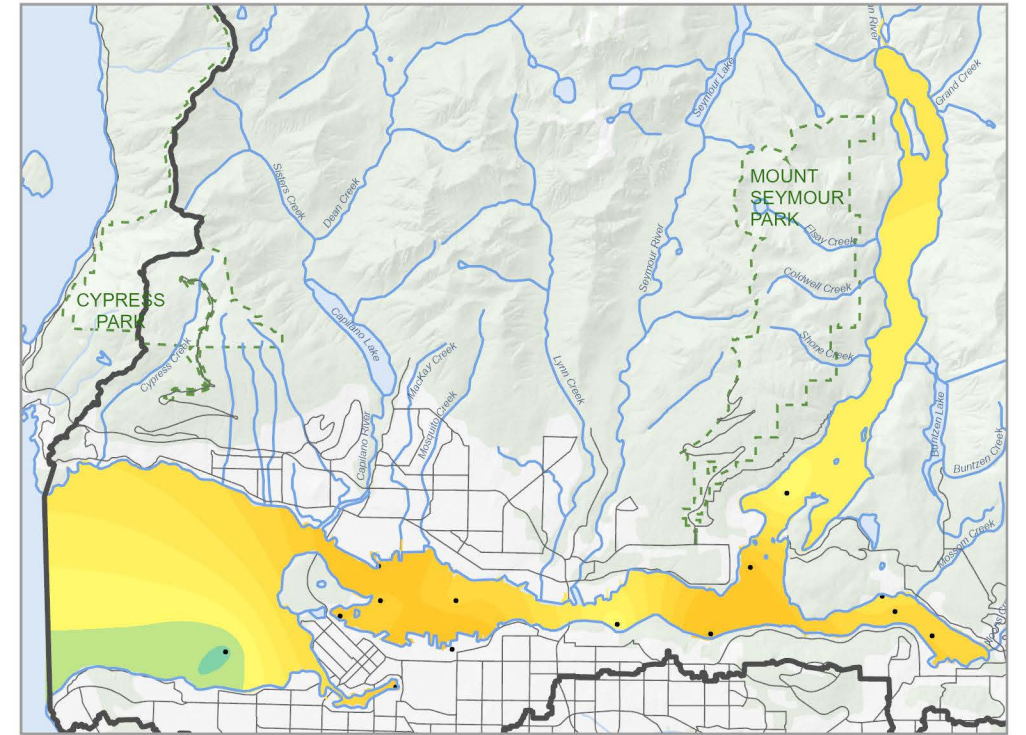
District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



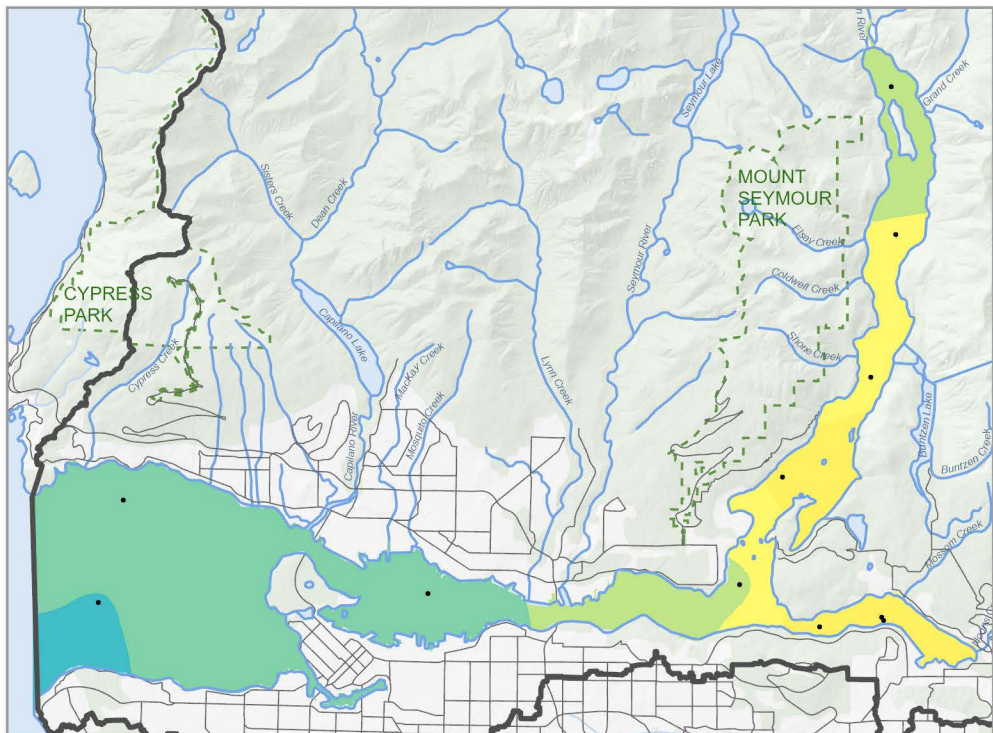
1985-1989



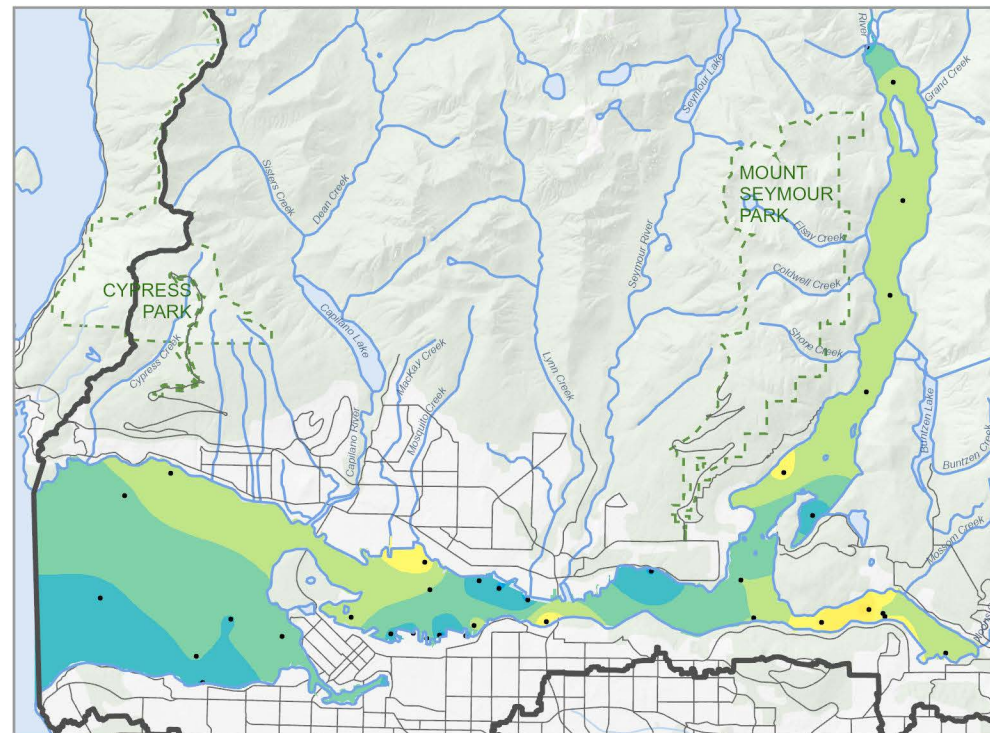
1990-1994



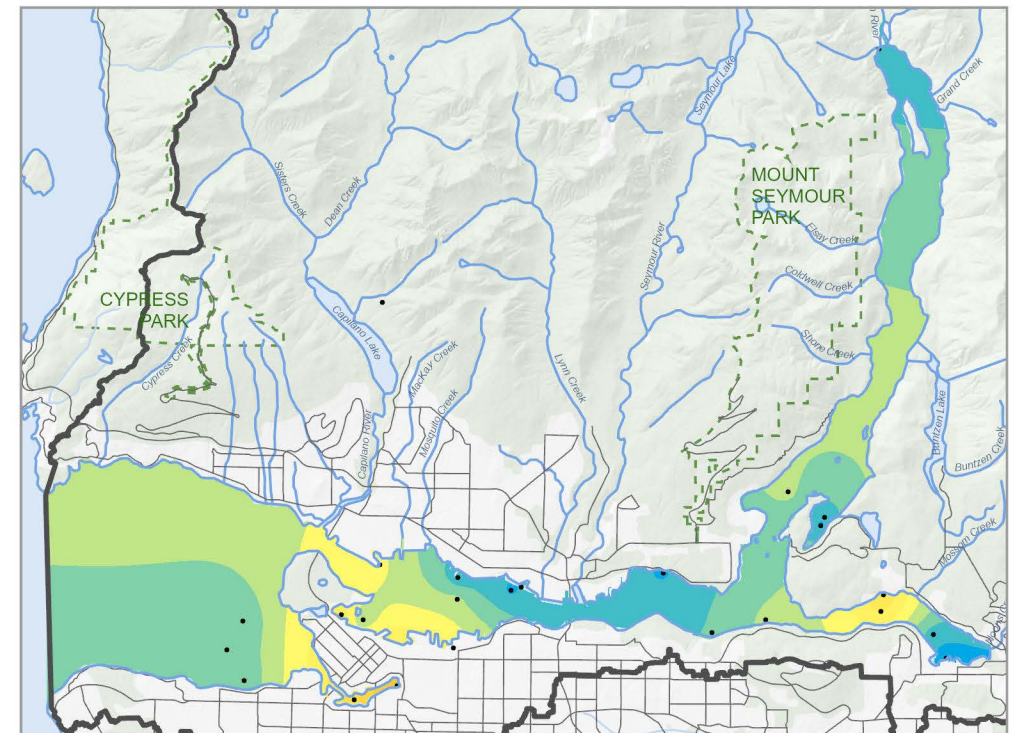
1999-2002



2008-2012



2013-2016



2017-2020

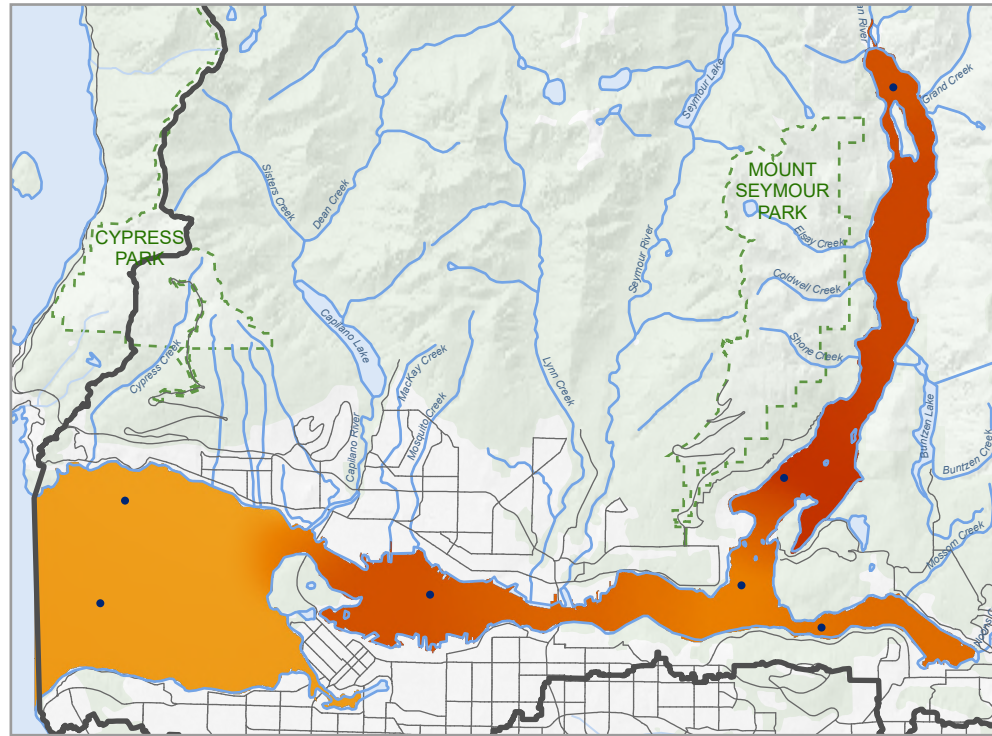
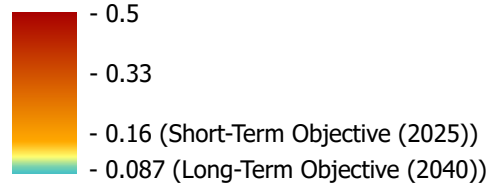
# Heat Map of Lead in Tissue Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

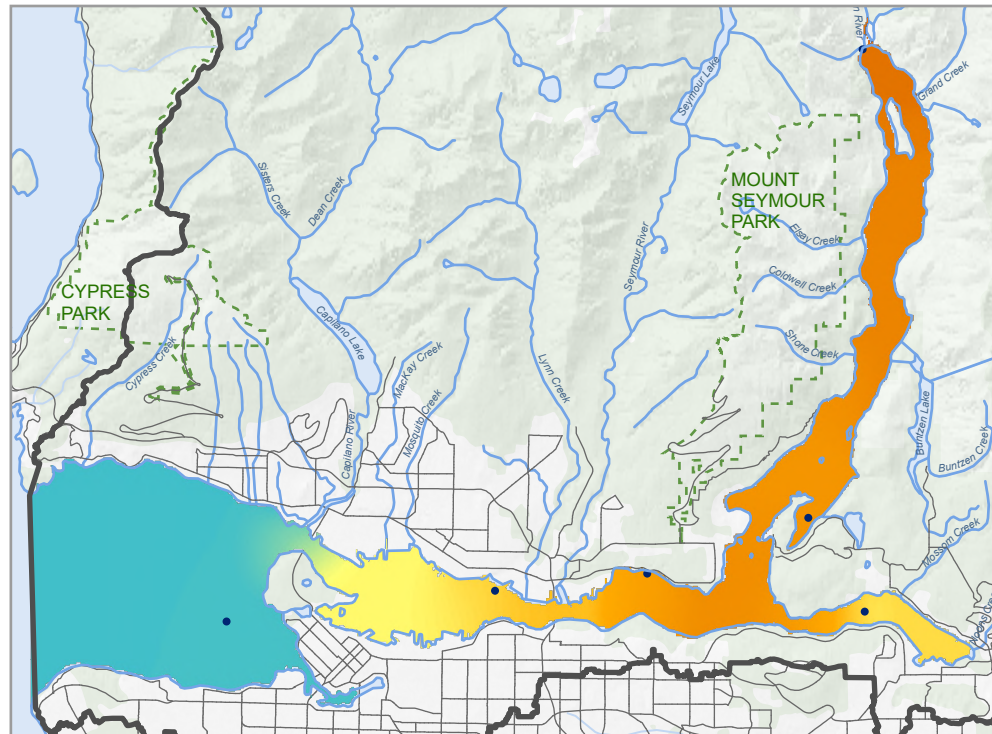
 Burrard Inlet Catchment (Study Area)

• Lead Sample Site

Total Lead in Tissue ( $\mu\text{g/g}$  wet weight max)



**English Sole (2007-2012)**



**Blue Mussel (2018-2019)**

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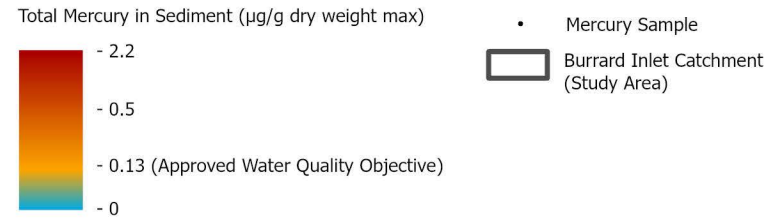
Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



# Heat Map of Mercury in Sediment Samples Collected by All Monitoring Programs

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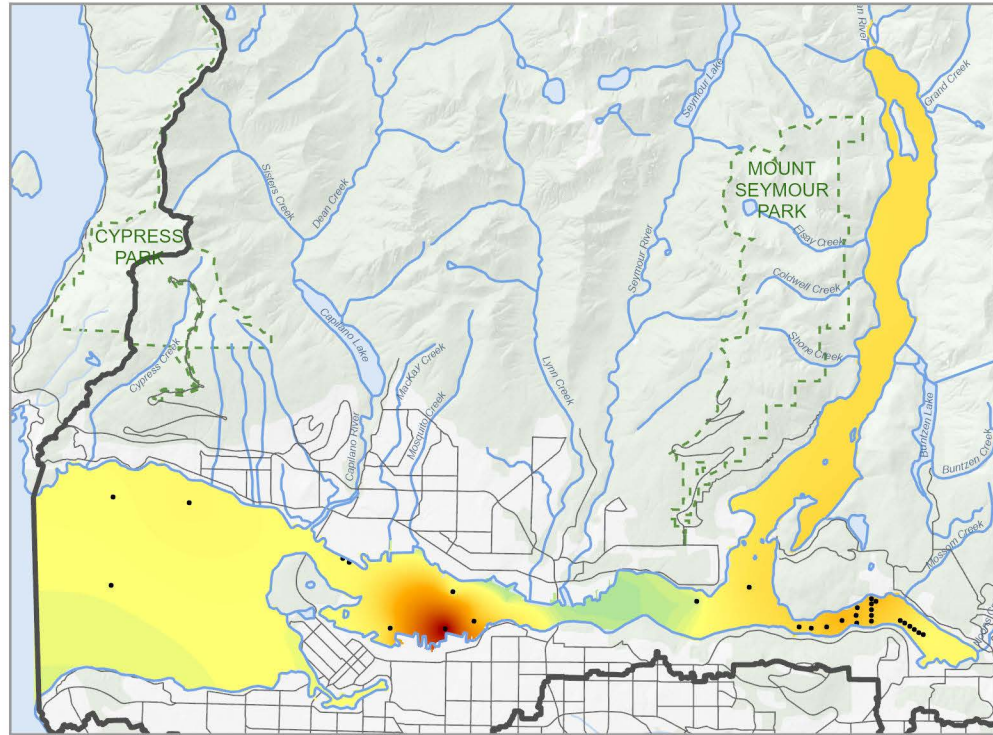


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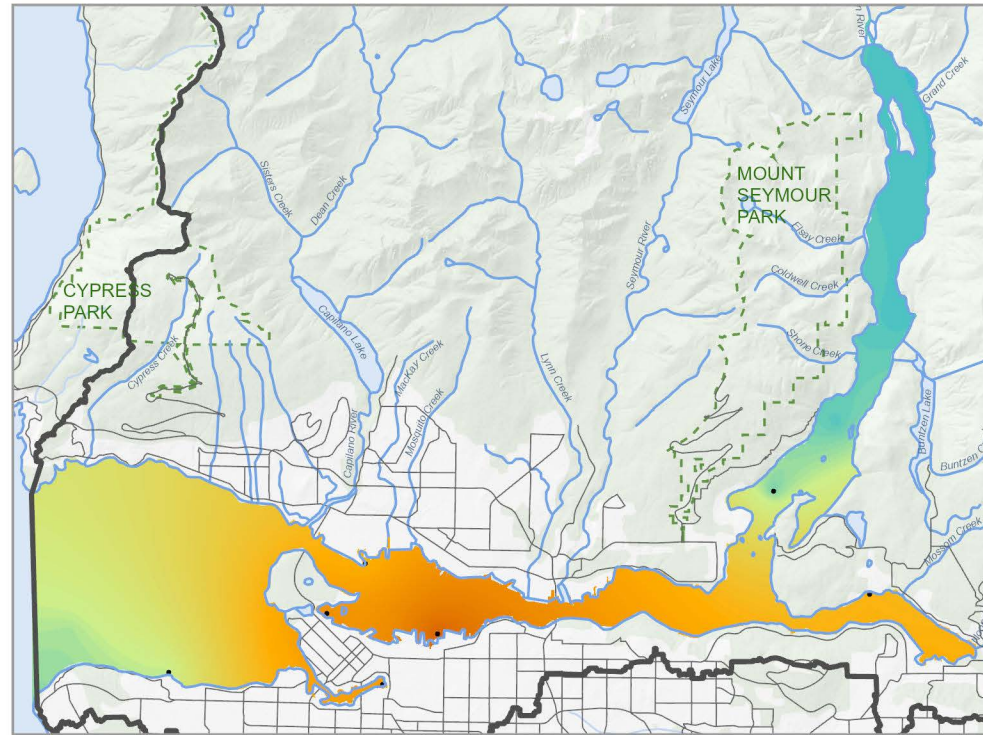
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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

