Potential PCB Atmospheric Loading

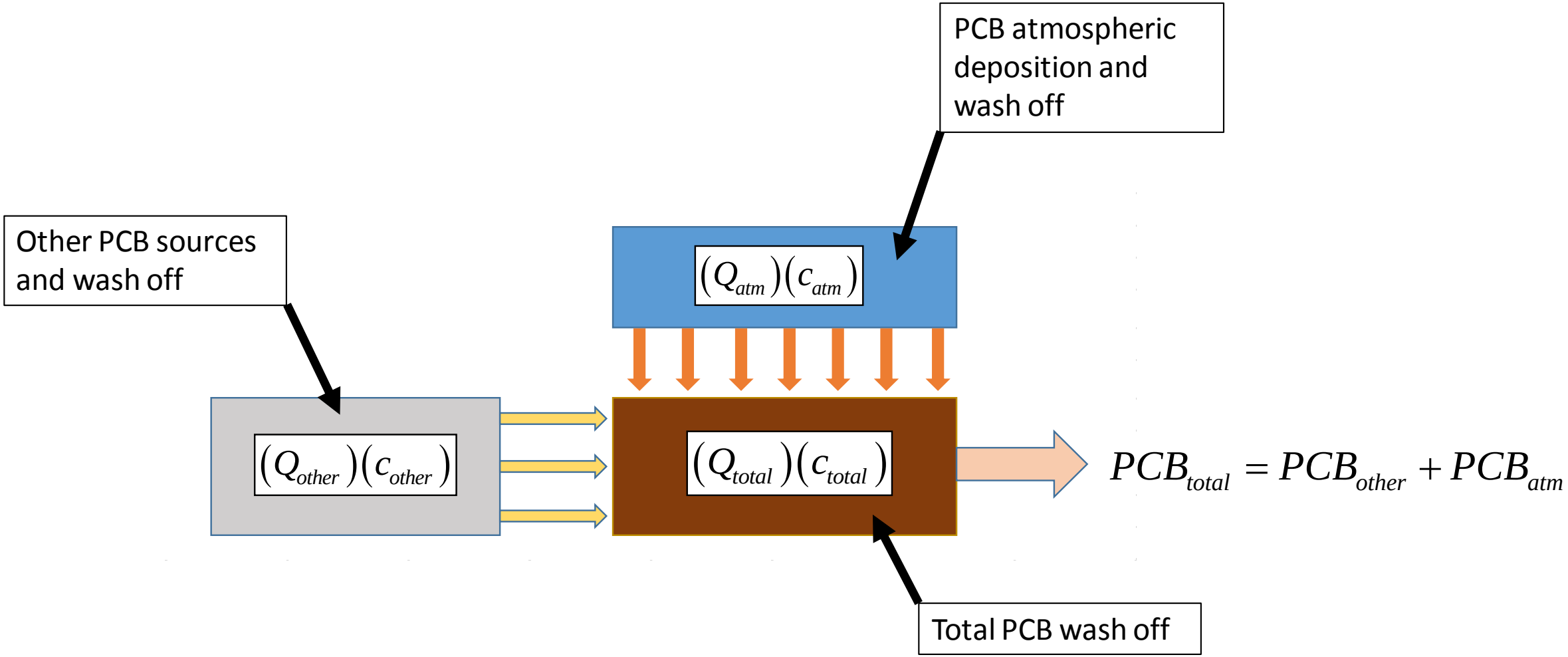
Duwamish Industrial Area

Upper Green River Basin

Potential PCB Atmospheric Loading

- A tool that assesses the relative magnitude of atmospheric PCB mass relative to other PCB mass sources (on the landscape).
- Evaluated within:
  - Duwamish Industrial Area
  - Upper Green River Basin
- Represent typical conditions over the calendar year.
  - annual rainfall
  - Average/median PCB concentrations

Potential PCB Atmospheric Loading



Potential PCB Atmospheric Loading

- Assume all atmospheric (atm) deposited PCB mass is washed off.

$$PCB_{mass}^{atm} = R_{pcb} A T$$

R_{pcb} is [pcb_{mass}/area/time]
A is area
T is elapsed time

- Total PCB mass washed off.

$$PCB_{mass}^{total} = PCB_{total} A d_{rain}$$

PCB_{total} is [pcb_{mass}/Volume]
A is area
d_{rain} is rainfall depth over T

- PCB mass ratio.

