Spokane County Regional Water Reclamation Facility (SCRWRF)

Source Identification and Apportionment by Homolog and PMF Analysis

- **Purpose:** Identify signatures of dominant sources to facilitate identification, prioritization, and removal of sources.
- **Problem:**
  - Aroclors and inadvertently generated PCBs are a unique mixture of PCB congeners.
  - Sources can be several Aroclors and other inadvertent PCBs mixed together creating another unique mixture of PCB congeners.
  - Samples that we collect contain multiple sources at different magnitudes creating yet another unique mixture of PCB congeners.
- **Question:** Is it possible to trace back from samples to the original source and Aroclor or inadvertently generated PCB?
- **Approach:** County used two approaches to evaluate patterns in our data – homolog analysis and congener analysis with Positive Matrix Factorization.

Homolog Analysis – Groups of Congeners

SCRWRF – Influent (NVI & SVI) and Effluent

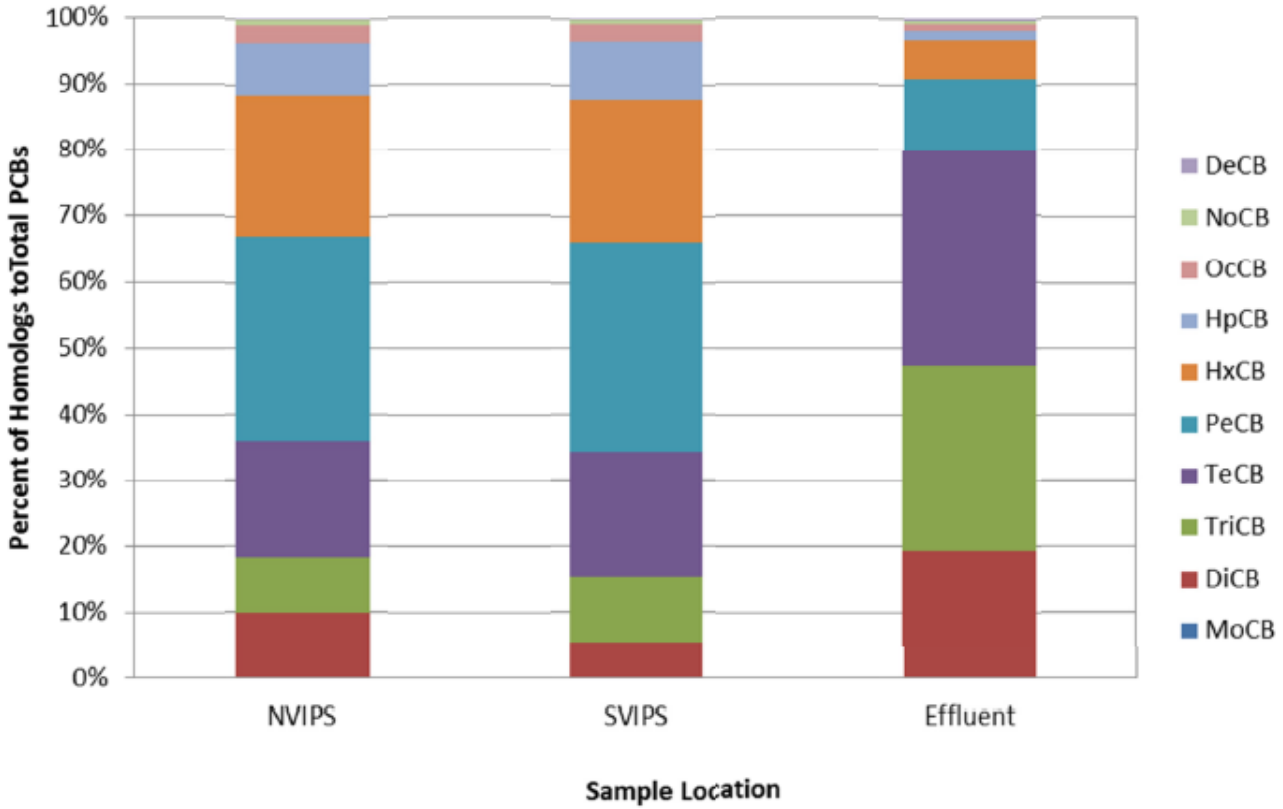

Figure 2-15. Comparison of PCB homolog composition for each sample type

The amount of each homolog was compared to the total PCB concentrations.

