

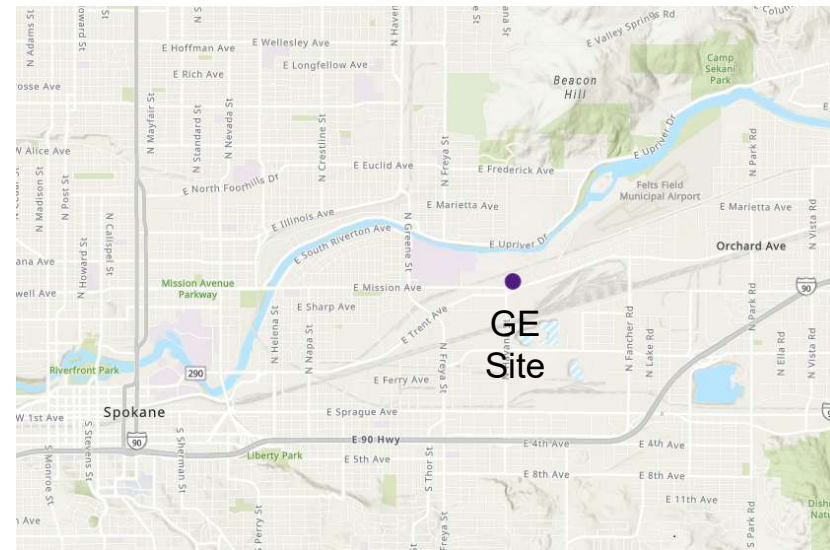
Groundwater and Surface Water Fingerprinting of PCB Data at GE site

**Spokane River Regional Toxics Task Force
Technical Track Work Group
September 21, 2022 Meeting**



Background

- GE has a Superfund NPL site located between Upriver Dam and Greene St.
 - 10 mg/kg cleanup-level for surface soils
 - Groundwater cleanup-level set at PQL
 - 0.1 ug/l → 0.067 ug/l
- EPA developed a scope of work to “ascertain whether the ambient water and biofilm data indicate a release of PCBs to surface water from the GE NPL Site”
 - EPA contractor had a conflict of interest
 - Task Force may be interested in conducting the work



Available Data

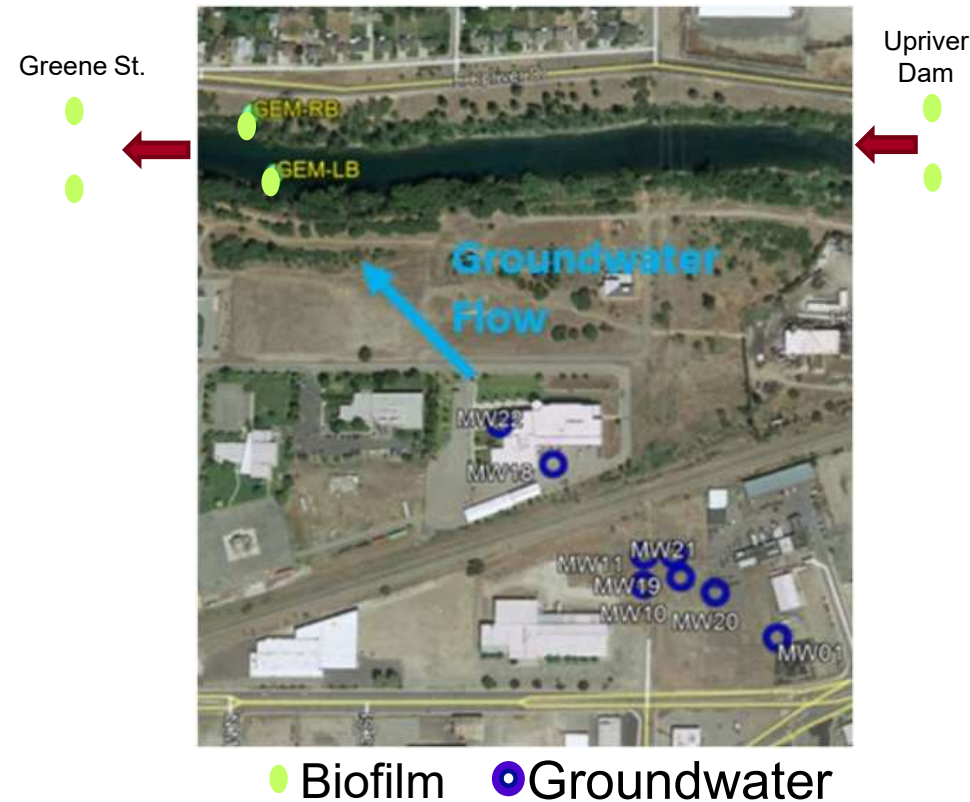
- Groundwater
 - Multiple wells between GE site and river
- Biofilm
 - Immediately downstream: left and right bank