$$PCB_{mass}^{atm} \Big/ PCB_{mass}^{total} = R_{pcb} T \Big/ PCB_{total}\, d_{rain}$$

Ratio of atm PCB mass to the total PCB mass

Potential PCB Atmospheric Loading

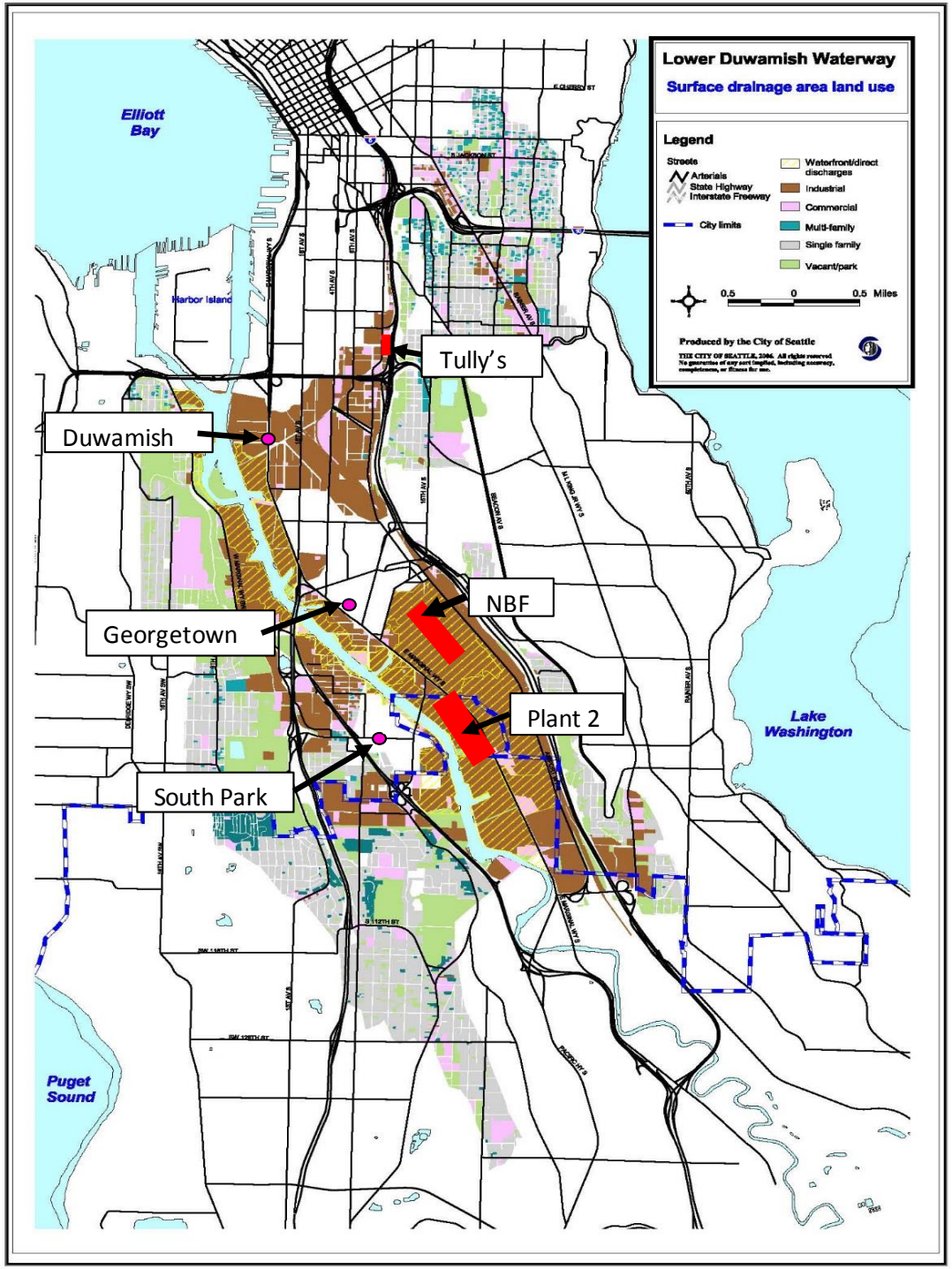
Duwamish Industrial Area

Four Basins:

- South Park
- Tully's/Brewery
- North Boeing Field (NBF)
- Plant 2

Three atm PCB sample sites:

- Duwamish
- Georgetown
- South Park



Potential PCB Atmospheric Loading
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- Basin Data.