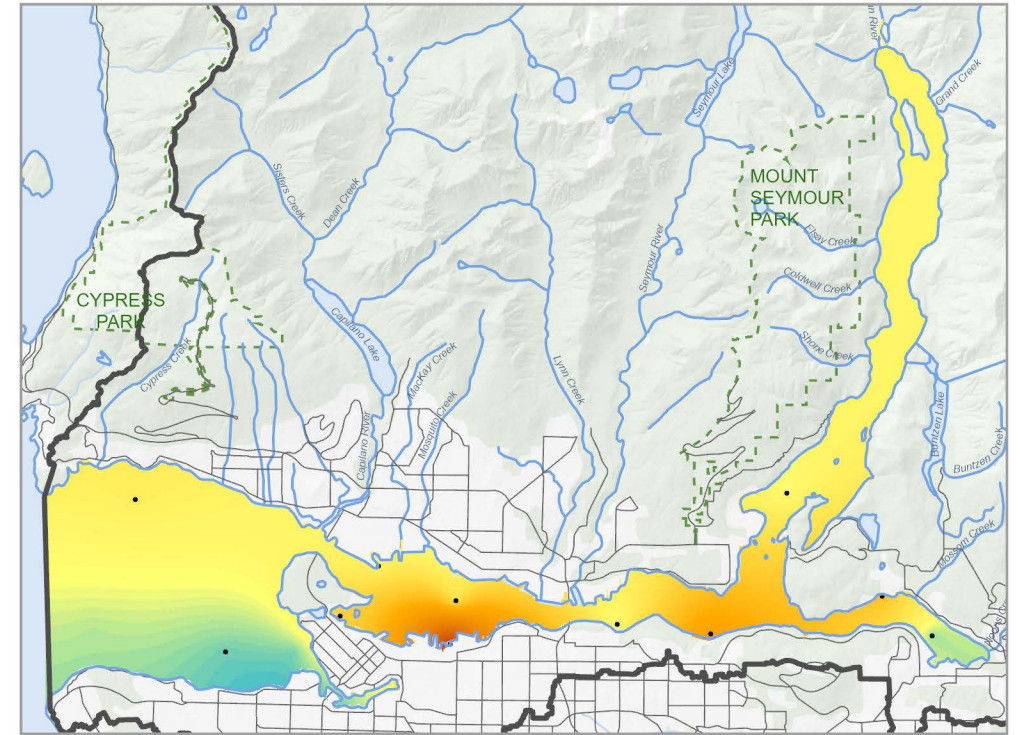
District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



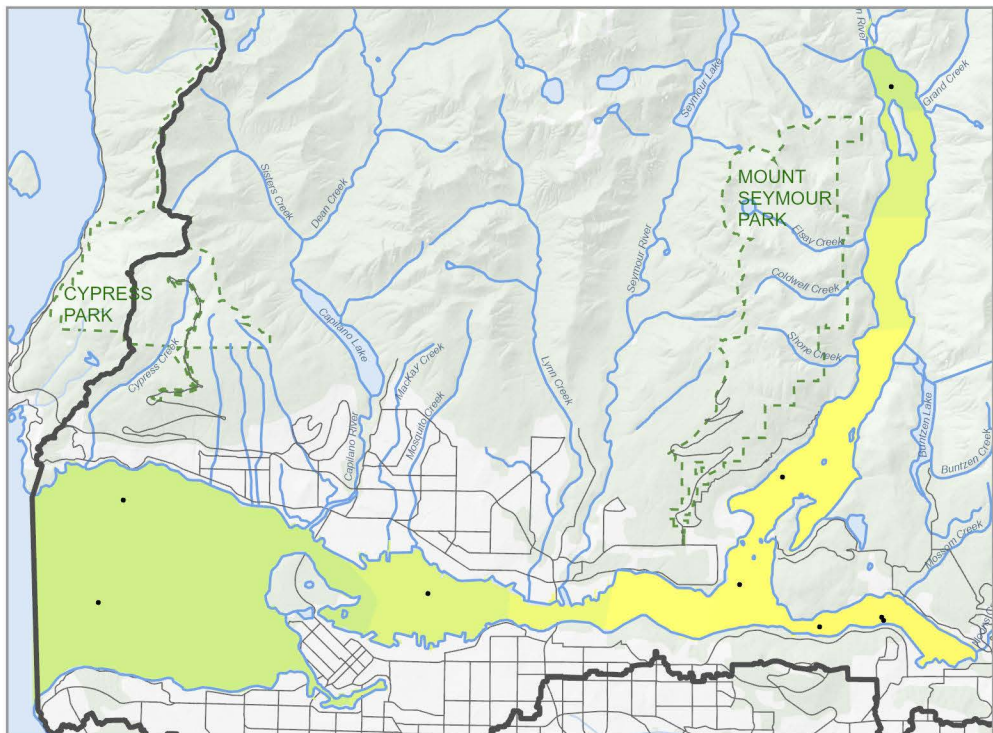
1985-1987



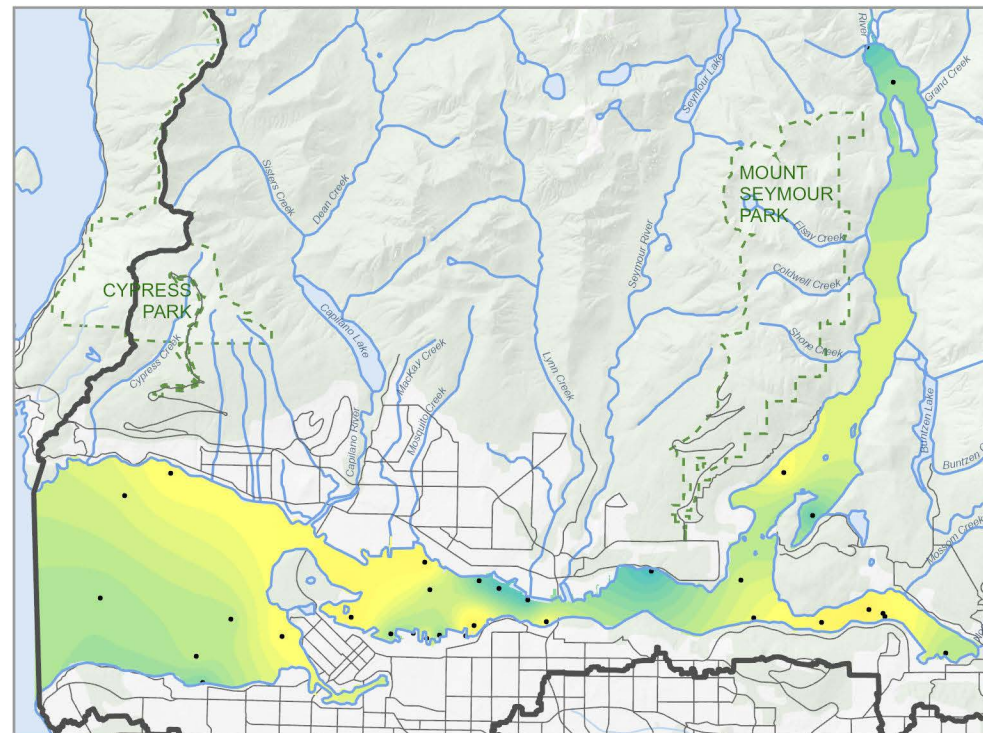
1990-1993



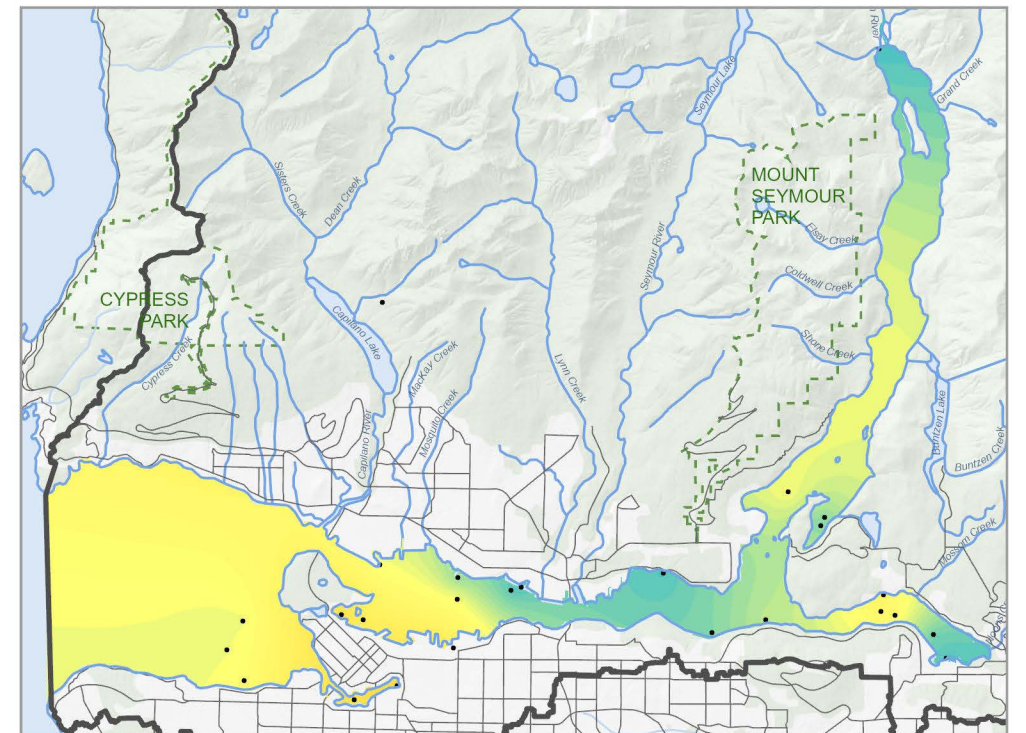
2000-2002



2008-2012



2013-2016



2017-2020

# Heat Map of Mercury in Tissue Samples Collected by All Monitoring Programs

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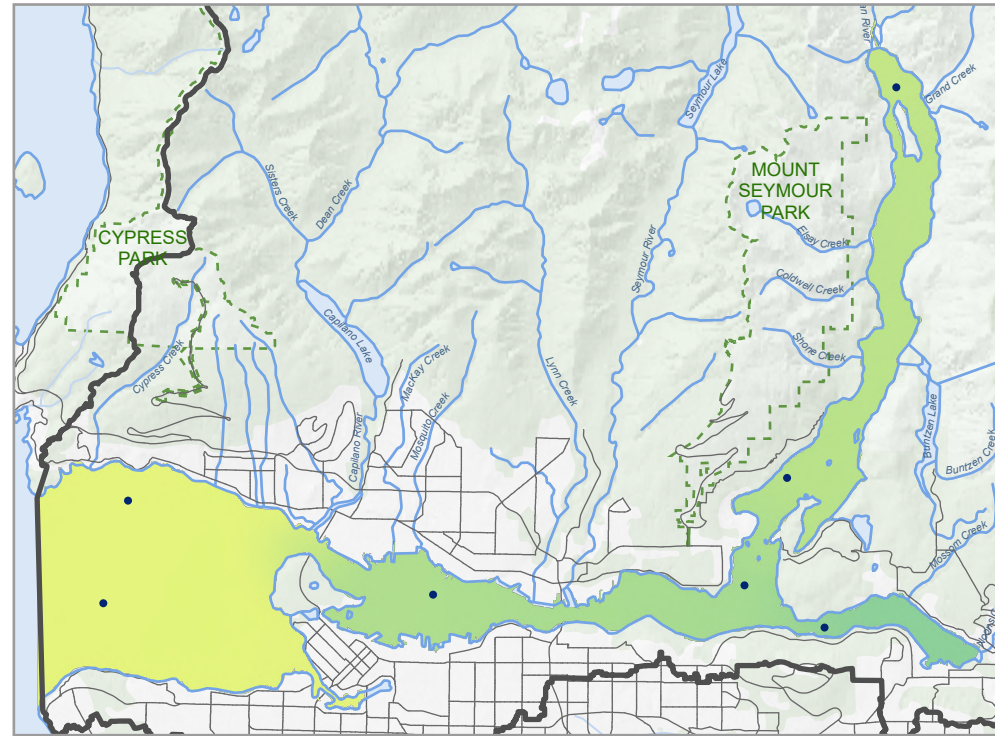
 Burrard Inlet Catchment (Study Area)

• Mercury Sample Site

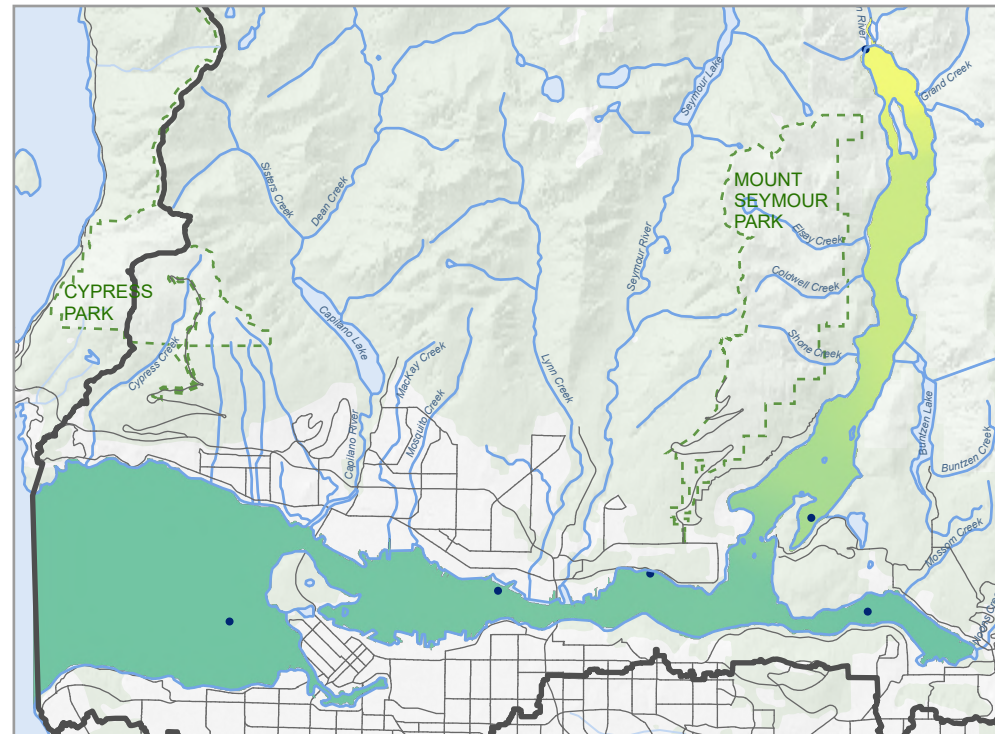
Total Mercury in Tissue ( $\mu\text{g/g}$  wet weight max)

 - 0.033 (Approved Water Quality)

 - 0



**English Sole (2007-2012)**



**Blue Mussel (2018-2019)**

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



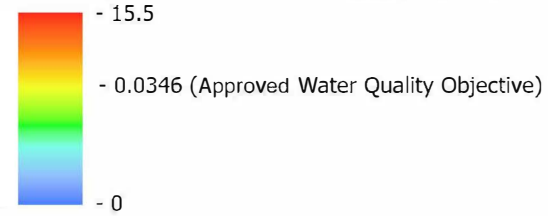
# Heat Map of Naphthalene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Naphthalene Sample Site

Total Naphthalene in Sediment ( $\mu\text{g/g}$  dry weight max)

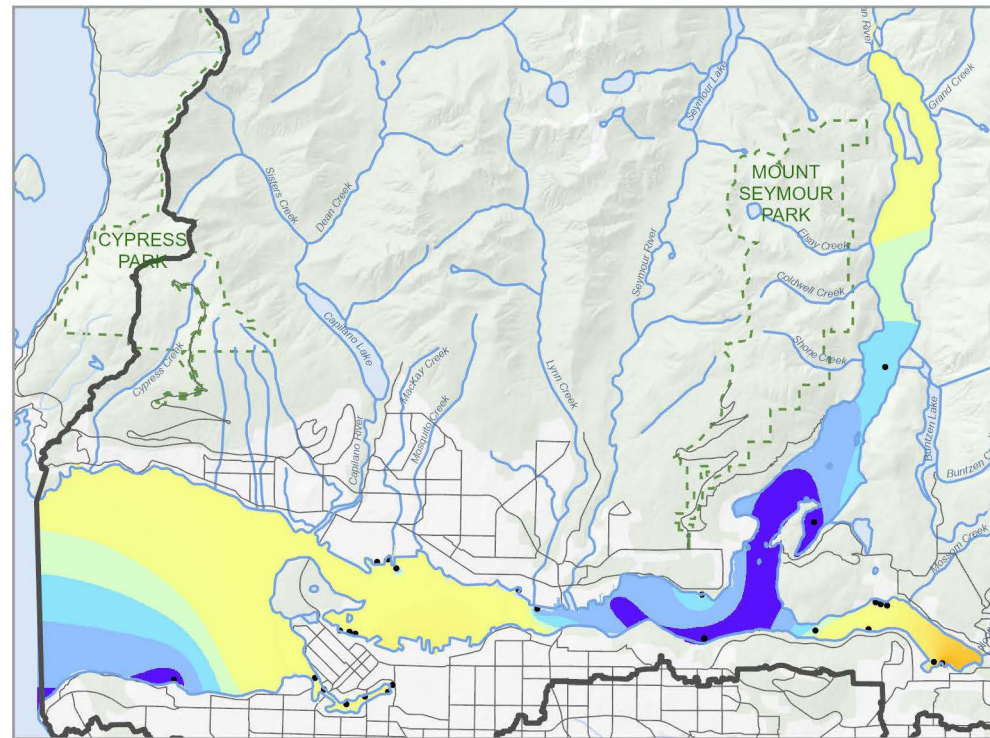


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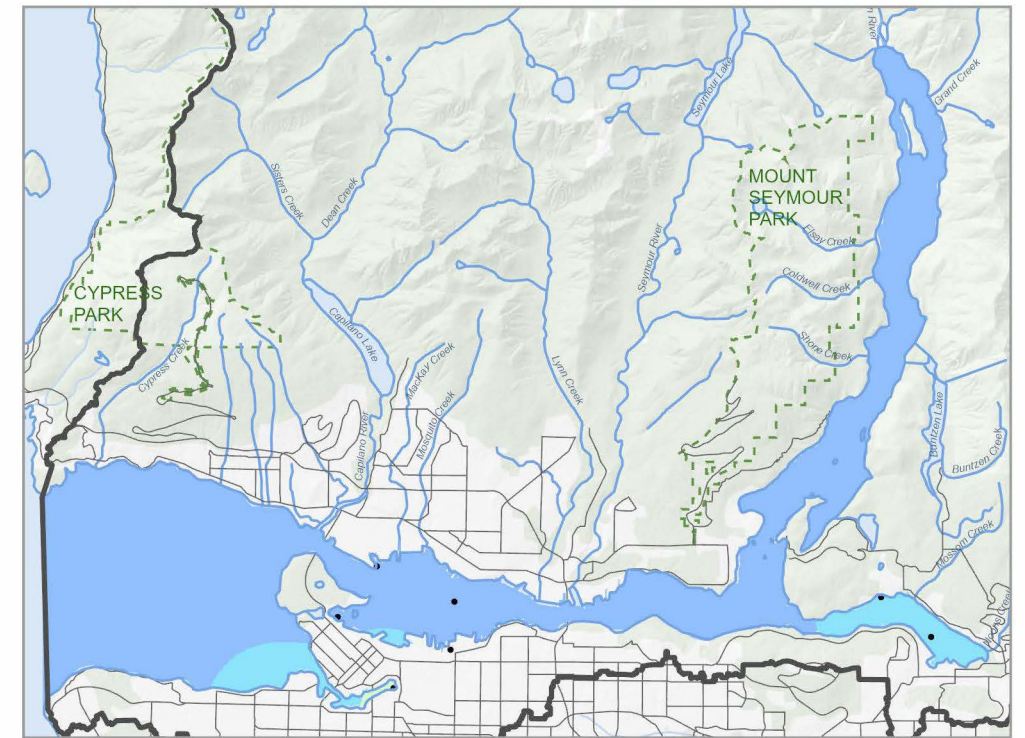
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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