● Biofilm ● Groundwater

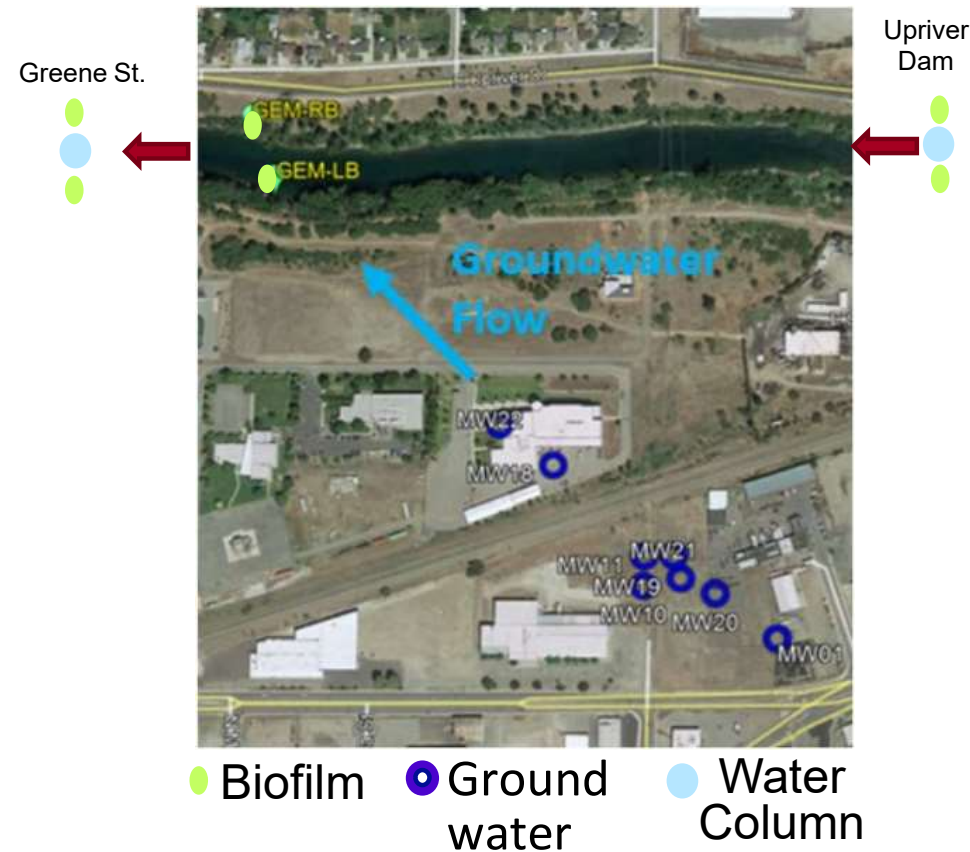
Available Data

- Groundwater
 - Multiple wells between GE site and river
- Biofilm
 - Immediately downstream: left and right bank
 - Far upstream and downstream



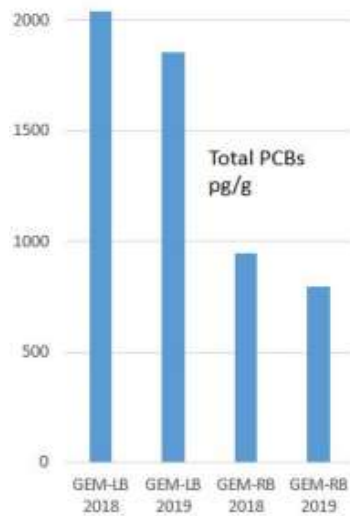
Available Data

- Groundwater
 - Multiple wells between GE site and river
- Biofilm
 - Immediately downstream: left and right bank
 - Far upstream and downstream
- Water column
 - Far upstream: mid-channel
 - Far downstream: mid-channel