Basin	Total Suspended Solids (mg/L)	Suspended Solids PCB Concentration (ug/kg)	Estimated Total Water PCB Concentration (ng/L)
South Park	81	190	85
Plant 2	81	4,500	2022
NBF	82	8,400	3821
Tully's/Brewery	81	757,500	340331
Seattle Public Utilities, 2007.			

- Atm Data.

Site	Date	PCB Mass Flux (ng/m^2-day)
Duwamish	4/25/13	6.86
	5/9/13	56.1
	8/1/13	2.87
	10/31/13	17.2
	11/14/13	20.9
Georgetown	4/25/13	67.9
	5/9/13	204
	8/1/13	37.0
	10/31/13	81.0
	11/14/13	9.68
South Park	4/25/13	9.68
	5/9/13	11.6
	8/1/13	5.76
	10/31/13	28.0
	11/14/13	85.8
Average		43.0
Median		20.9
95th CI of Median		67.9
King County, 2015.		

Potential PCB Atmospheric Loading
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- PCB mass ratios.

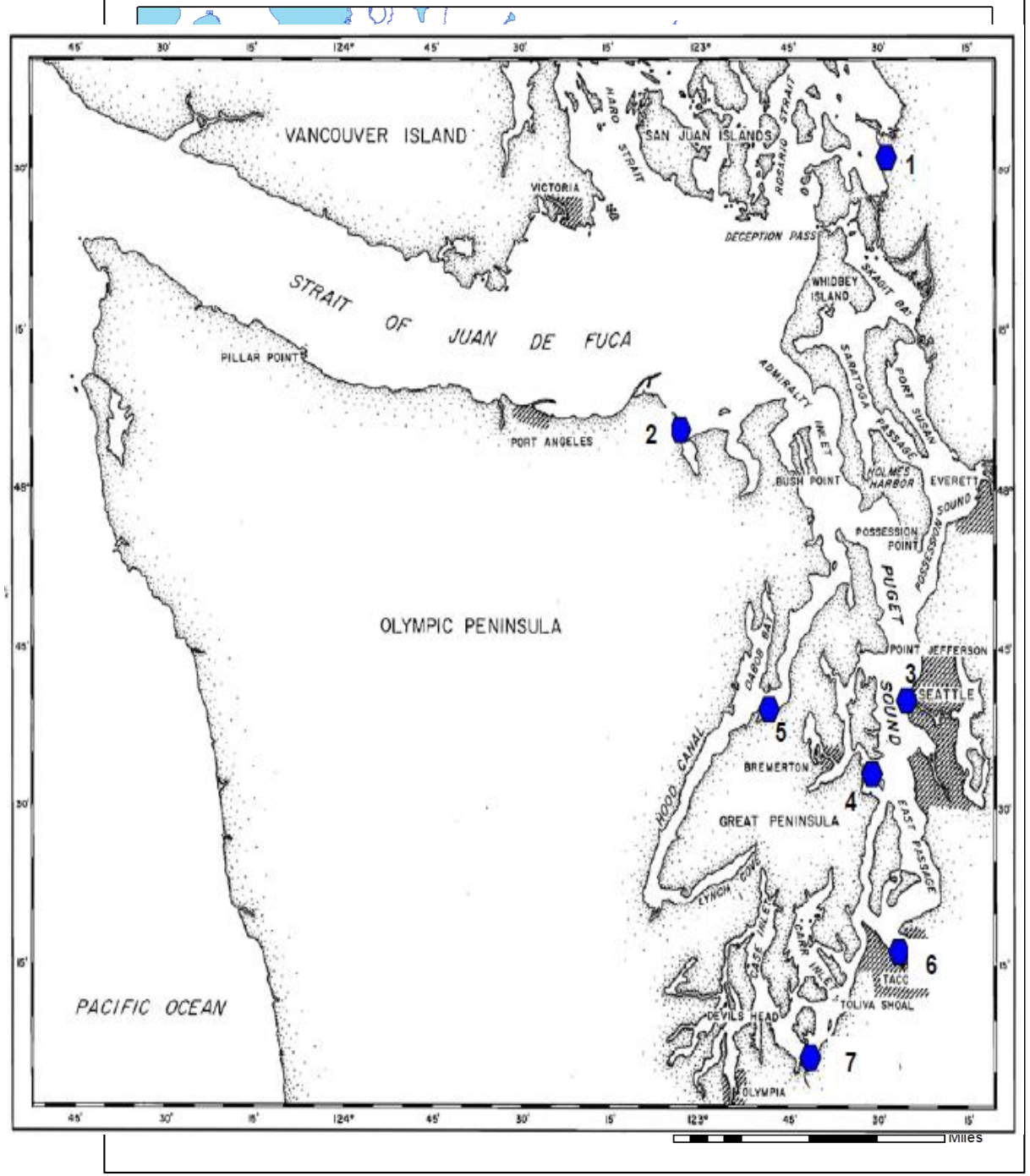
Stormwater Basin	Estimated Total Water PCB Concentration (ng/L)	PCB mass ratio PCB_{atm}/PCB_{total} R_{pcb}=21 (ng/m^2-day) Median	PCB mass ratio PCB_{atm}/PCB_{total} R_{pcb}=68 (ng/m^2-day) 95th CI of Median
South Park	85	9%	30%
Plant 2	2022	0.4%	1%
NBF	3821	0.2%	0.7%
Tully's/Brewery	340331	0.002%	0.008%