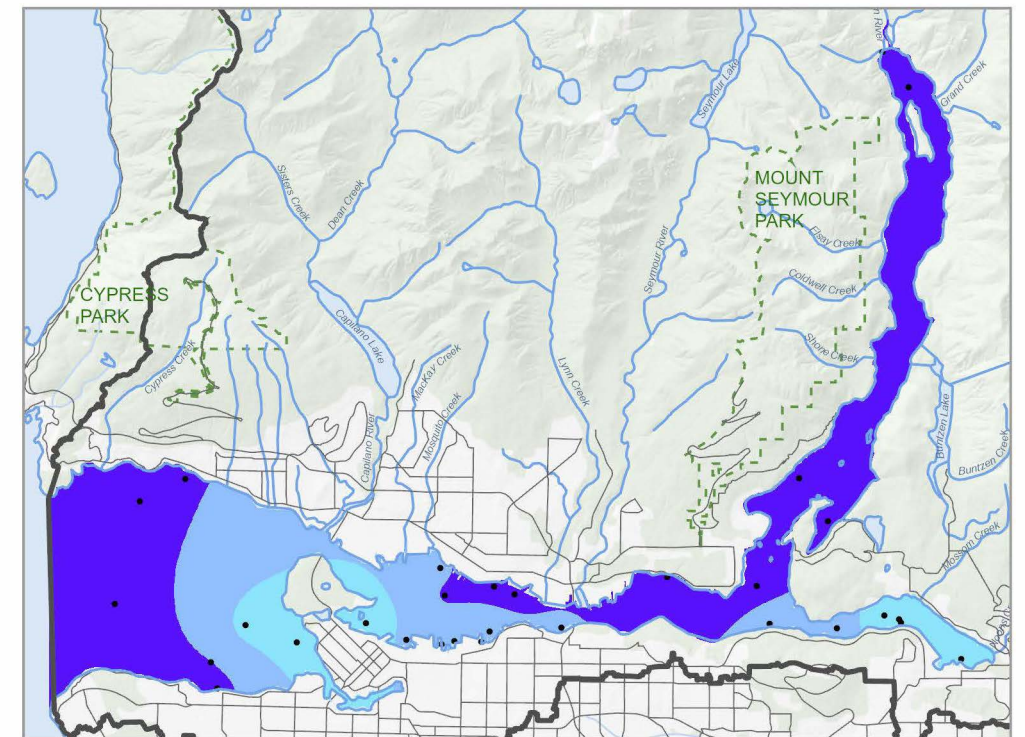
1991-1994



1999-2002



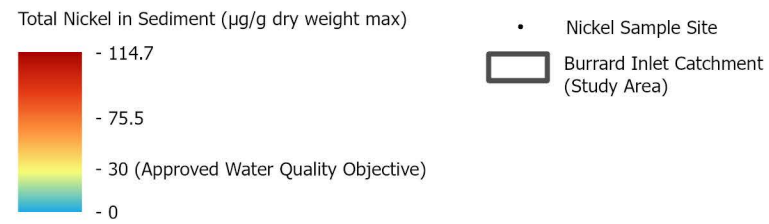
2008-2011



2013-2017

# Heat Map of Nickel in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas



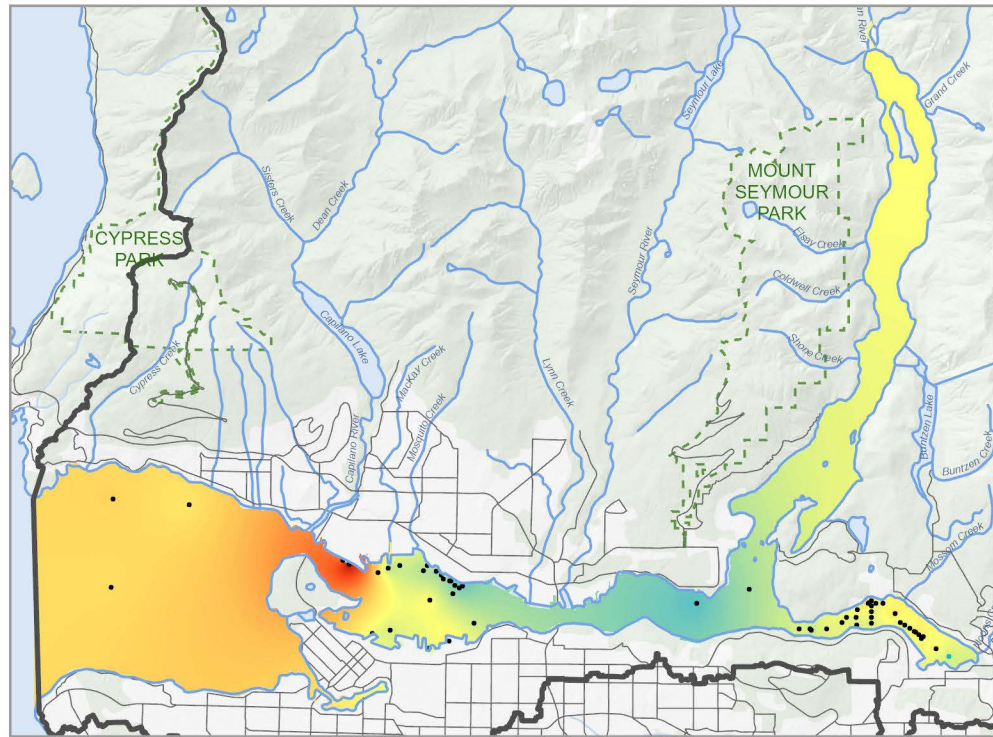
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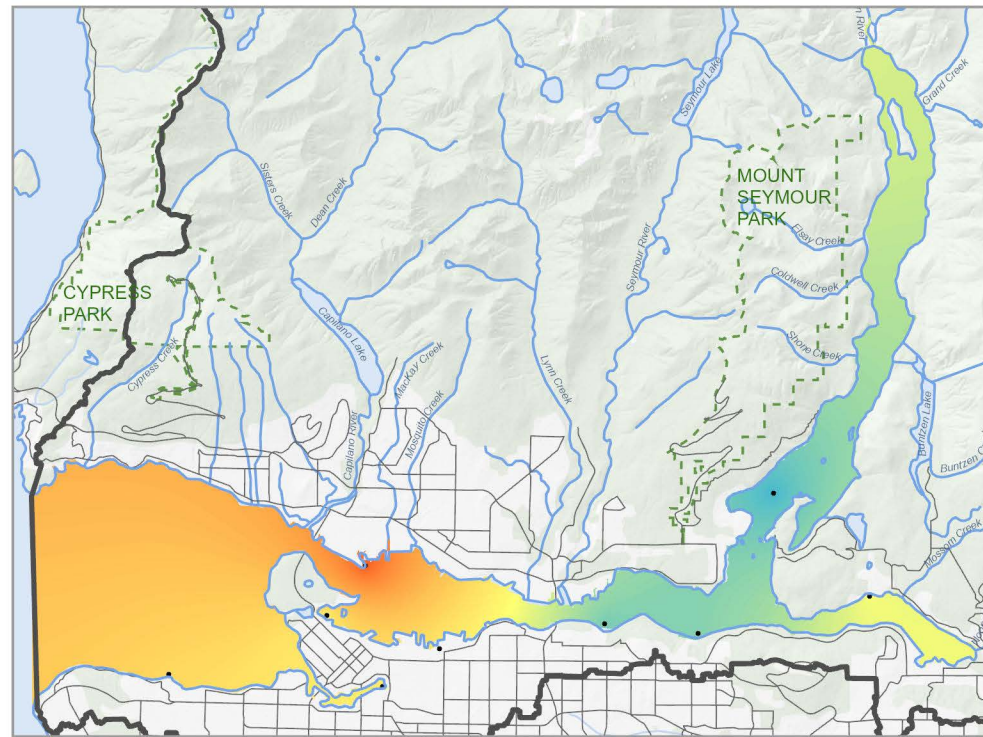
Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).

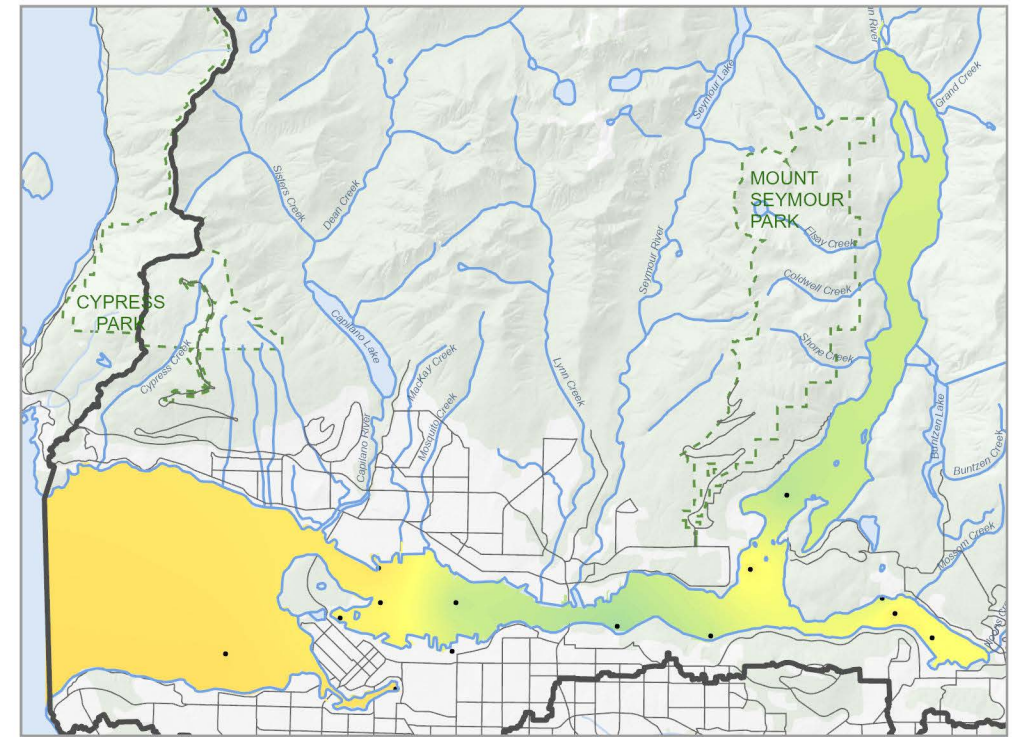
N



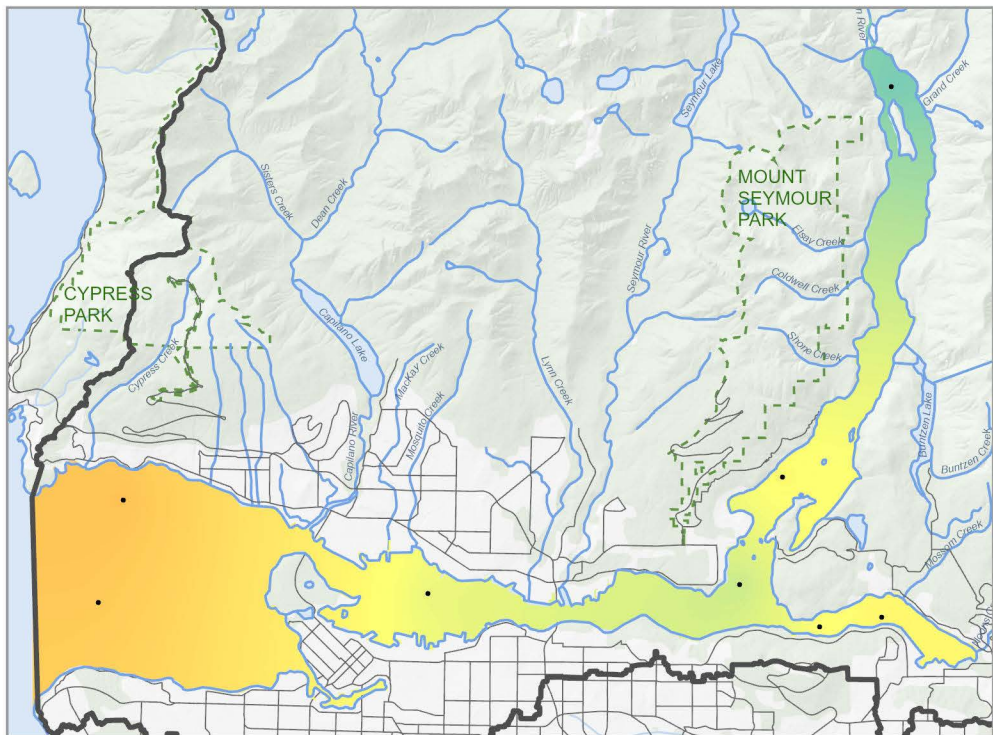
1985-1989



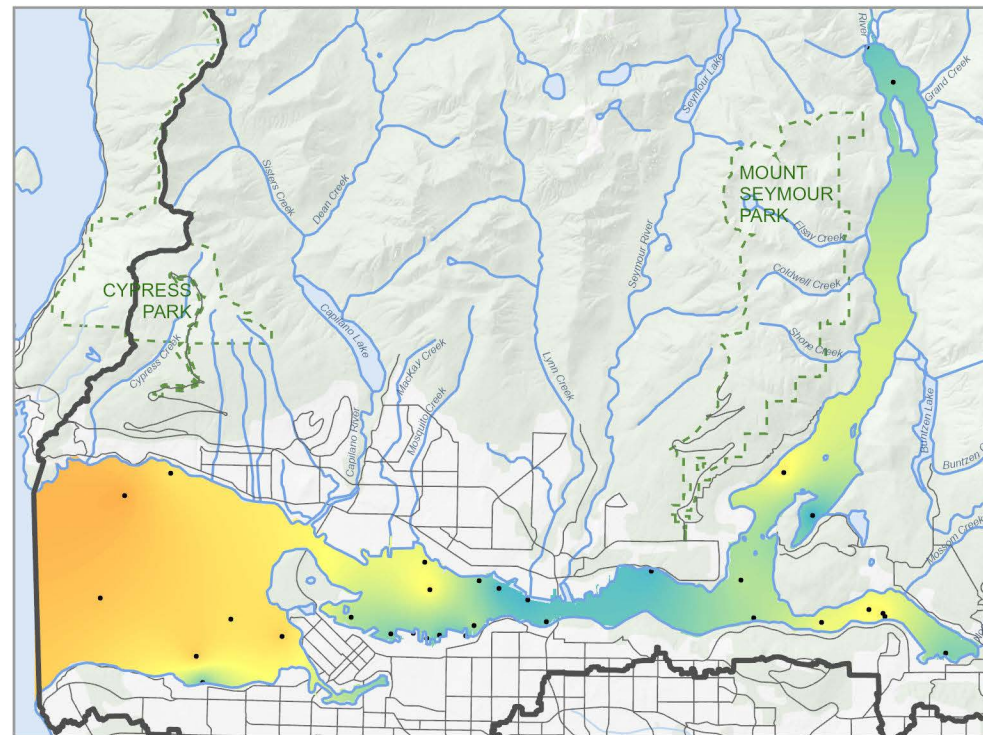
1990-1994



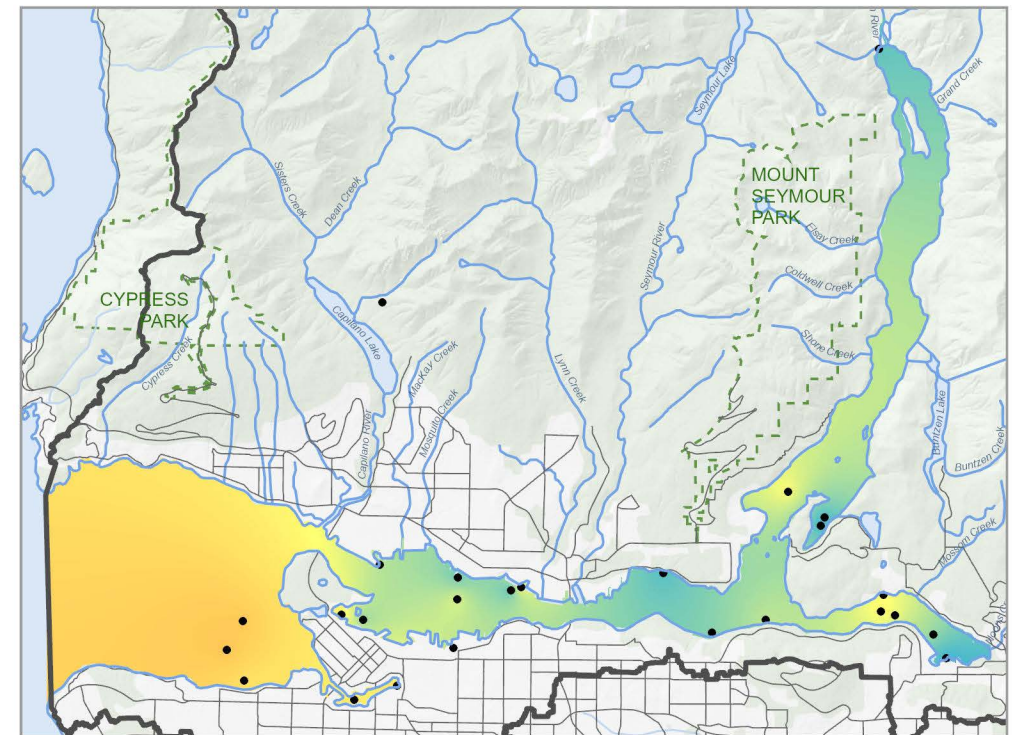
1999-2002



2008-2012



2013-2016



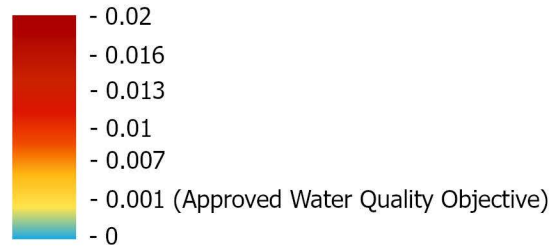
2017-2020

# Heat Map of PBDEs in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

-  Burrard Inlet Catchment (Study Area)
- PBDE Sample Site

PBDE in Sediment ( $\mu\text{g/g}$  dry weight max)

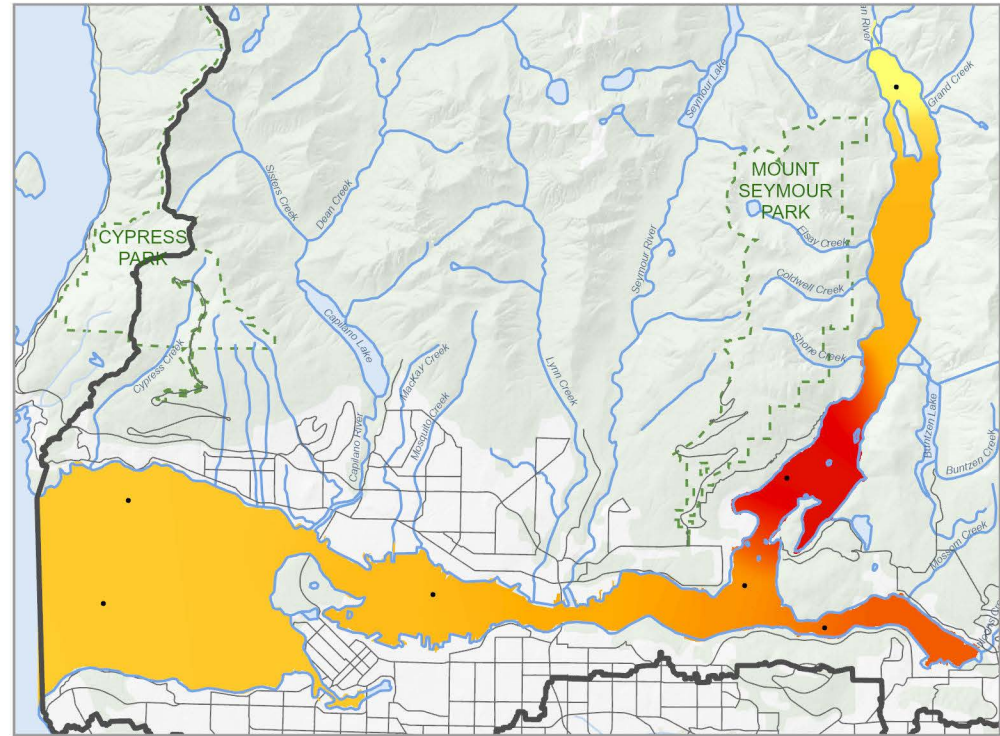


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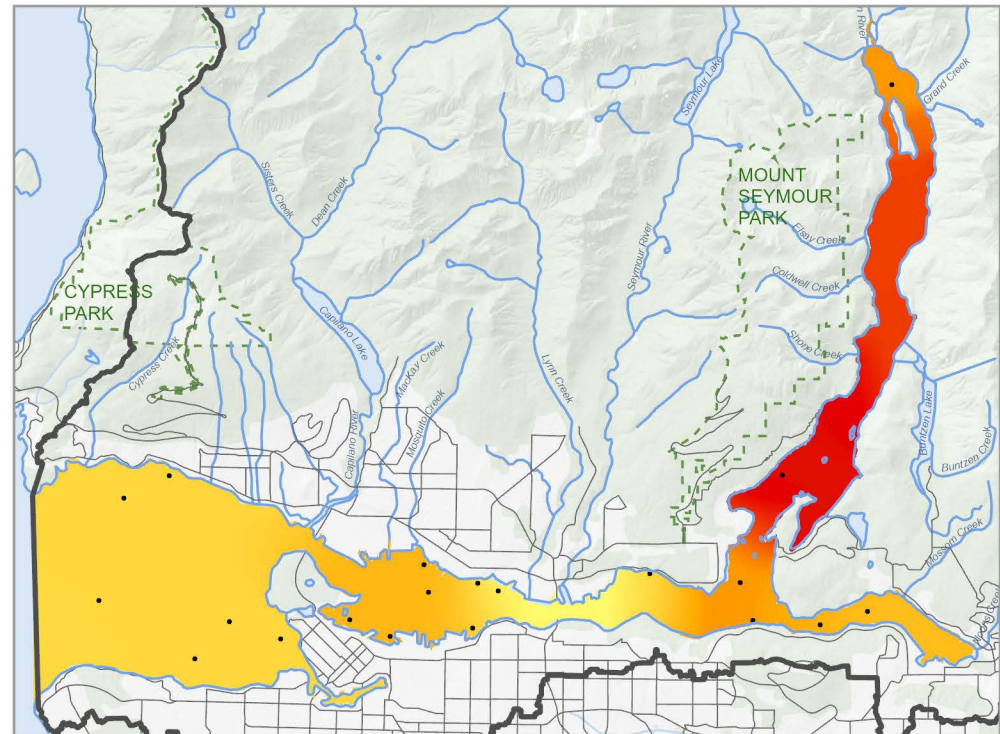
This map is a living document and is intended to be amended and refined over time. The data used to produce this map originate from many sources and are presented without prejudice. Heat map interpolations were prepared by Kerr Wood Leidal Associates Ltd. using methods available in ArcGIS. This map is the property of the Tsleil-Waututh Nation and may not be reproduced without written permission.

Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



2008-2011



2013-2016

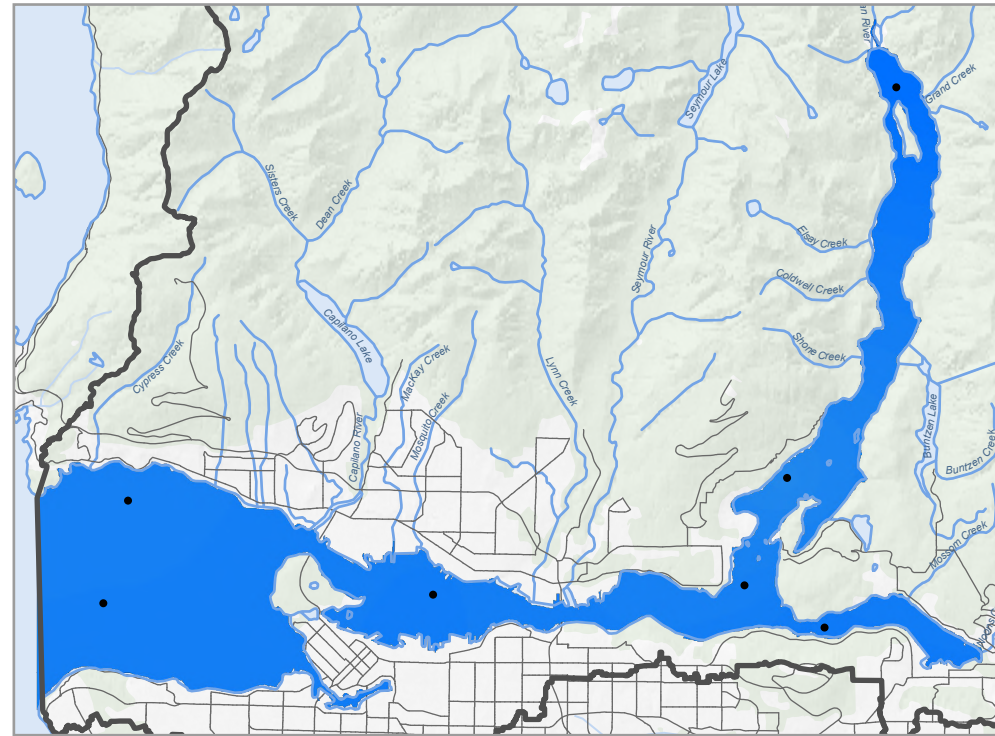
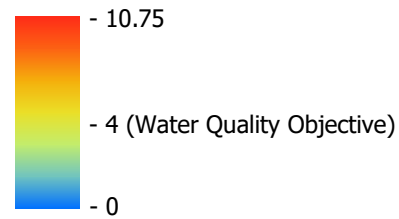
# Heat Map of BDE-47(tetraBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

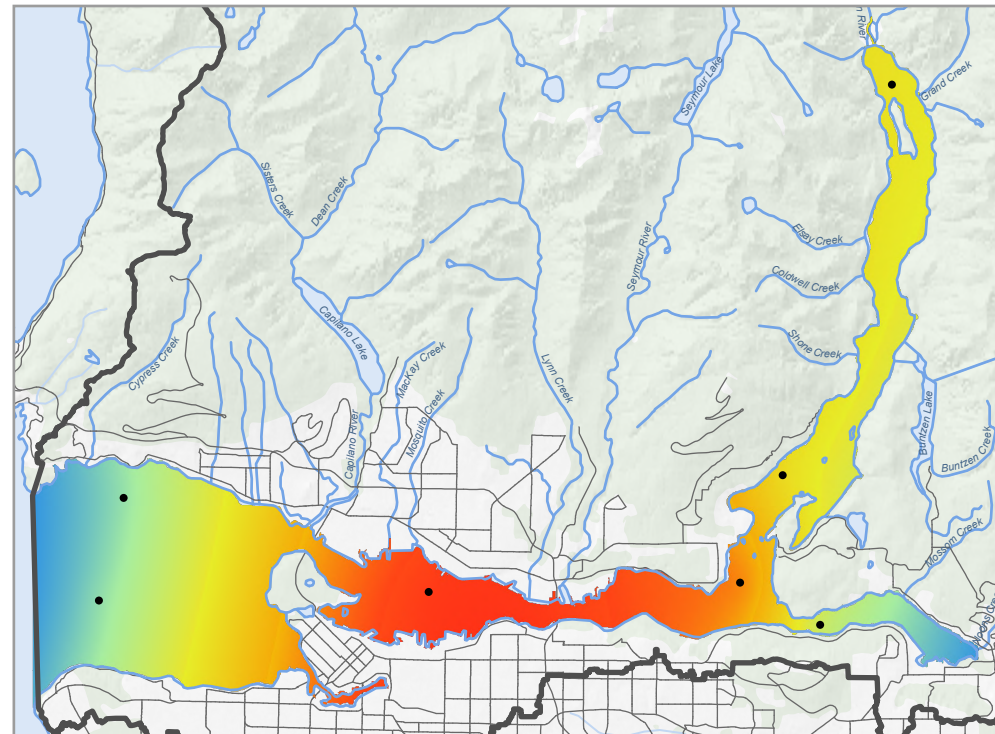
 Burrard Inlet Catchment (Study Area)

• BDE-47 Sample Site

Total BDE-47 in Tissue (ng/g wet weight)



2007



2012

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



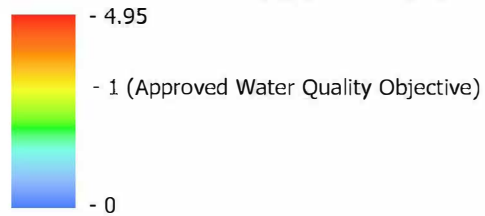
# Heat Map of BDE-99 (pentaBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

 BDE-99 (pentaBDE) Sample Site

Total BDE-99 in Tissue (ng/g wet weight)

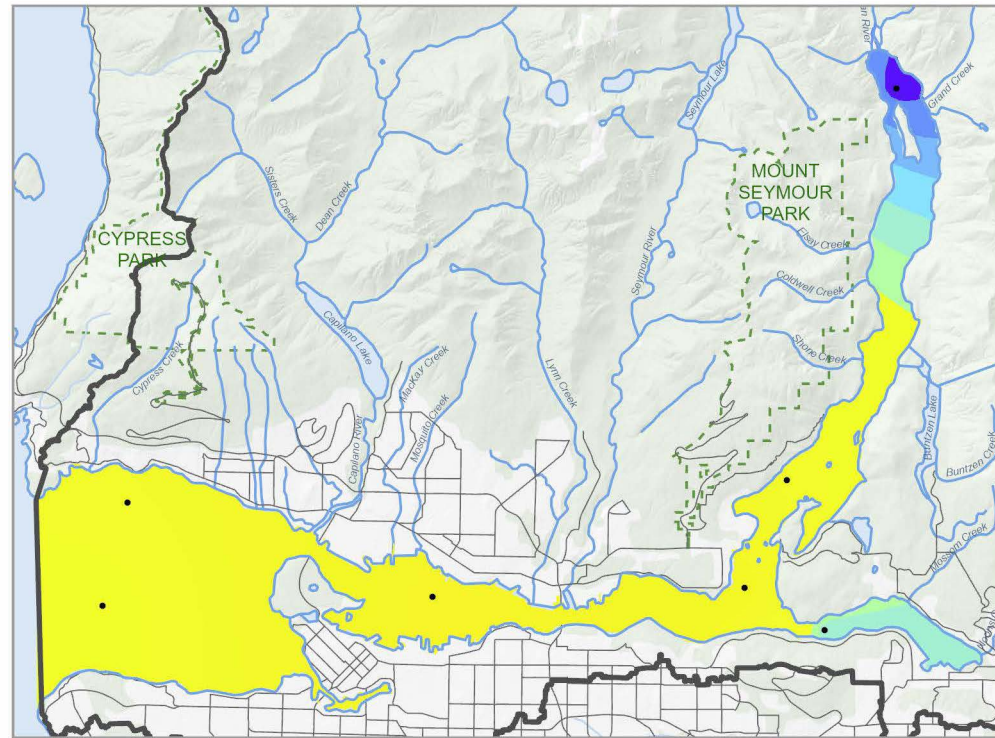


This heat map is based on interpolations from limited data obtained from specific sites, and is for illustrative purposes only. This map should not be used to infer actual values at particular sites. The map was developed through a combination of different interpolation methods in ArcGIS. Values were assigned to cells in between the points at which real data were taken, based on the relationship and distance between sample points, to produce a clean surface/gradient across the map. For more details refer to [desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm](http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm)

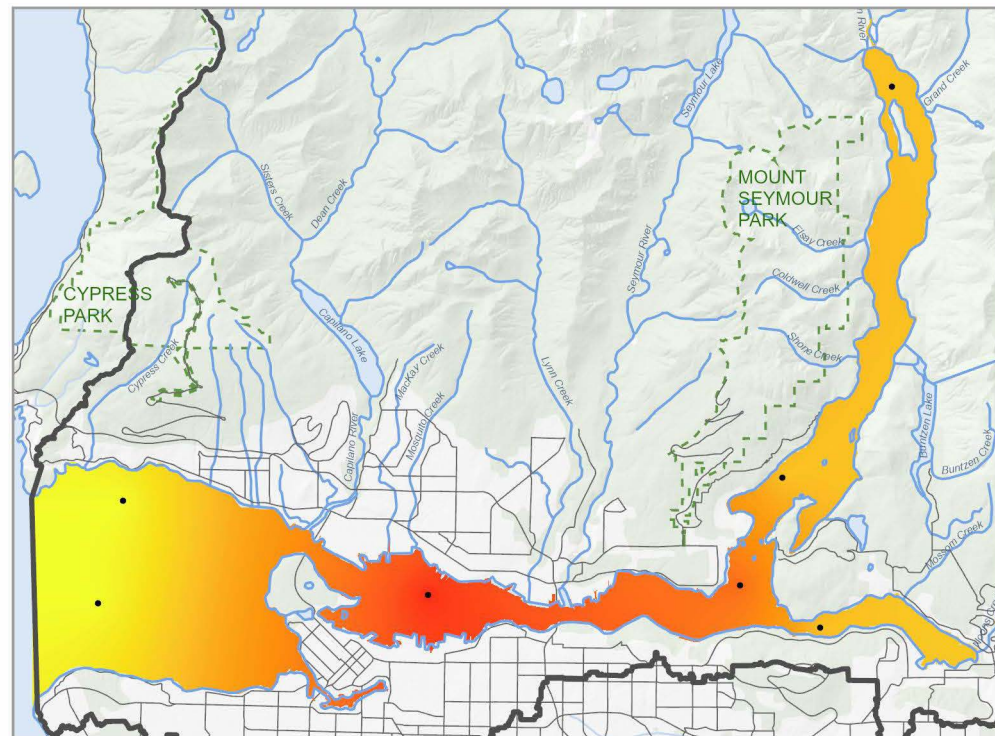
This map is a living document and is intended to be amended and refined over time. The data used to produce this map originate from many sources and are presented without prejudice. Heat map interpolations were prepared by Kerr Wood Leidal Associates Ltd. using methods available in ArcGIS. This map is the property of the Tseil-Waututh Nation and may not be reproduced without written permission.

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



2007



2012

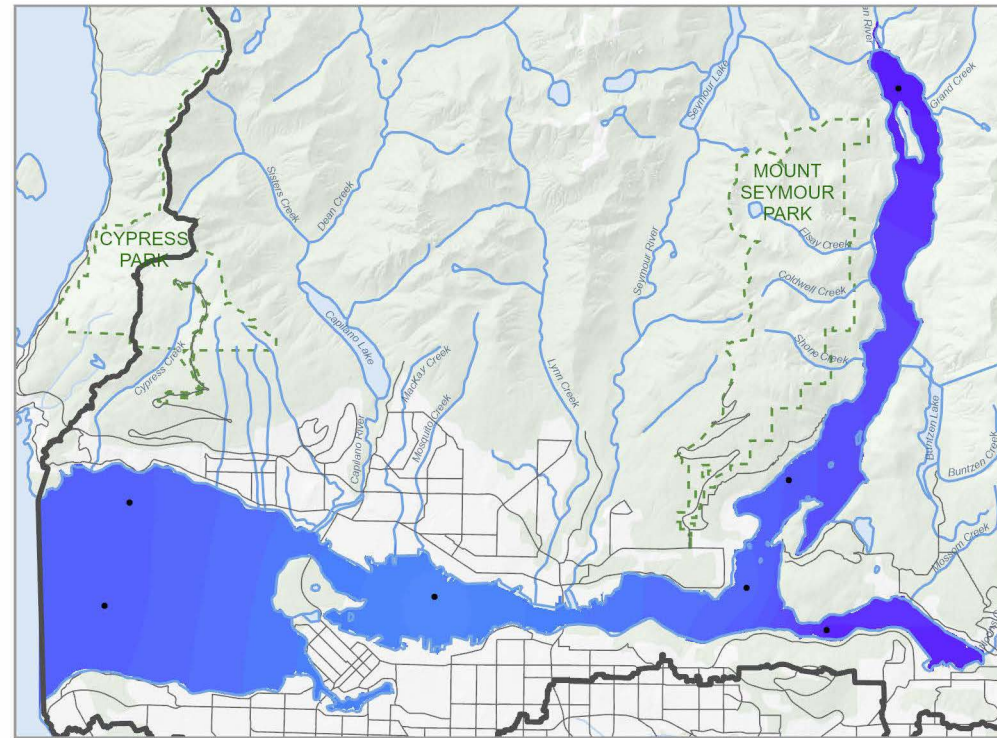
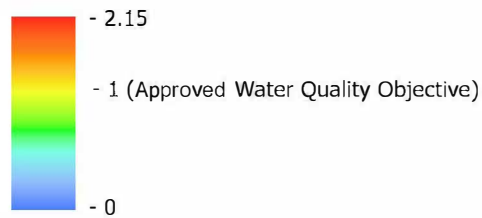
# Heat Map of BDE-100 (pentaBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

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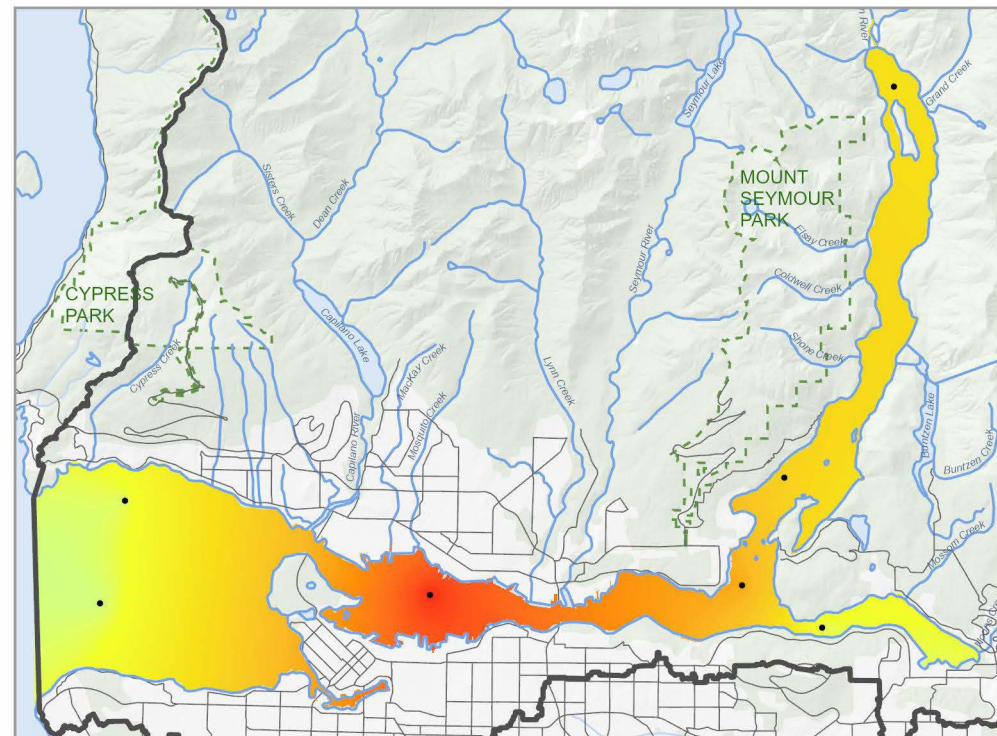
 Burrard Inlet Catchment (Study Area)

• BDE-100 (pentaBDE) Sample Site

Total BDE-100 in Tissue (ng/g wet weight)



2007



2012

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



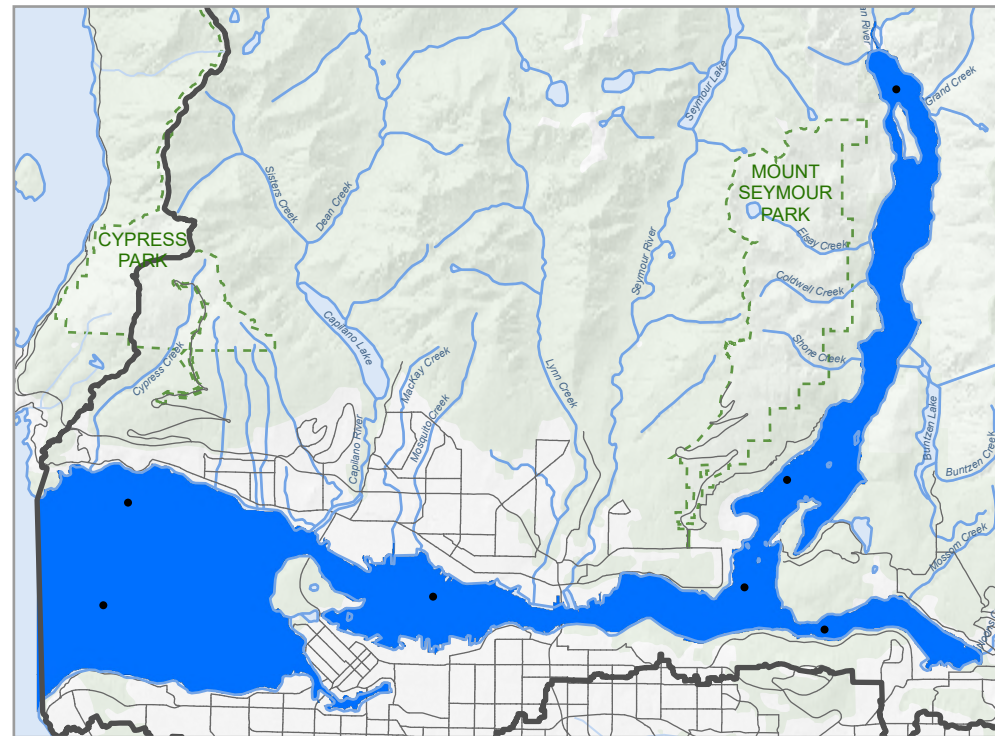
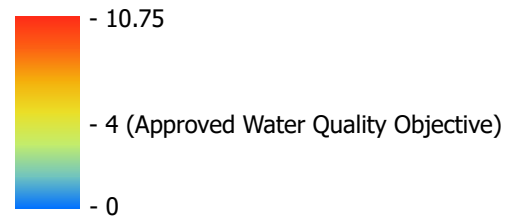
# Heat Map of BDE-153 (hexaBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