Influent and Effluent Samples

- Observations:
  - Influent has a broad spectrum of homologs.
  - Interceptors have similar homolog profiles.
  - Effluent contains primarily low molecular weight homologs.
  - Facility is more effective at removing higher-molecular weight congeners.

PMF Analysis – Congener Specific

118 Samples

- Effluent Samples
- Influent Samples
- Dish-Mica Basin Samples
- NVI Basin Samples

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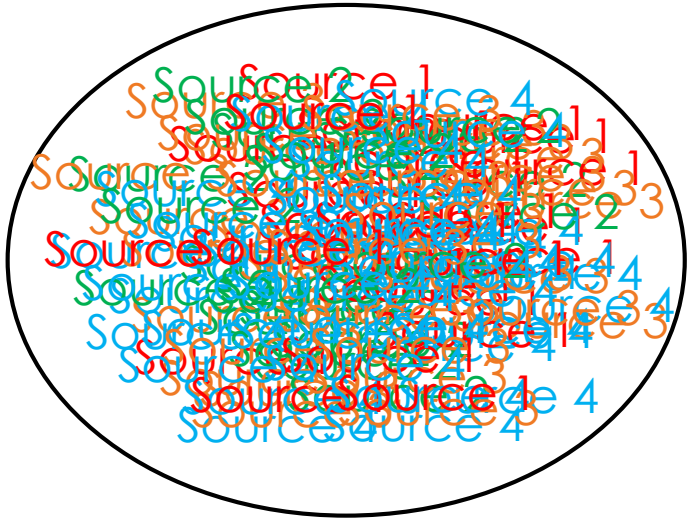

PMF Analysis

Factors

Source 1
Source 2
Source 3
Source 4

- A data set of all samples from the system is created.
- PMF is conducted on the system wide data set
- A congener profile for each source is identified, called a Factor

6 Factors within County Sanitary Sewer System

- Factor 1 – dissolved phase
- Factor 2 – Aroclor 1248 + mixture
- Factor 3 – PCB 11
- Factor 4 – weathered Aroclor 1254
- Factor 5 – Aroclor 1254
- Factor 6 – Aroclor 1260 + low MW congeners