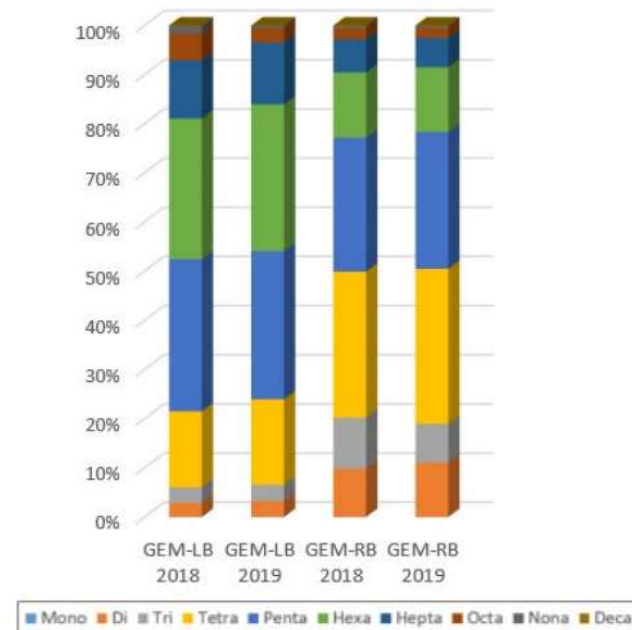


Data Analyses Conducted by Ecology

- Biofilm concentrations are higher on the left bank (i.e., GE side of the river)

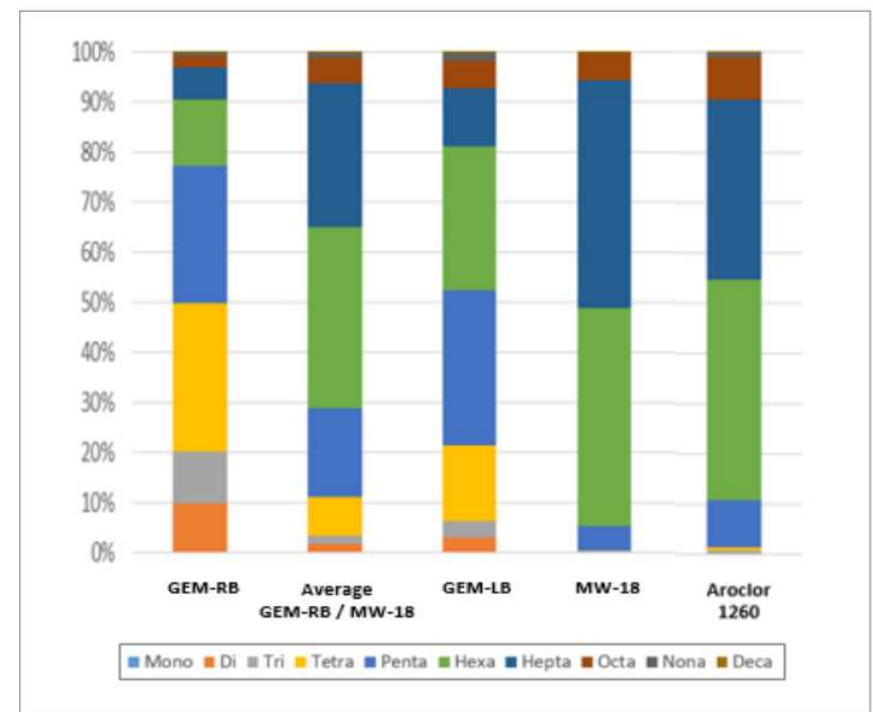


- Homolog distributions appear different between GE left bank and right bank




Data Analyses Conducted by Ecology

- Homolog distributions at GE left bank:
 - are different than GE groundwater
 - appear similar to a mixture of GE groundwater and GE right bank



Task Order As Issued by EPA

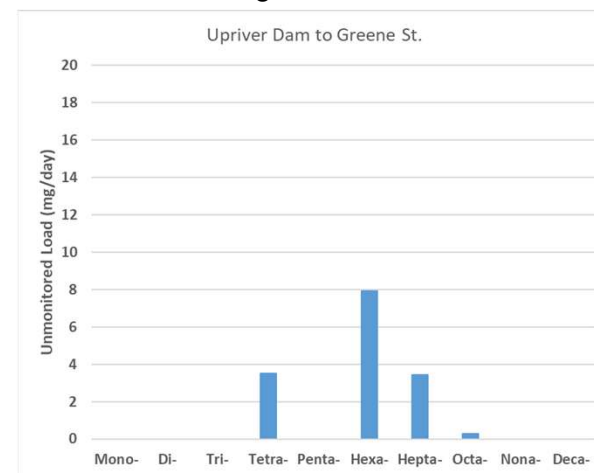
- Ascertain whether the ambient water and biofilm data indicate a release of PCBs to surface water from the GE NPL Site
 - Component steps
 - Perform mass balance on PCB congeners in water upstream and downstream of GE
 - Analyze differences in congener patterns in biofilm data
 - Compare water column and biofilm data to congener data for PCBs in groundwater wells
- 