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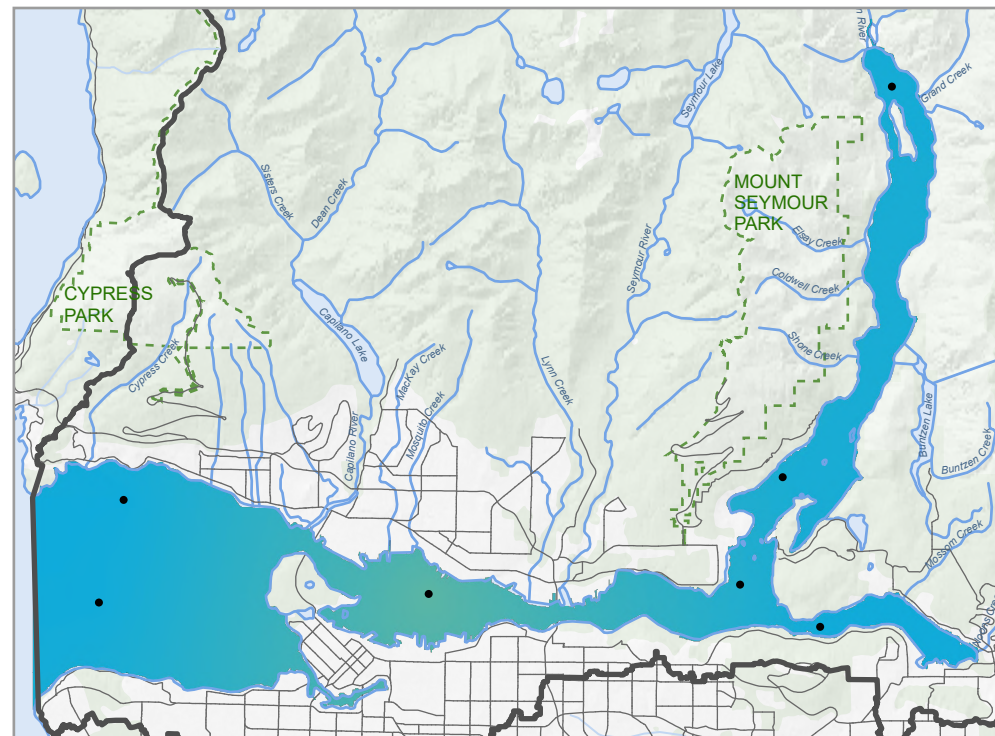
 Burrard Inlet Catchment (Study Area)

• BDE-153 Sample Site

Total BDE-153 in Tissue (ng/g wet weight)



2007



2012

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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



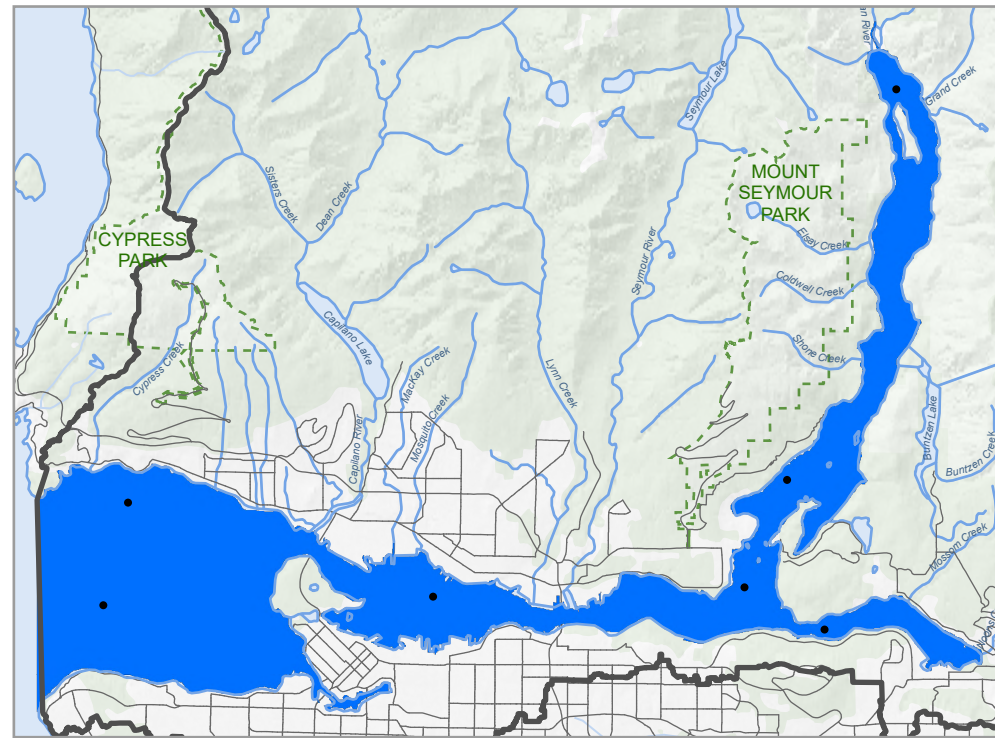
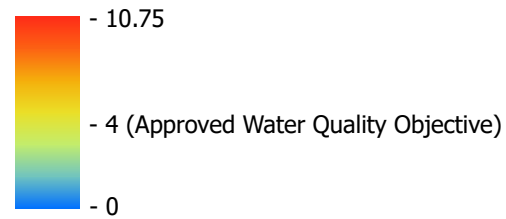
# Heat Map of BDE-154 (hexaBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

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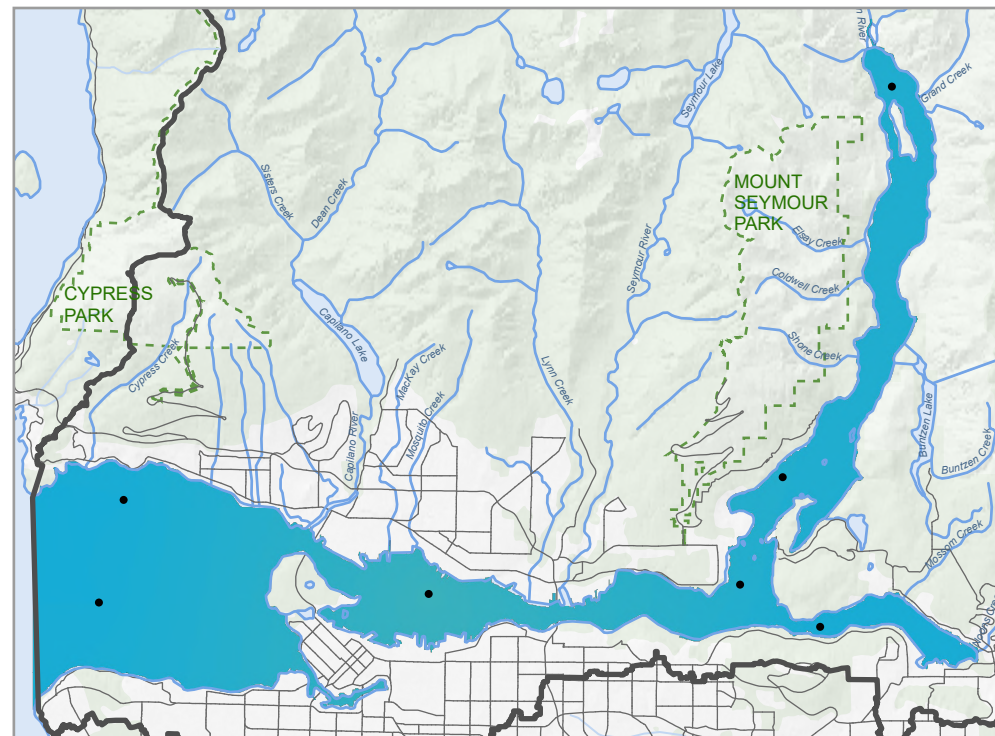
 Burrard Inlet Catchment (Study Area)

• BDE-154 Sample Site

Total BDE-154 in Tissue (ng/g wet weight)



2007



2012

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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



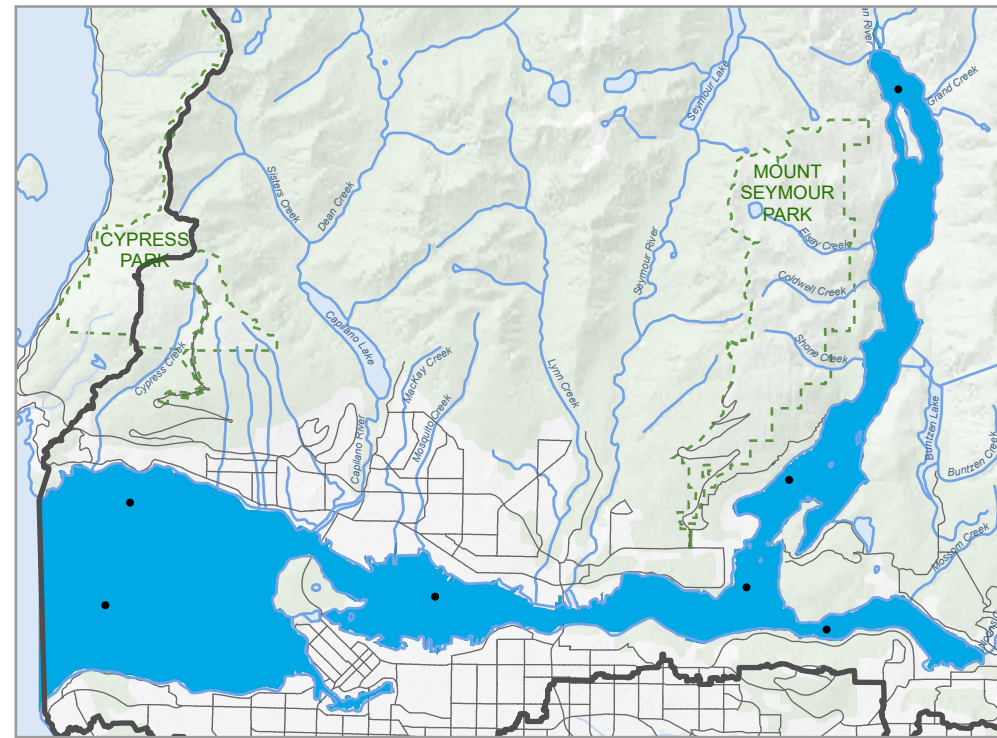
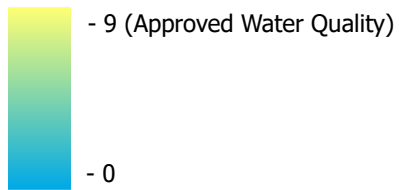
# Heat Map of BDE-209 (decaBDE) in English Sole Tissue Samples Collected by All Monitoring Programs

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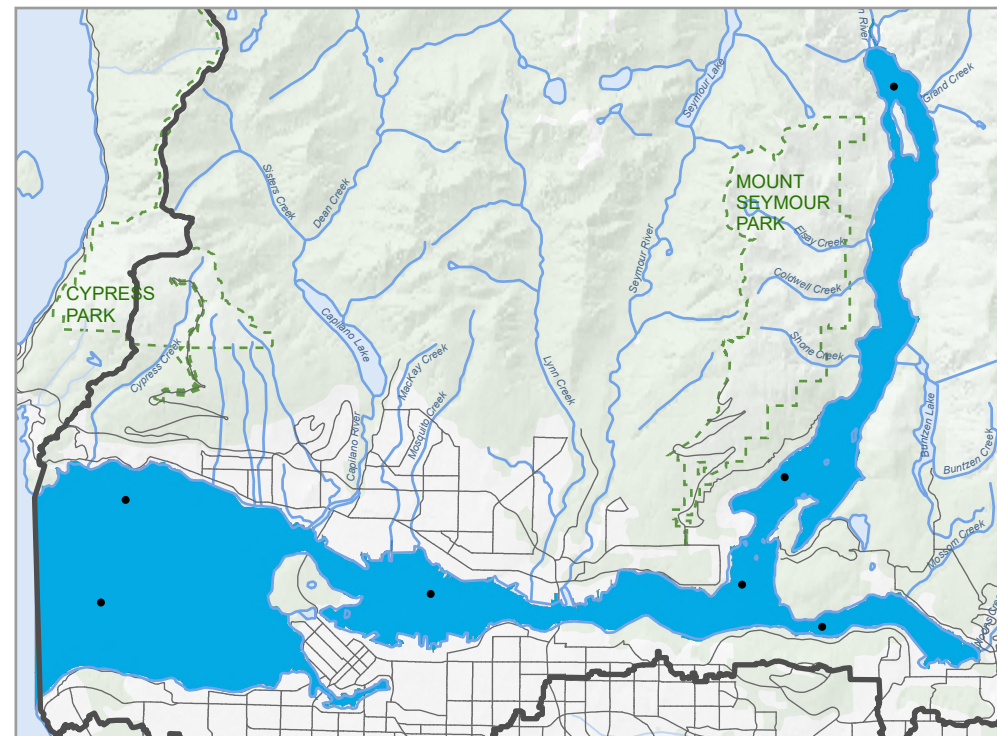
 Burrard Inlet Catchment (Study Area)

• BDE-209 Sample Site

Total BDE-209 in Tissue (ng/g wet weight)



2007



2012

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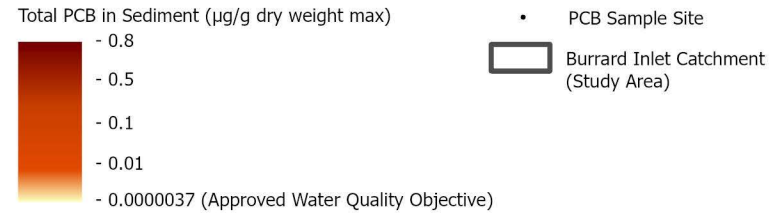
Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWW), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



# Heat Map of PCBs in Sediment Samples Collected by All Monitoring Programs

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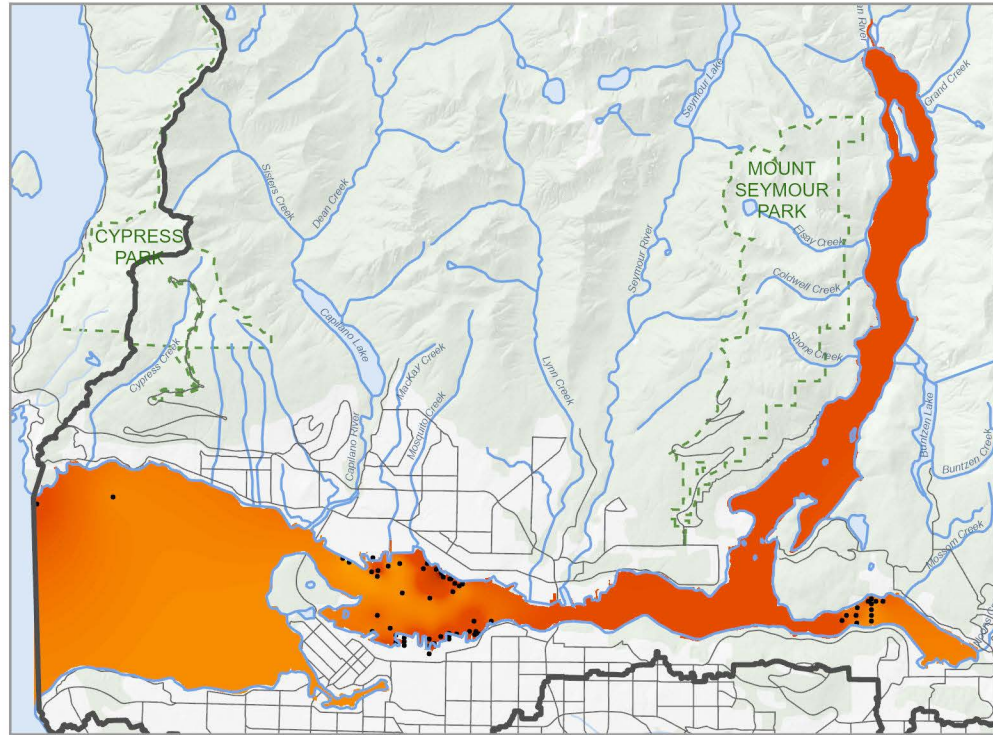


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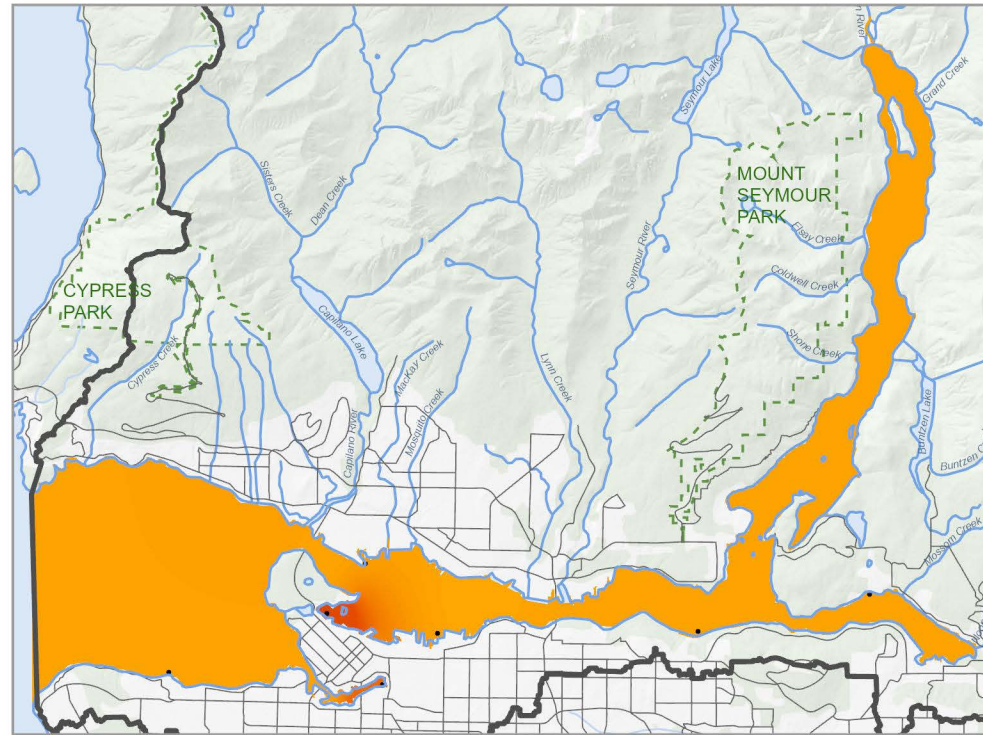
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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

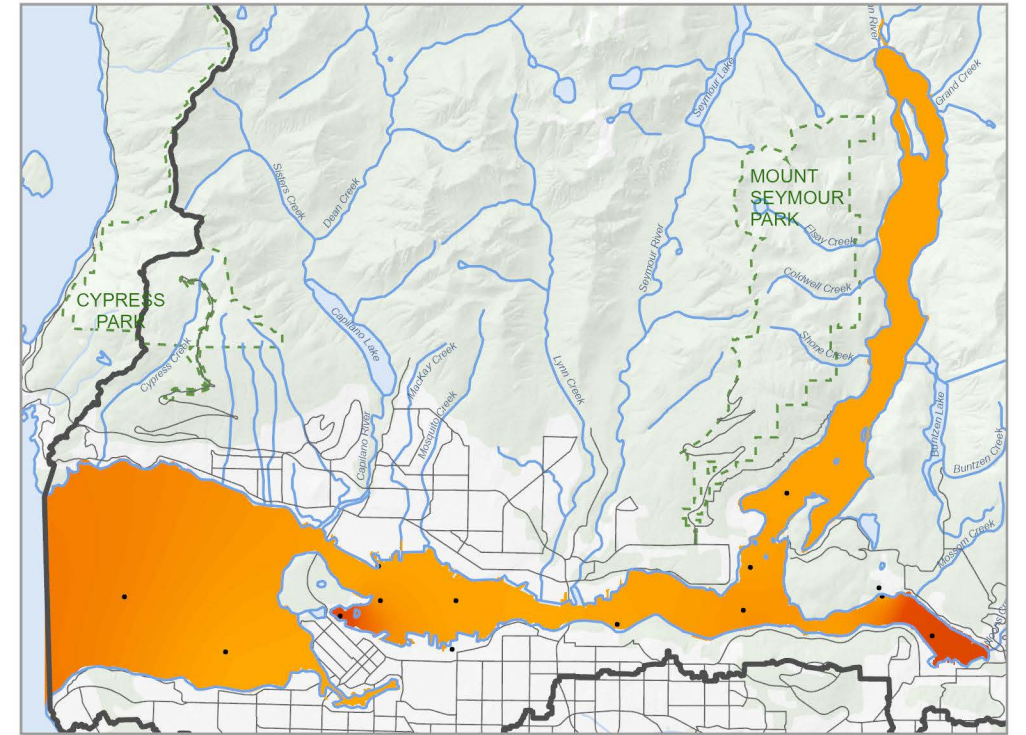
District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