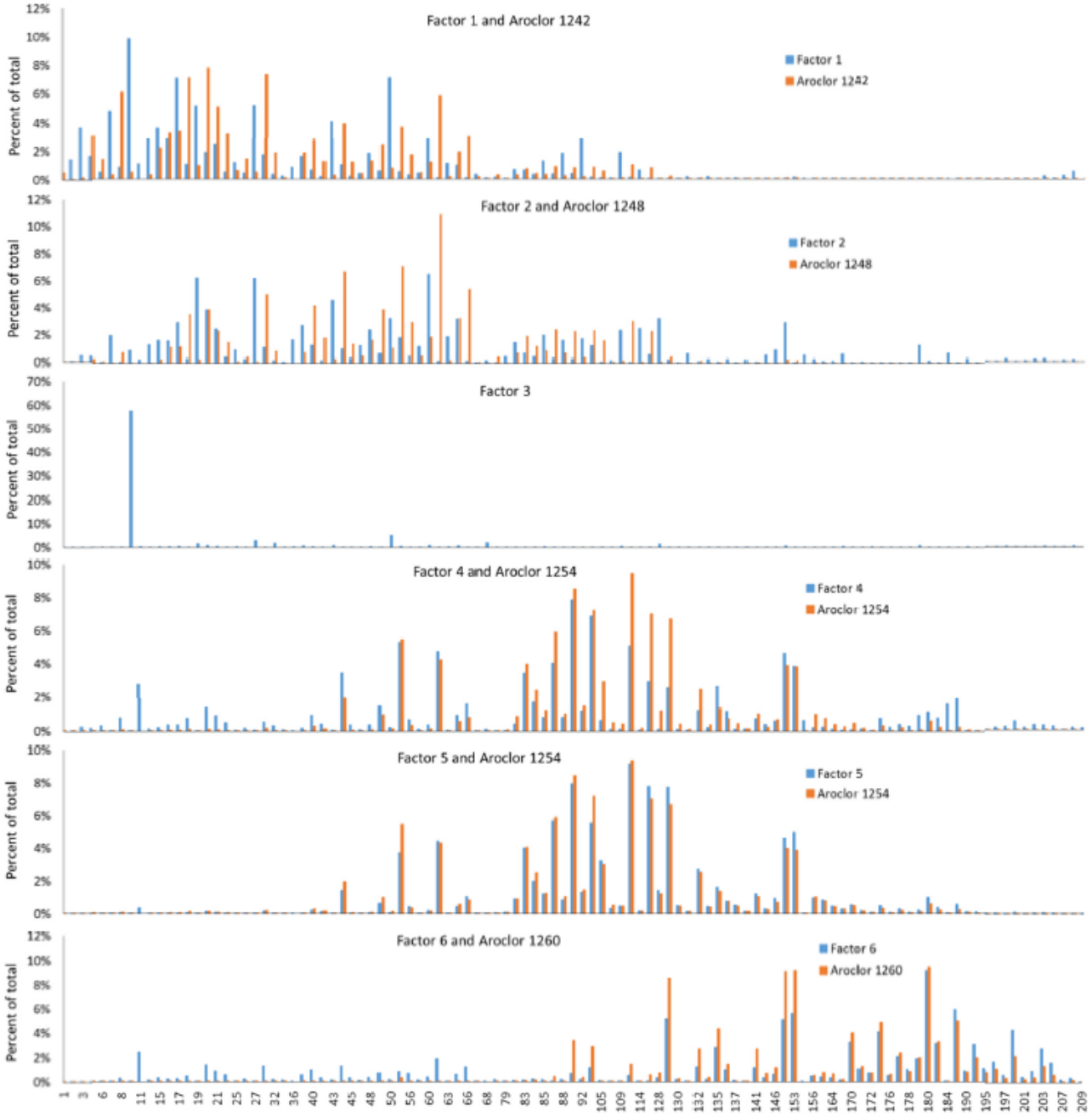

Figure 2-19. Fingerprints of the six factors compared to Aroclors

Figure shows each congener as percent of total mass in the data set.

Factor Composition of Influent & Effluent

- NVI and SVI have similar factor compositions.
- Predominant influent factor is F4 & F5 – both related to Aroclor 1254
- Predominant effluent factor is F1- dissolved phase