Perform Mass Balance on PCB Congeners in Water Upstream and Downstream of GE

- Similar to mass balances conducted in past at a homolog level
 - Calculate mass of PCBs at upstream and downstream end of a river reach
 - Assign any calculated difference to “unmonitored” load



2018 Homolog Mass Balance Results



Compare Water Column And Biofilm Data To Congener Data for PCBs in Groundwater Wells

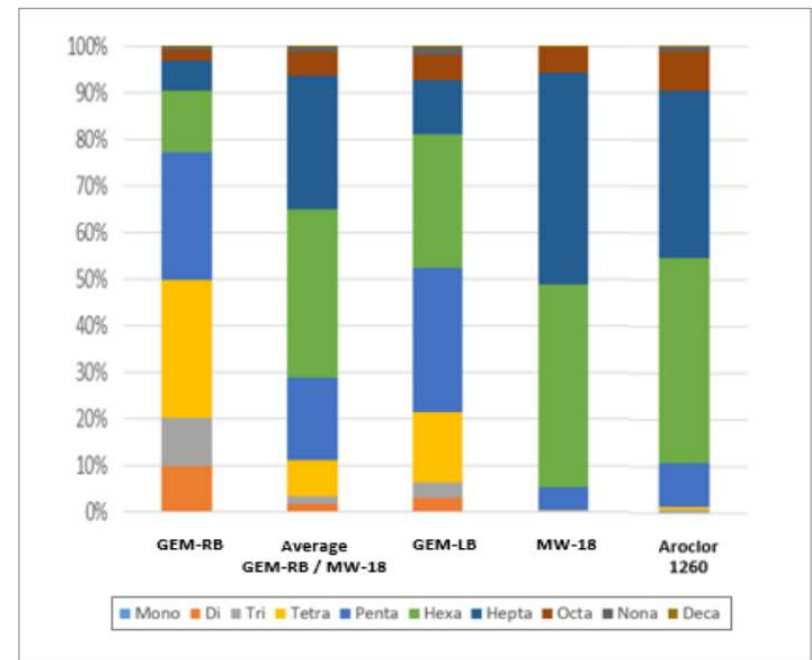
- Two levels of options
 - Cosine theta sample similarity analysis
 - Polytopic vector analysis (fingerprinting)
- Different levels of effort, different benefits

Cosine Similarity Assessment

- Quantitative method for assessing similarity in patterns between two samples
- Cos- θ parameter is similar to a correlation coefficient
 - Ranges from 0 to 1

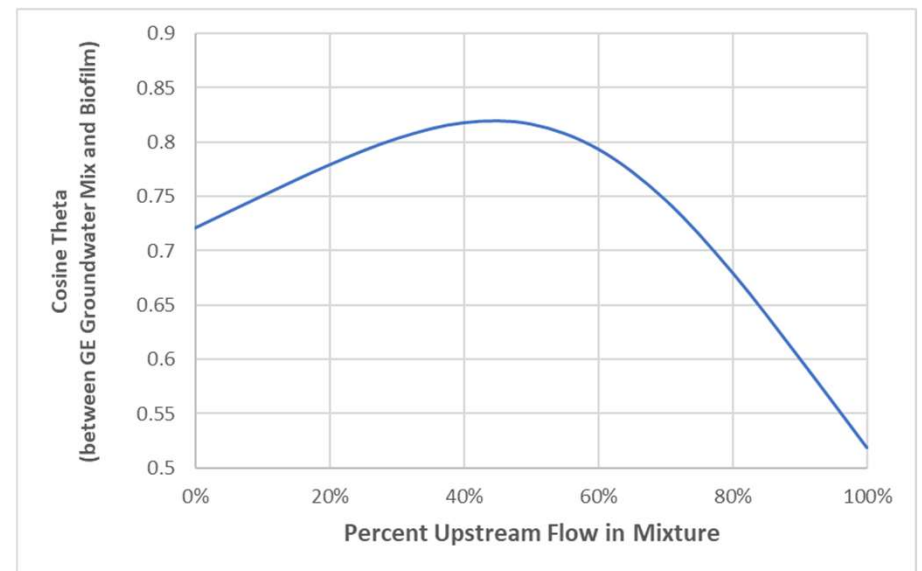
What Do We Get from Cosine Similarity Assessment?