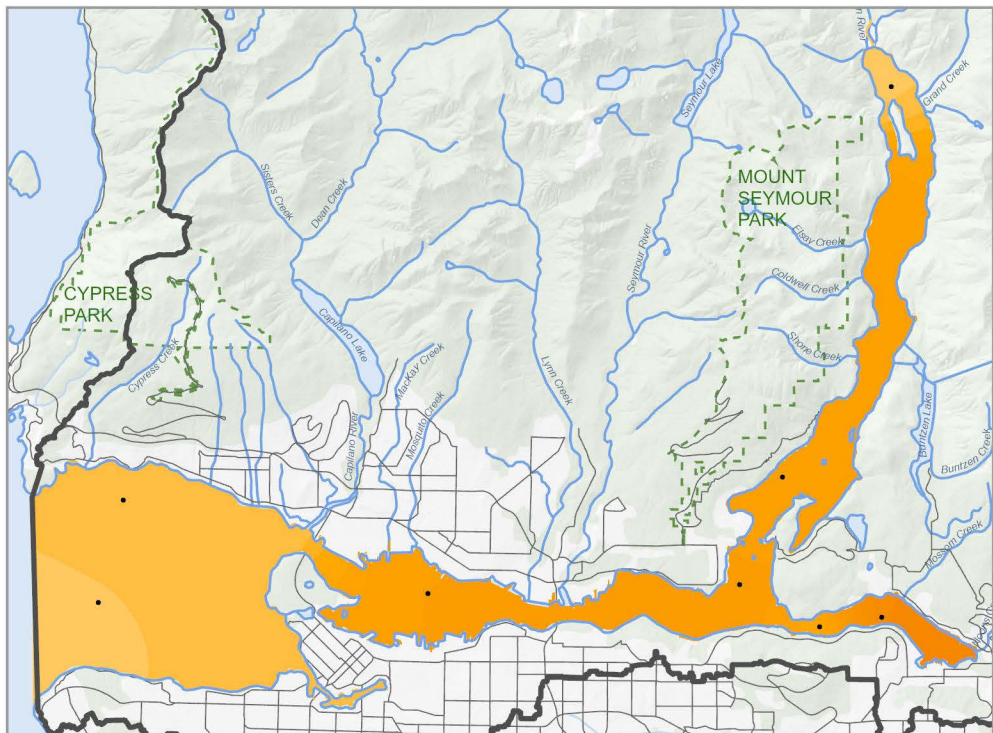
1985-1986



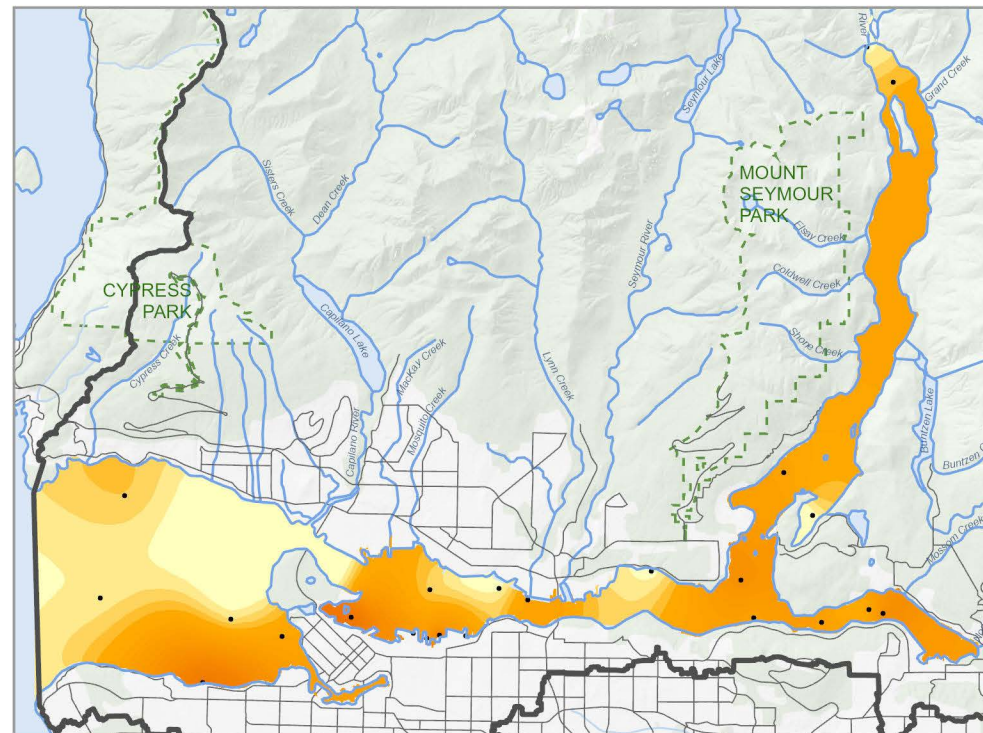
1991-1994



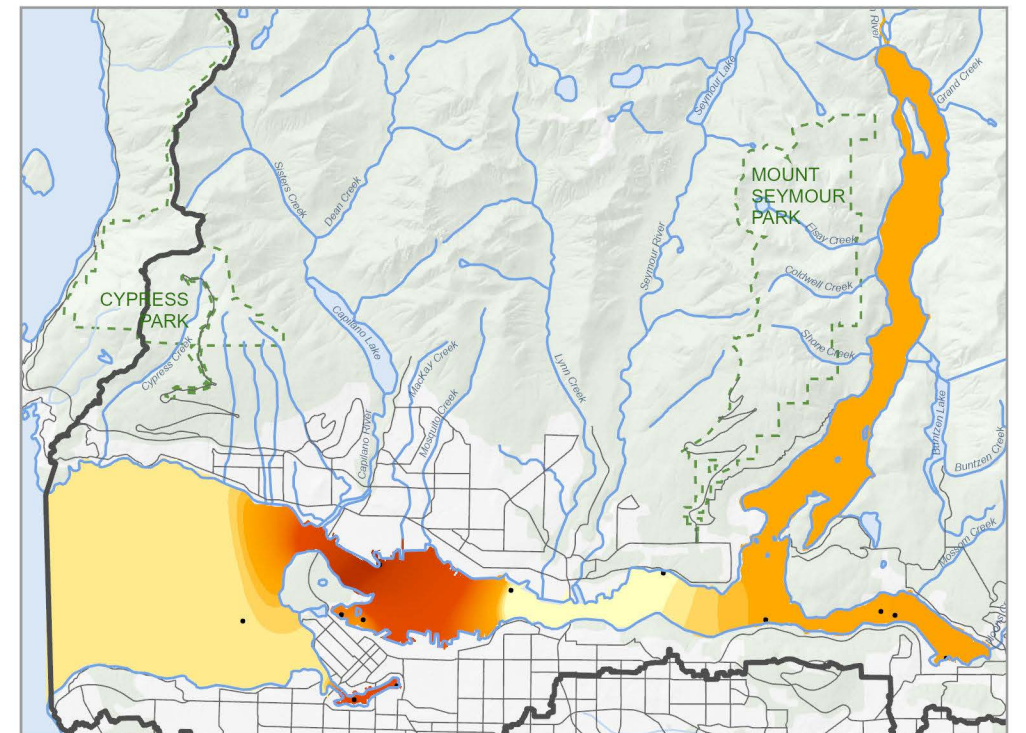
1999-2002



2008-2012



2013-2016



2017-2020

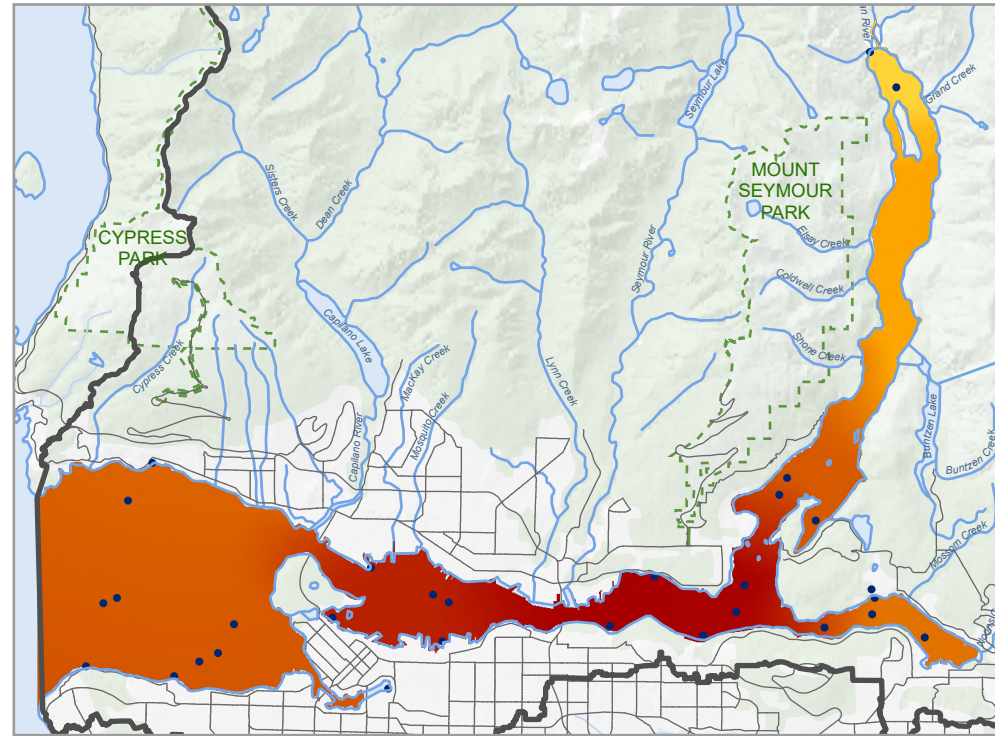
# Heat Map of PCBs in Tissue Samples Collected by All Monitoring Programs

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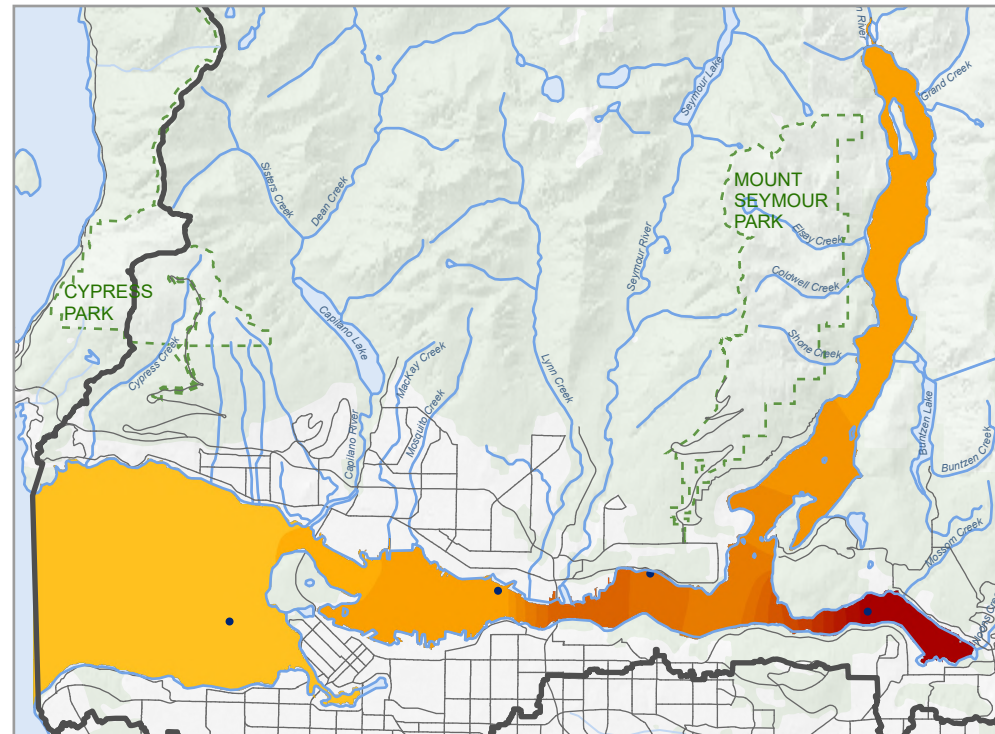
 Burrard Inlet Catchment (Study Area)

• PCB Sample Site

Total PCBs in Tissue ( $\mu\text{g/g}$  wet weight max)



**English Sole (1991-2016)**



**Blue Mussel (2018)**

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



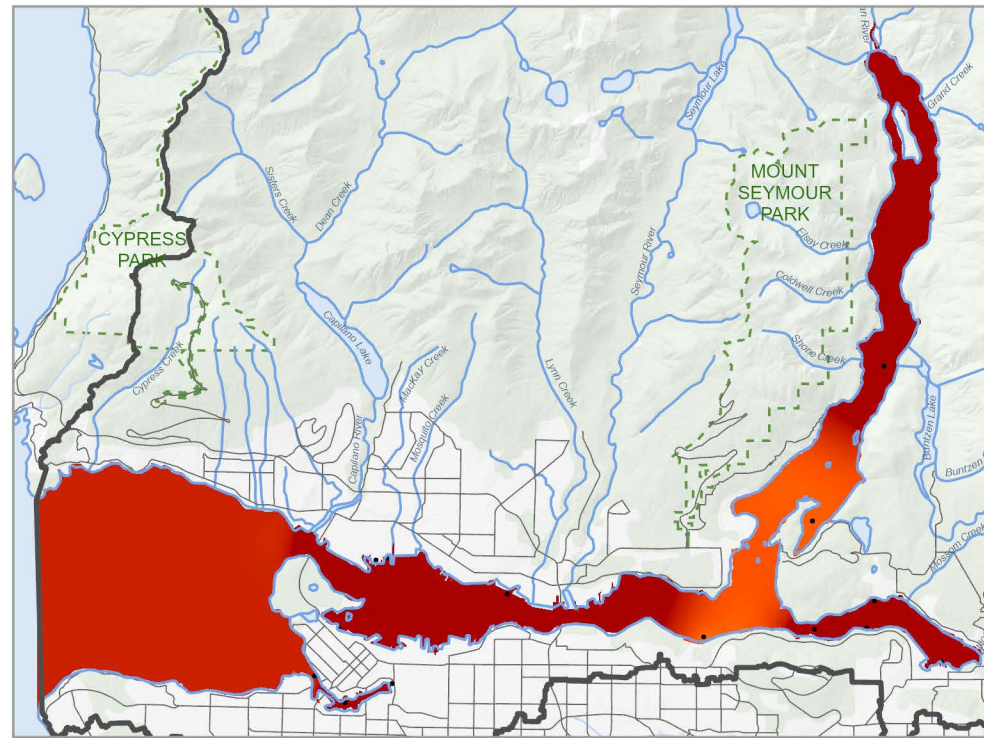
# Heat Map of PCDDs & PCDFs Sediment Samples Collected by All Monitoring Programs

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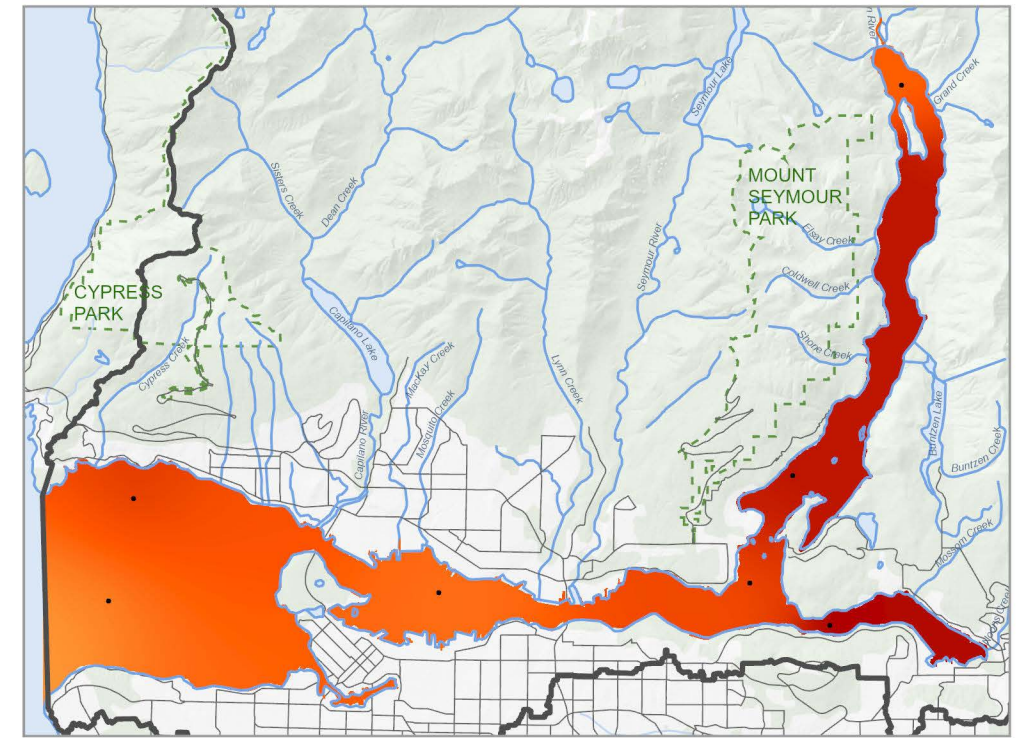
 Burrard Inlet Catchment (Study Area)

• PCDD & PCDF Sample Site

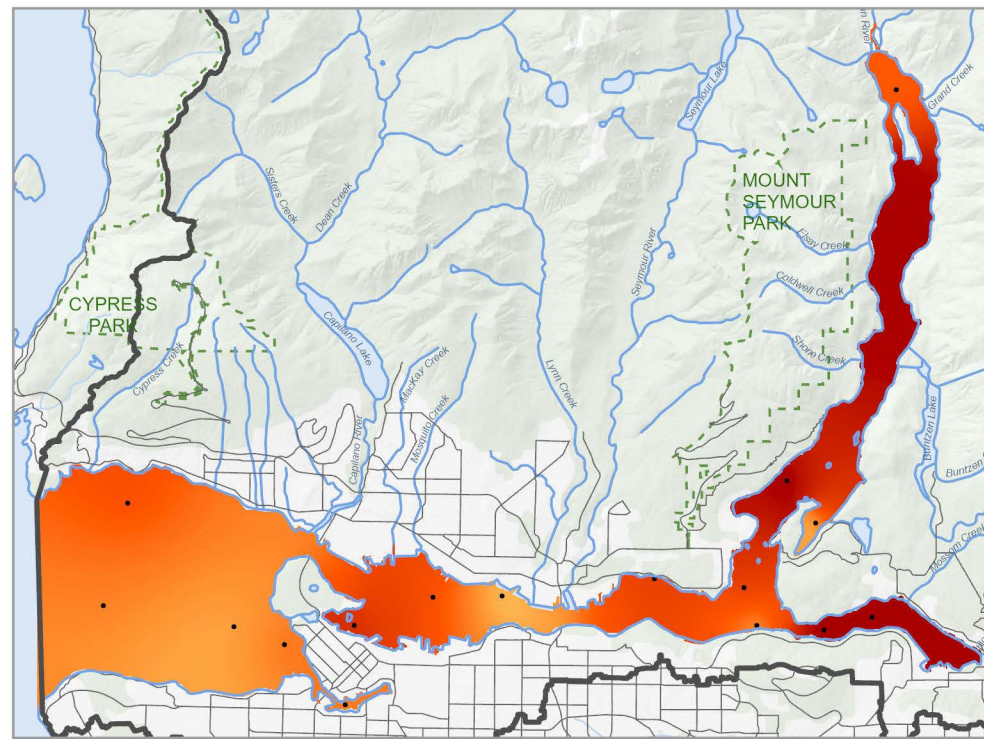
Total PCDDs & PCDFs in Sediment ( $\mu\text{g/g}$  dry weight max)



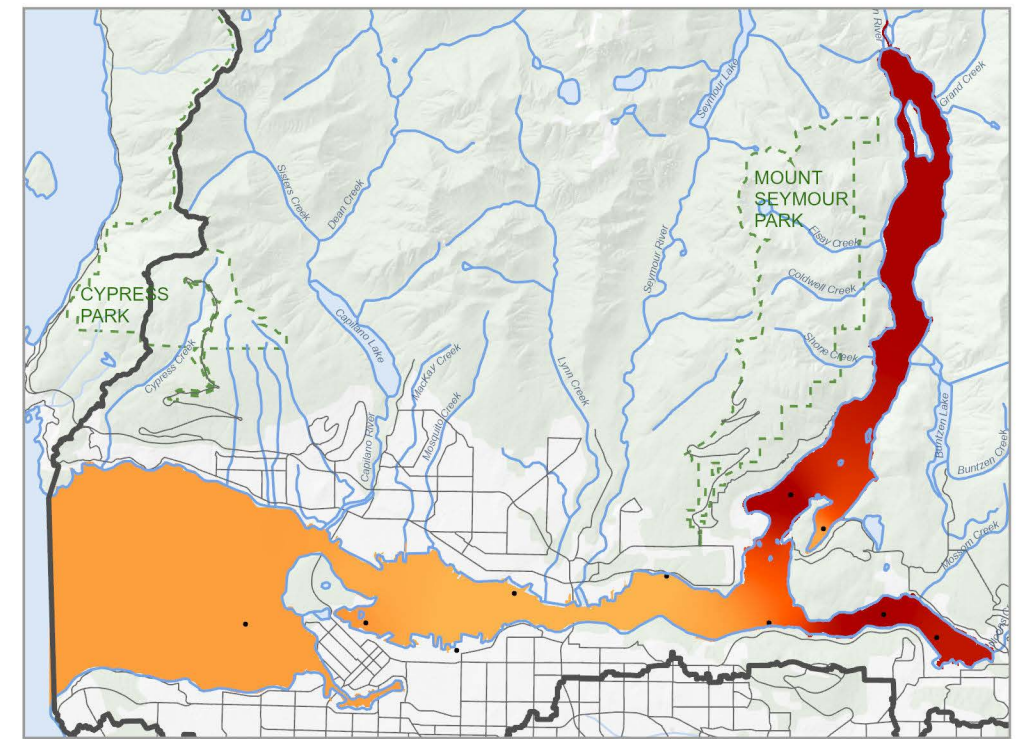
1991



2008-2011



2013-2015



2018-2020

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Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