- Total PCB if Atmospheric PCB is only pathway.

R_{pcb} (ng/m^2/day)	Annual Average Atmospheric PCB Loading Concentration (ng/L)
21	8

Potential PCB Atmospheric Loading Upper Green River Basin

- Two river sample sites:
  - SC319
  - UG319
- Seven regional PCB sample sites:
  - 1-Padilla Bay
  - 2-Sequim Bay
  - 3-West Point
  - 4-Manchester
  - 5-Hood Canal
  - 6-Tyee Marina
  - 7-Nisqually River



Potential PCB Atmospheric Loading Upper Green River Basin

- Stream Data

Field Site	Flow Condition	FOD	Min (ng/L)	Max (ng/L)	Average (ng/L)	Median (ng/L)
Upper Green-RM 85 (UG319)	Base	3/3	0.012 J	0.023 J	0.018 J	0.020 J
	Storm	3/3	0.018 J	0.10 J	0.054 J	0.044 J
Sunday Creek-RM 82 (SC319)	Base	3/3	0.013 J	0.04 J	0.022 J	0.02 J
	Storm	3/3	0.02 J	0.055 J	0.039 J	0.042 J

FOD is frequency of detection.
J – Estimated value.
King County, 2018

- Atm Data

Location	PCB Mass Flux (ng/m^2-day)
Hood Canal	0.24
Nisqually R.	0.64
Padilla Bay	0.40
Port Orchard	0.39
Sequim Bay	0.32
Tyee Marina	0.45
West Point	0.57
Median	0.40

Department of Ecology, 2010.

Potential PCB Atmospheric Loading
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- Total PCB concentration assuming 100% wash off.

Atmospheric PCB Flux	R_{pcb} (ng/m^2-day)	Annual Average Rainfall Depth (in)	Annual Average Atmospheric PCB Loading Concentration (ng/L)	Stream Data (ng/L)
Regional	0.4	80	0.071	0.02-0.044

Potential PCB Atmospheric Loading
Summary

- Duwamish Industrial Area
  - For a given R_{pcb}, PCB_{atm}/PCB_{total} mass ratio depends on the total PCB concentration from a particular site.

$$\frac{R_{pcb}T}{PCB_{total}\ d_{rain}} = \frac{\left(R_{pcb}/I_{rain}\right)}{PCB_{total}}$$

I_{rain} is d_{rain}/T

- Upper Green River Basin
  - The potential total PCB water concentrations is 0.071 (ng/L); measured stream PCB concentrations were 0.02-0.044 (ng/L).

References:

- King County, 2015. Lower Duwamish Waterway Source Control: Supplemental Bulk Atmospheric Deposition Study Final Data Report.
- King County, 2018. Lower Duwamish Waterway Source Control: Upper and Middle Green River Surface Water Data Report. Jan. 2015, Revised Feb. 2018.
- Department of Ecology, 2010. Control of Toxic Chemicals in Puget Sound, Phase 3: Study of Atmospheric Deposition of Air Toxics to the Surface of Puget Sound. Publication No. 10-02-012.
- Seattle Public Utilities, 2007. Lower Duwamish Waterway, Lateral Load Analysis for Stormwater and City-Owned CSOs.