- Can assess similarity between observed congener patterns in biofilm and different assumptions regarding presence of GE groundwater
 - Existing assessment says “biofilm at GE Left Bank looks like some mixture of upstream and GE groundwater”



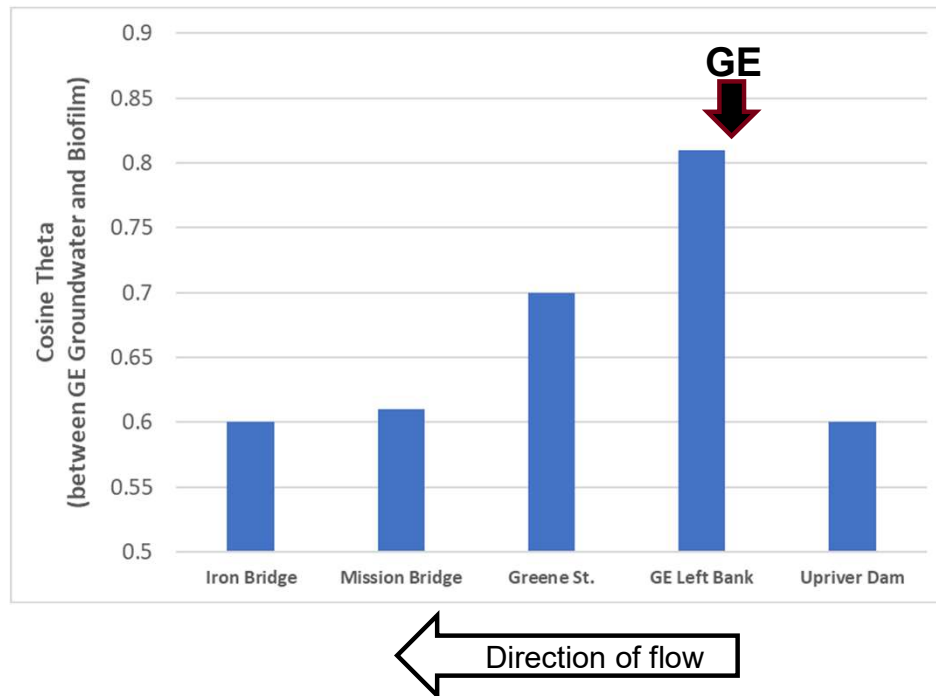
What Do We Get from Cosine Similarity Assessment?

- Can assess similarity between observed congener patterns in biofilm and different assumptions regarding presence of GE groundwater
 - Cosine similarity assessment says “a mixture of 45% upstream and 55% GE groundwater provides the highest similarity to biofilm at GE Left Bank”



What Do We Get from Cosine Similarity Assessment?

- Can roughly assess how long GE groundwater signal persists in biofilm patterns as we move to downstream stations



Polytopic Vector Analysis (PVA)

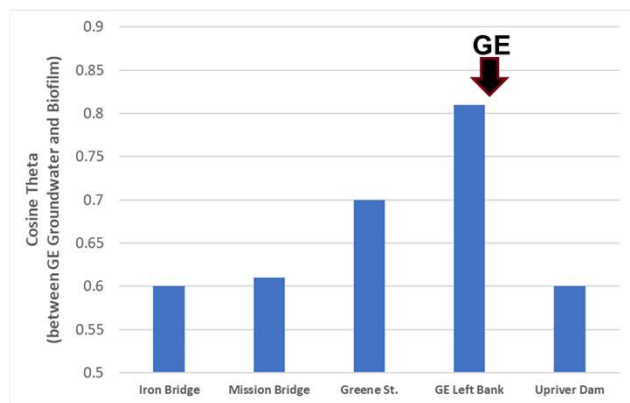
- Same concept as positive matrix factorization (PMF) conducted by Dr. Rodenburg
- “Un-mixes” environmental samples into the original source contributions

What More Do We Get from PVA?

- Potential identification of a signal related to GE groundwater
- More quantitative (and less uncertain) assessment of presence of this signal at GE site and downstream stations
 - Cosine theta analysis is a more semi-quantitative weight of evidence approach

Hypothetical Examples Demonstrating Types of Results Provided by each Method

Cosine Theta



PVA

Station	Do We See a GE Signal?	Portion of Biofilm PCB Contributed by GE
GE Left Bank	Yes	45%
Greene St.	Yes	5%
Mission Bridge	No	-
Iron Bridge	No	-

- Allows for consideration of broader set of sources and processes

Costs for Various Options

- Cosine Theta
 - \$25,000
 - Consistent with EPA-specified level of effort of 178 hours
- Polytopic Vector Analysis
 - \$45,000

Discussion

- Should we prepare a formal scope of work for Task Force approval?
 - If so, at what level of effort?