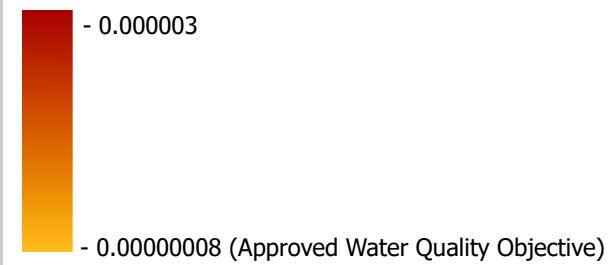
# Heat Map of PCDDs, PCDFs, and Dioxin-like (planar) PCBs in Tissue Samples Collected by All Monitoring Programs

## English Sole (2007-2012)

Please note the data presented on this map may not be complete in all areas

-  Burrard Inlet Catchment (Study Area)
-  PCDD, PCDF, and Dioxin-like (planar) PCB Sample Site

Total PCDD, PCDF, and Dioxin-like (planar) PCB in Tissue ( $\mu\text{g/g}$  wet weight max)

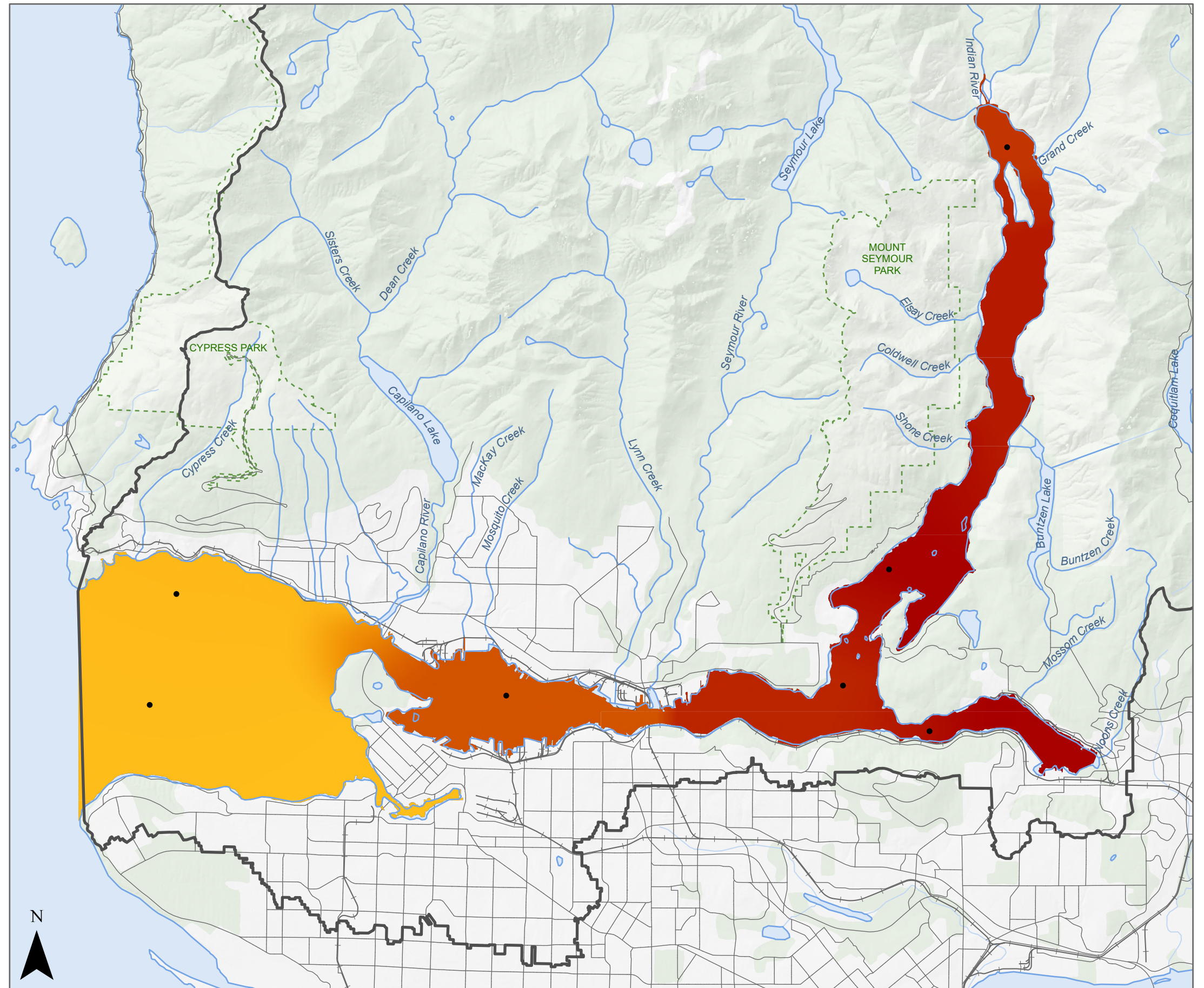


This heat map is based on interpolations from limited data obtained from specific sites, and is for illustrative purposes only. This map should not be used to infer actual values at particular sites. The map was developed through a combination of different interpolation methods in ArcGIS. Values were assigned to cells in between the points at which real data were taken, based on the relationship and distance between sample points, to produce a clean surface/gradient across the map. For more details refer to [desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm](http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm)

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Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam (COC), City of Vancouver (COV), City of Port Moody (CPM), District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL).

Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



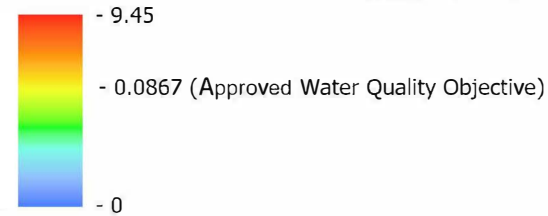
# Heat Map of Phenanthrene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Phenanthrene Sample Site

Total Phenanthrene in Sediment ( $\mu\text{g/g}$  dry weight max)

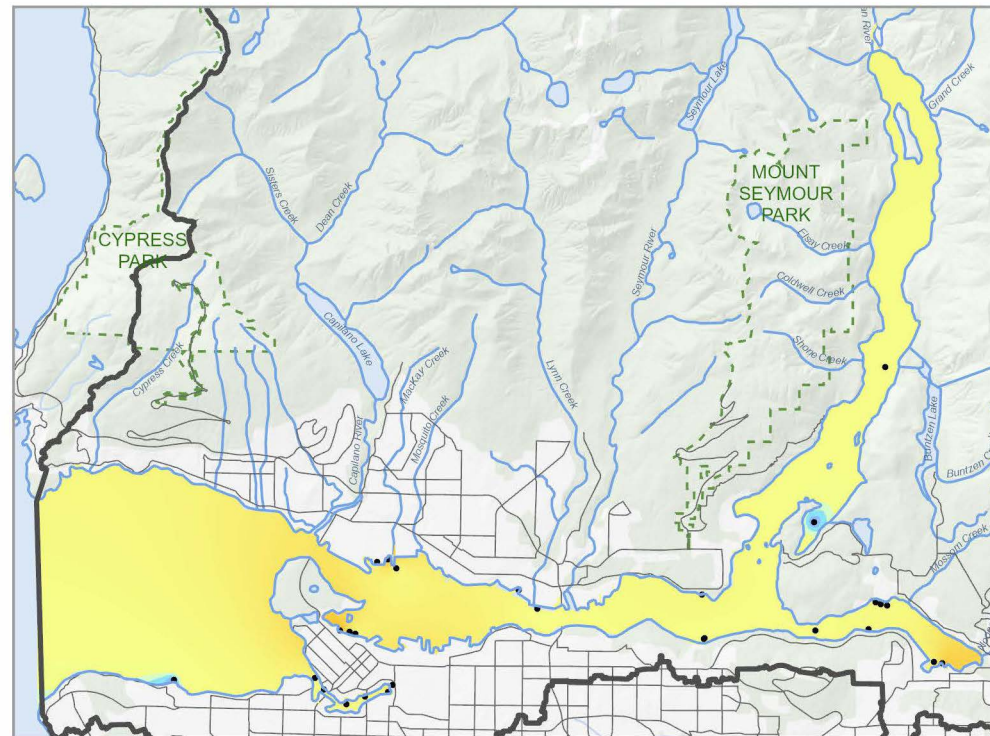


This heat map is based on interpolations from limited data obtained from specific sites, and is for illustrative purposes only. This map should not be used to infer actual values at particular sites. The map was developed through a combination of different interpolation methods in ArcGIS. Values were assigned to cells in between the points at which real data were taken, based on the relationship and distance between sample points, to produce a clean surface/gradient across the map. For more details refer to [desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm](http://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-topo-to-raster-works.htm)

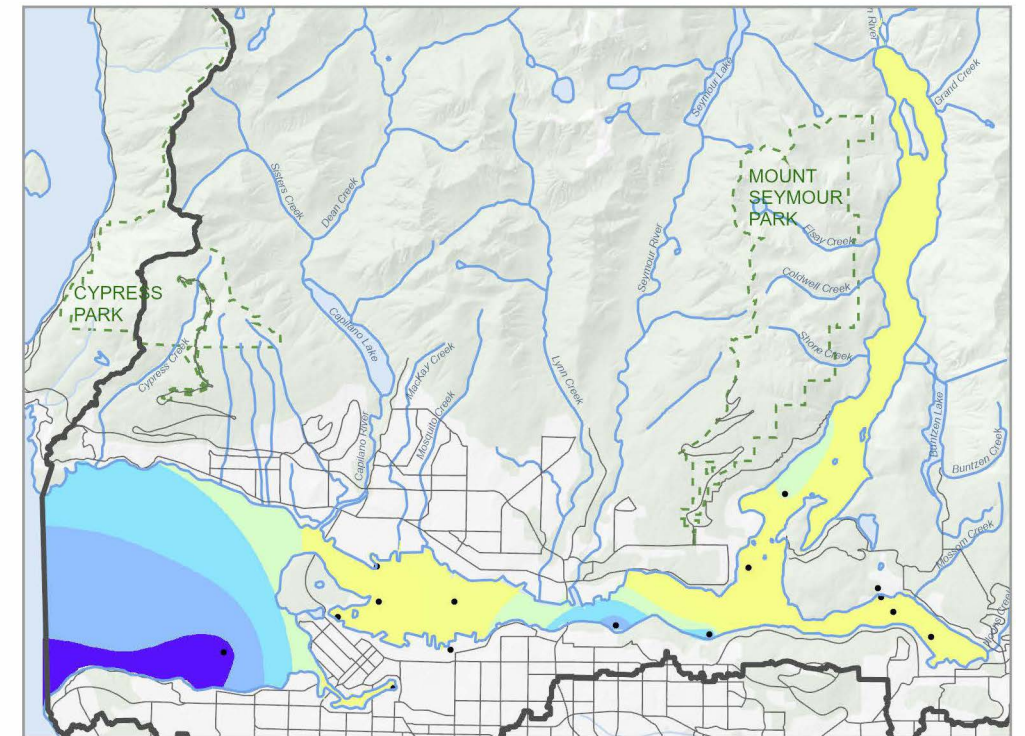
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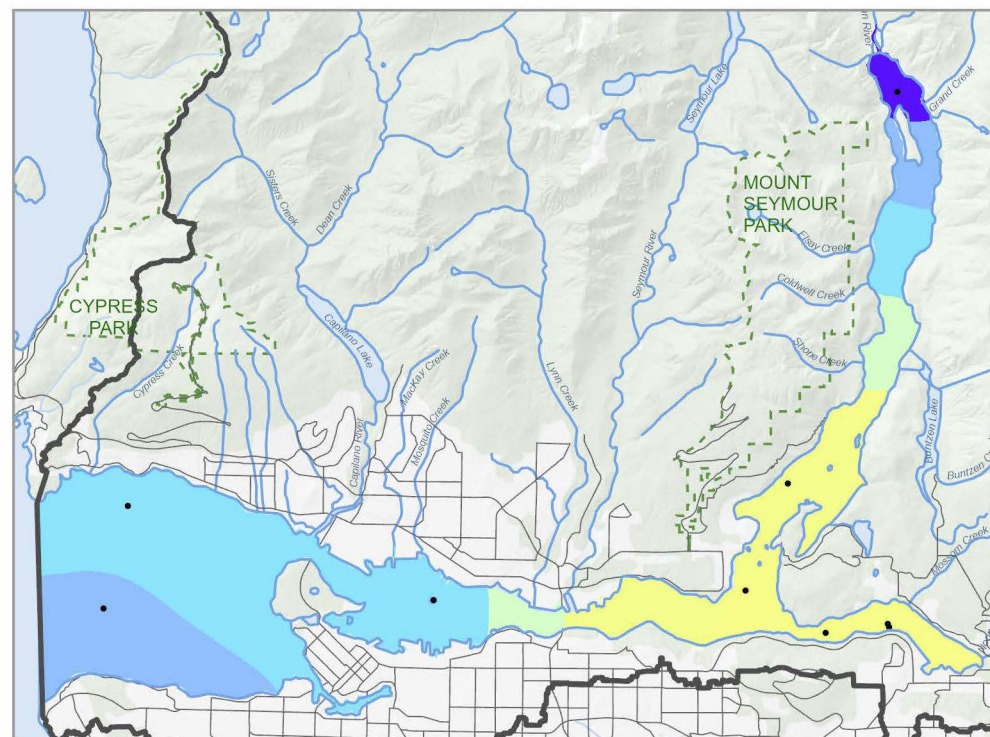
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



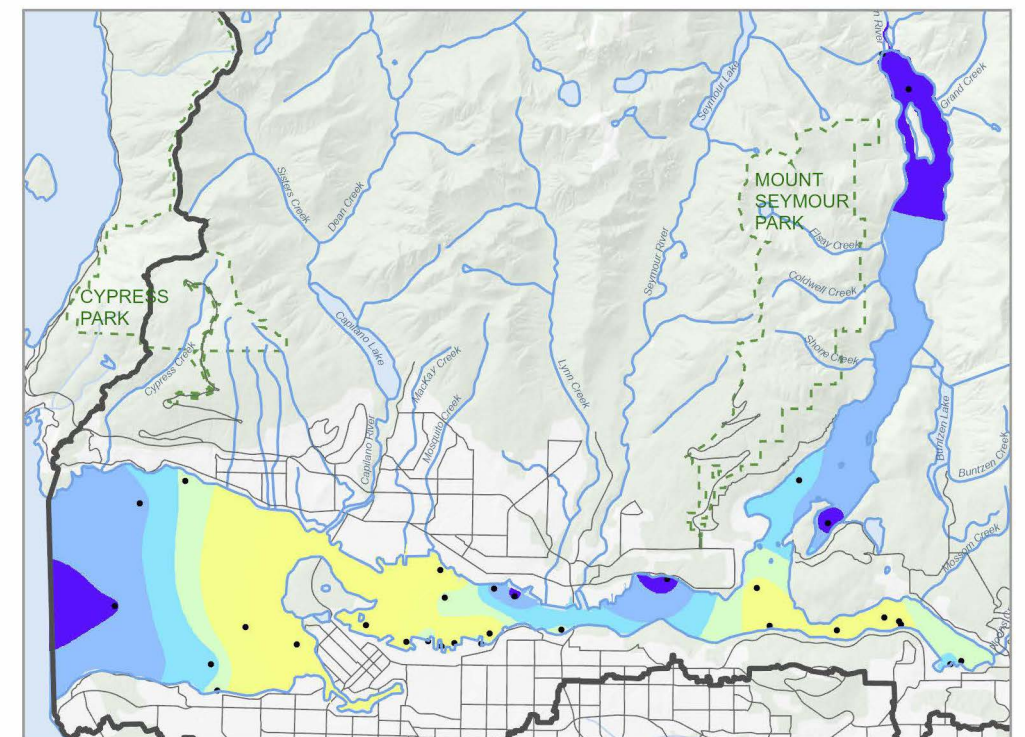
1991-1994



1999-2002




2008-2011



2013-2017

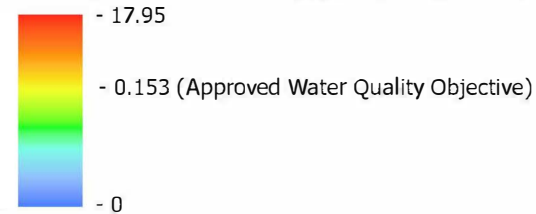
# Heat Map of Pyrene in Sediment Samples Collected by All Monitoring Programs

Please note the data presented on this map may not be complete in all areas

 Burrard Inlet Catchment (Study Area)

• Pyrene Sample Site

Total Pyrene in Sediment ( $\mu\text{g/g}$  dry weight max)

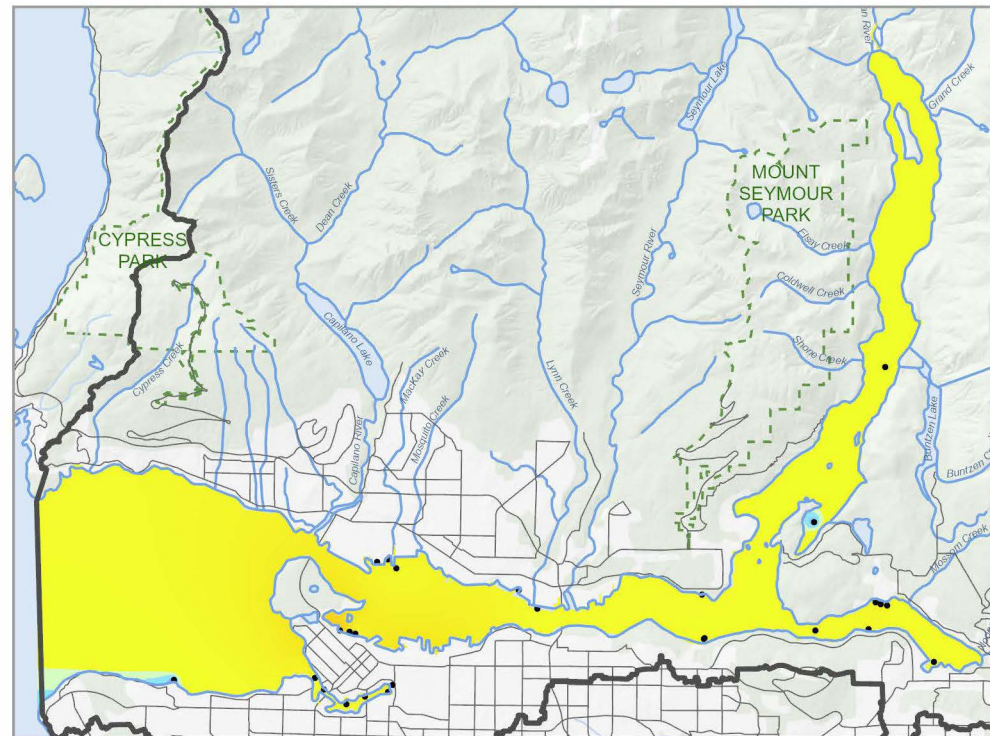


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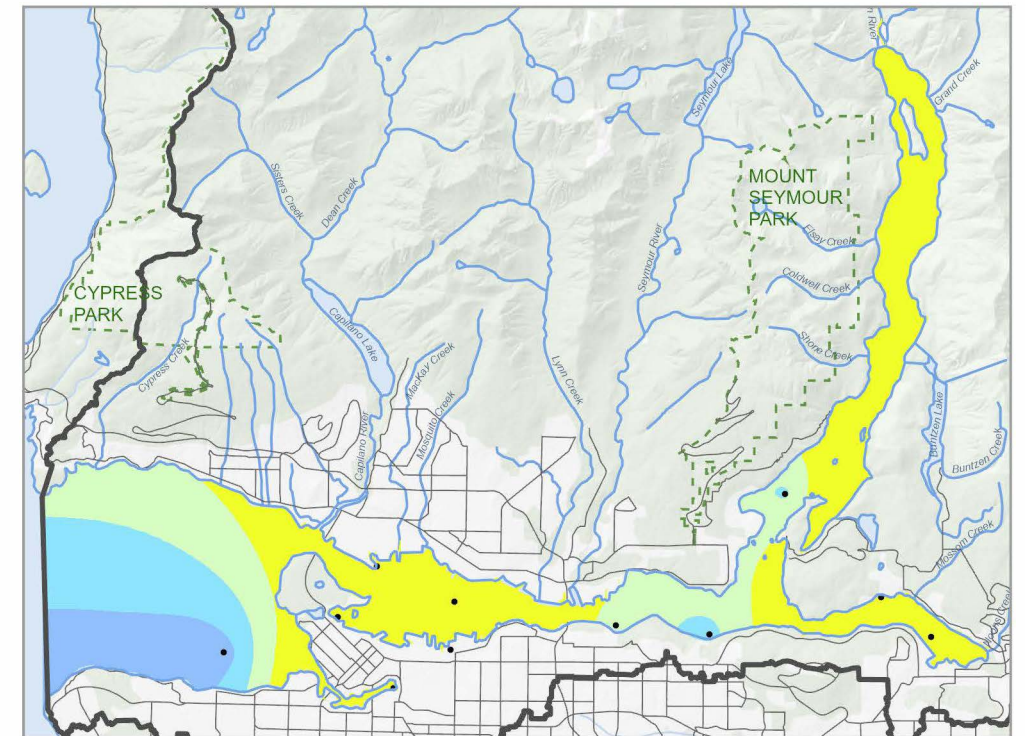
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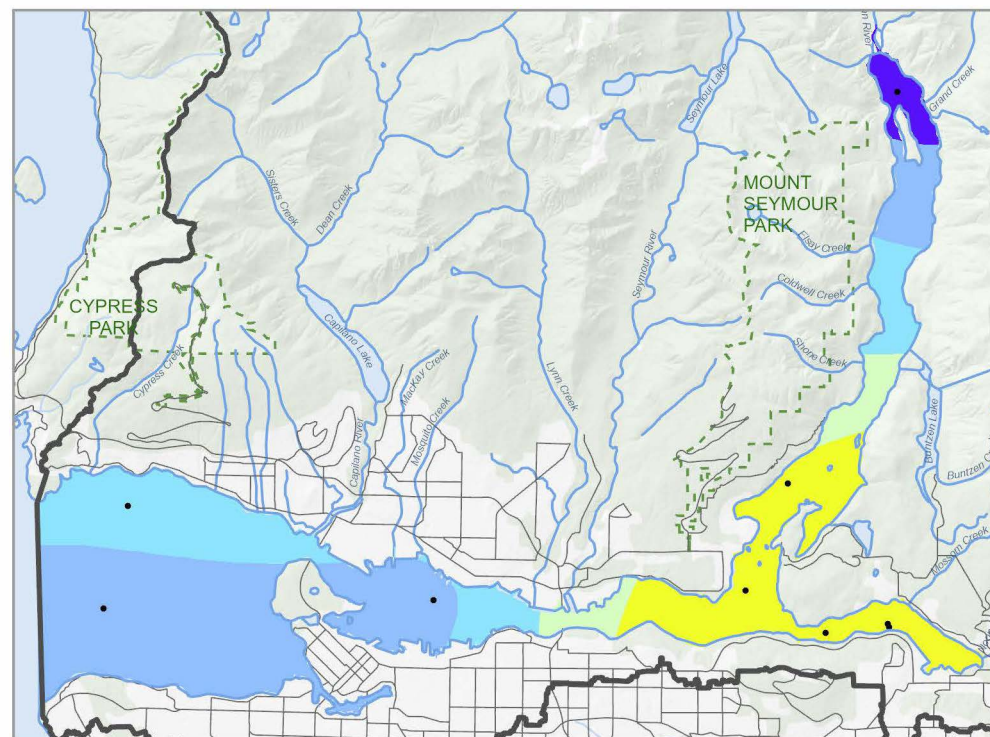
Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).



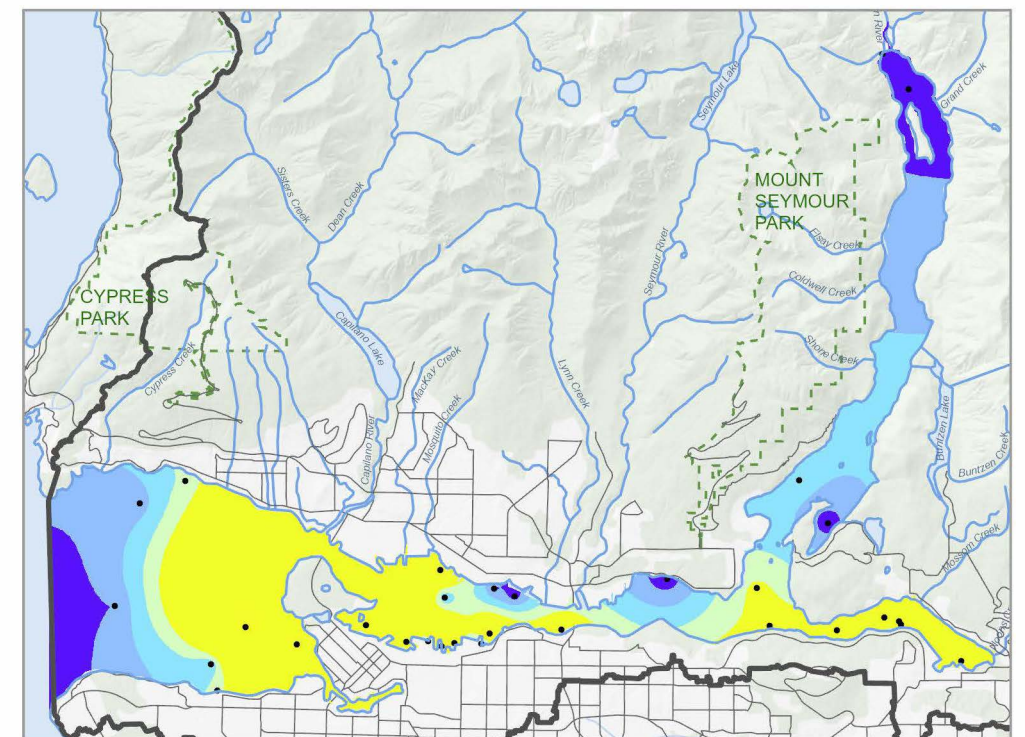
1991-1994



1999-2002

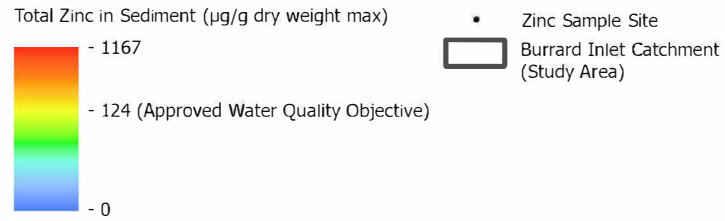


2008-2011



2013-2017

# Heat Map of Zinc in Sediment Samples Collected by All Monitoring Programs



Please note the data presented on this map may not be complete in all areas

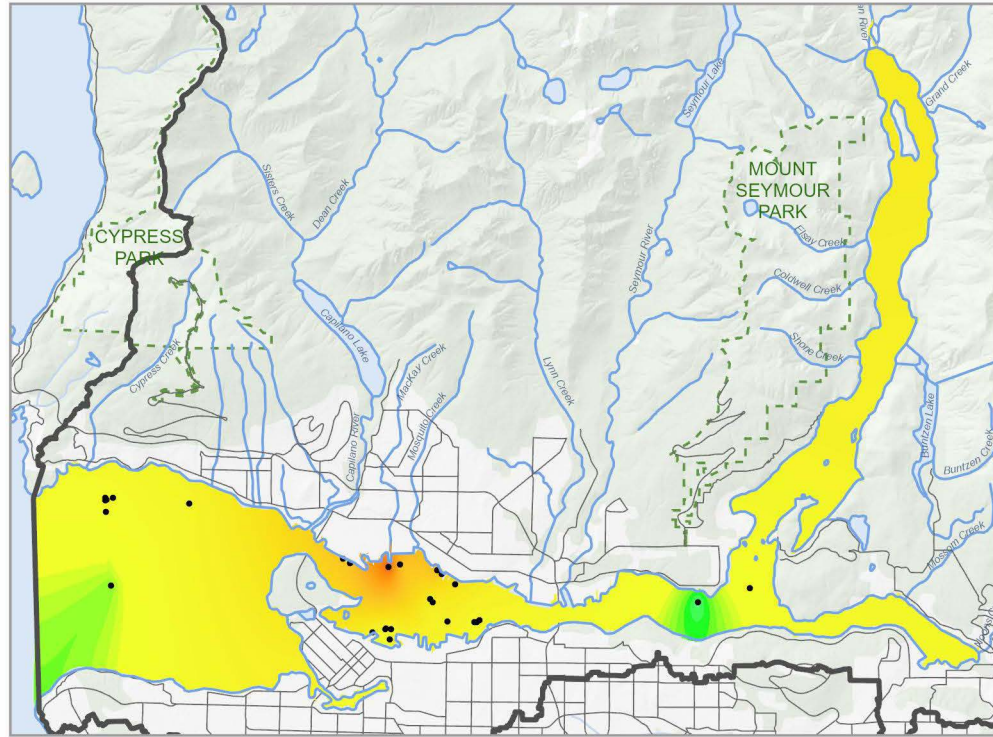
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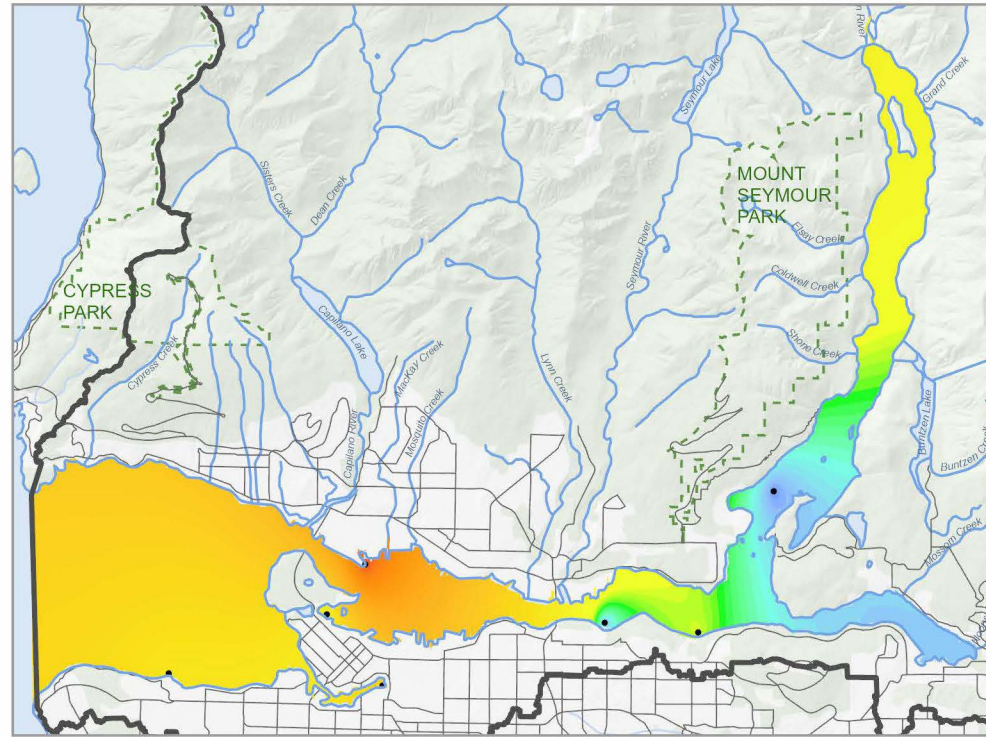
Data Sources for Study Area and Basemap: AECOM, Province of BC (BC), BC Hydro, City of Burnaby (COB), City of Coquitlam

District of North Vancouver (DNV), District of West Vancouver (DWV), Government of Canada (GOC), Kerr Wood Leidal (KWL), (COC), City of Vancouver (COV), City of Port Moody (CPM), Data Sources for Heat Map: Burrard Inlet Environmental Action Program (BIEAP) Environment Quality Objectives and Monitoring Action Team (EQOMAT), BC Ministry of Environment and Climate Change Strategy (ENV), Environment and Climate Change Canada (ECCC), Metro Vancouver (MV), Ocean Wise Pollution Tracker (OW), North Pacific Marine Science Organization (PICES).

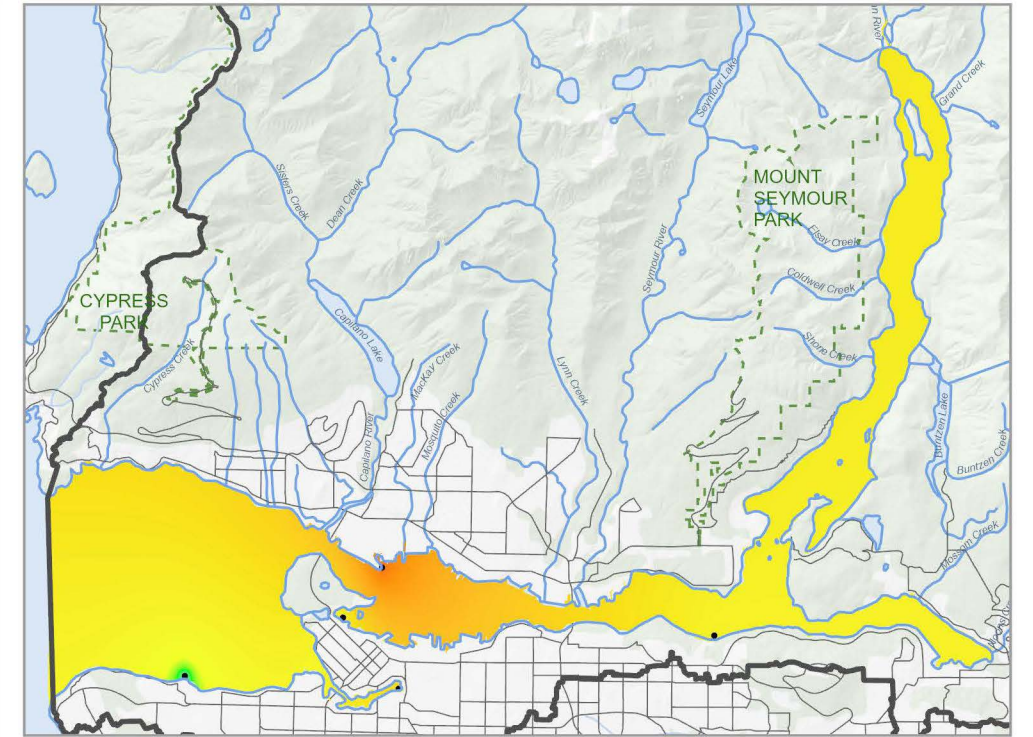
N



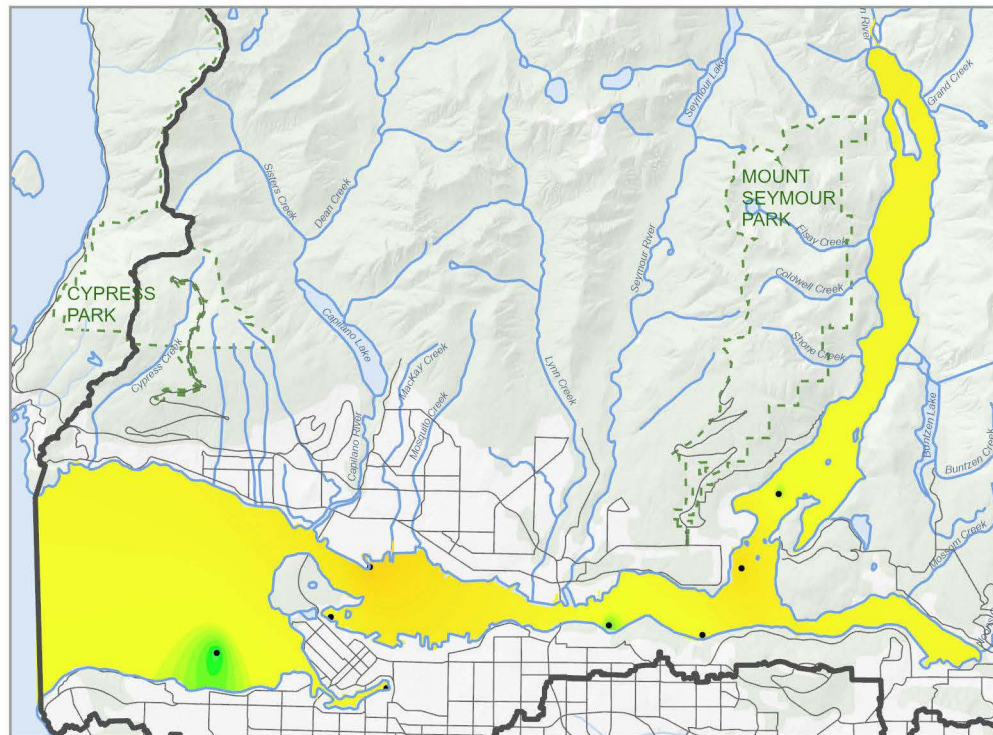
1985-1987



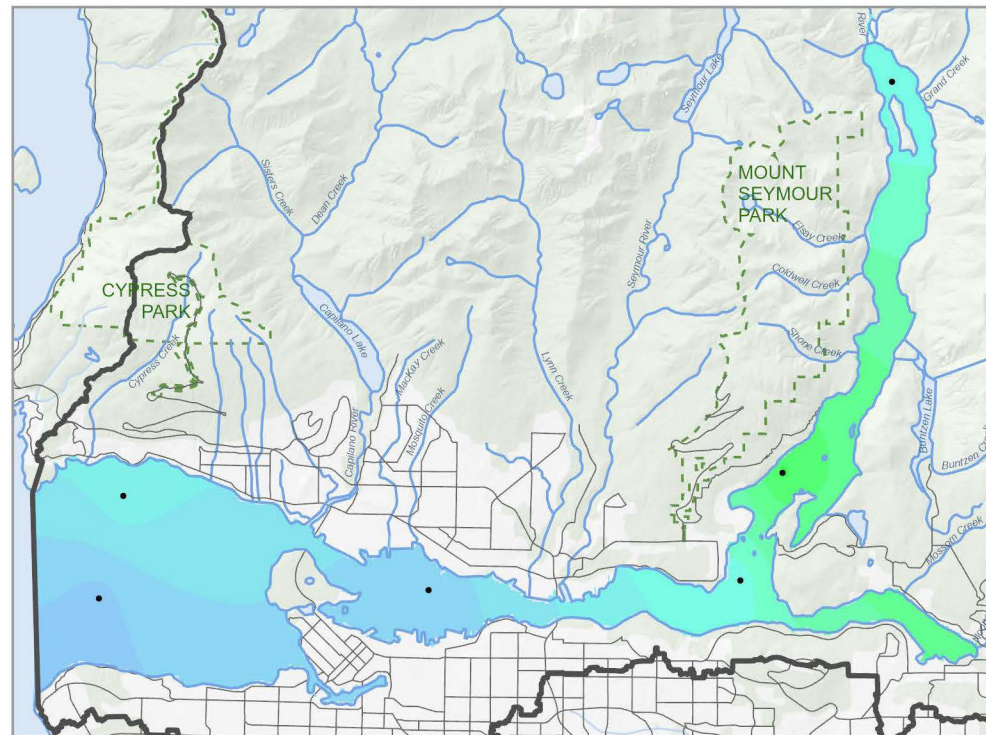
1988-1992



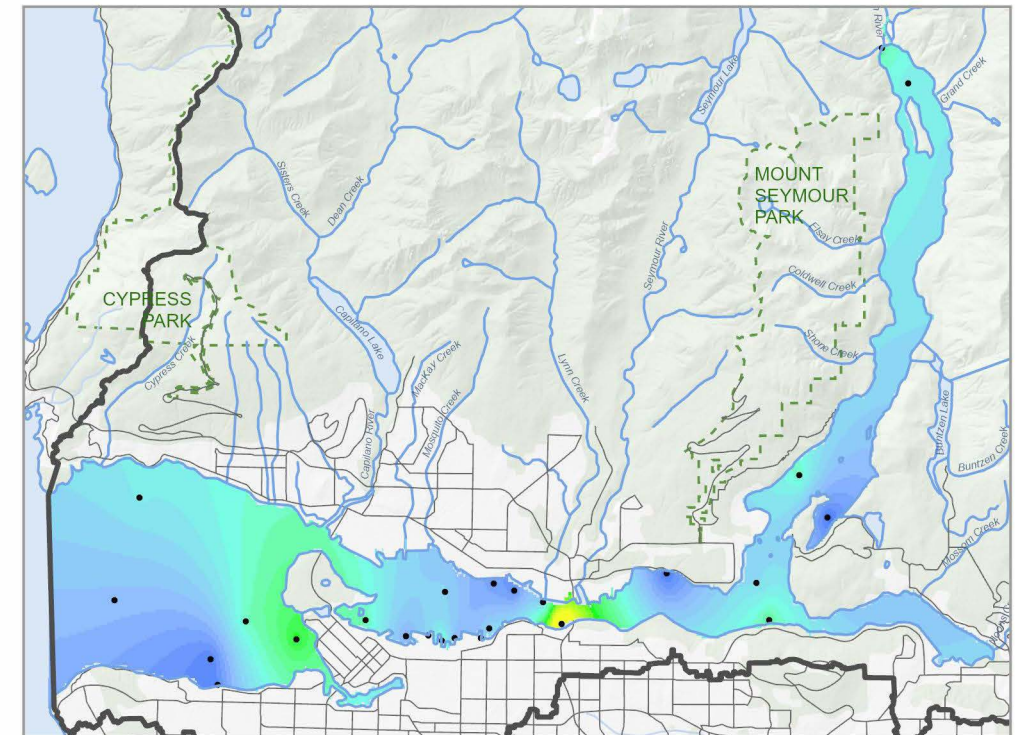
1993-1997



1998-2002



2008-2012



2013-2017