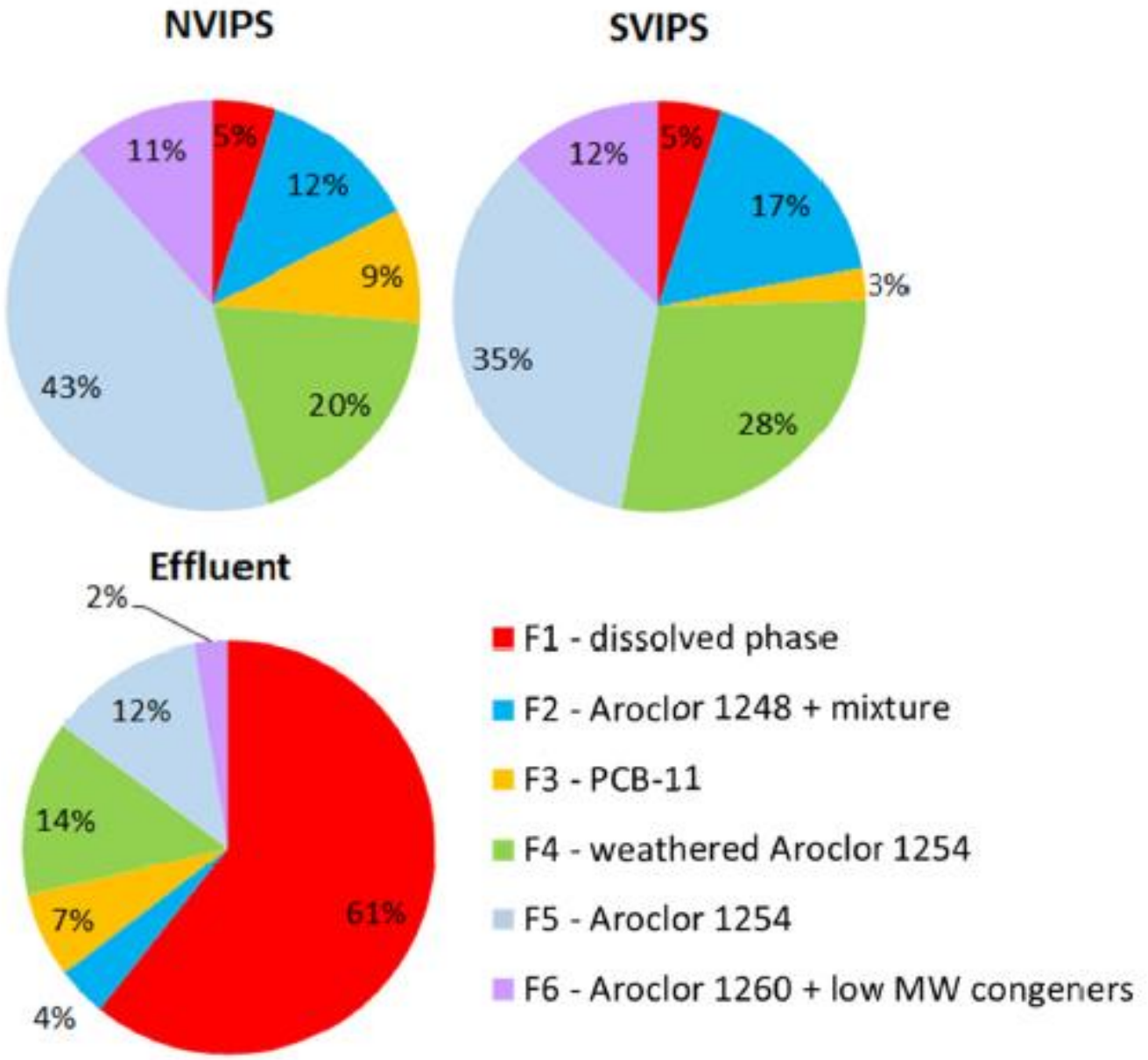

Figure 2-20. Average PMF factor contribution for NVIPS, SVIPS, and effluent

2015 SRRTTF Synoptic Sampling Data

Homolog profile at river stations

Table 1 - Loads at each river location by homolog (mg/day)

3x Lab Corrected

	Barker	Mirabeau	Trent	Greene	Spokane
Monochloro	0.00	0.00	0.00	0.00	3.76
Dichloro	0.54	0.64	3.69	3.65	2.65
Trichloro	0.53	0.39	66.68	41.05	49.10
Tetrachloro	0.47	0.69	123.04	107.72	107.00
Pentachloro	0.25	3.99	30.79	70.45	71.10
Hexachloro	0.45	2.61	3.14	54.66	50.38
Heptachloro	0.34	1.18	1.00	18.13	17.71
Octachloro	0.20	0.07	0.24	3.88	2.50
Nonachloro	0.00	0.00	0.00	3.80	0.34
Decachloro	0.00	0.00	0.00	0.34	0.63
TOTAL	2.77	9.57	228.57	303.67	305.17

Draft-preliminary data

2015 SRRTTF Synoptic Sampling Data
Homolog profile of unaccounted for load

Unaccounted for loads between river stations by homolog (mg/day)					
		Barker to Mirabeau	Mirabeau to Trent	Trent to Greene	Greene to Spokane
3x Lab Corrected	Monochloro	*0.00*	*0.00*	*-1.23*	*3.76*
	Dichloro	*0.11*	*-1.46*	*-20.20*	*-1.00*
	Trichloro	*-0.14*	*36.37*	*-65.06*	*8.05*
	Tetrachloro	*0.22*	*80.88*	*-44.61*	*-0.72*
	Pentachloro	*3.74*	*19.15*	*31.20*	*0.65*
	Hexachloro	*2.16*	*-0.54*	*49.59*	*-4.29*
	Heptachloro	*0.84*	*-0.37*	*16.73*	*-0.41*
	Octachloro	*-0.13*	*0.10*	*3.52*	*-1.37*
	Nonachloro	*0.00*	*0.00*	*3.77*	*-3.45*
	Decachloro	*0.00*	*0.00*	*0.34*	*0.28*
	TOTAL	*6.80*	*134.13*	*-25.92*	*1.50*

Draft-preliminary data

2014 SRRTTF Synoptic Sampling Data

Homolog profile of unaccounted for load

Unaccounted for loads between river stations by homolog (mg/day)		
	Barker to Trent	Trent to Spokane
Monochloro	-1.45	-1.03
Dichloro	-0.15	30.95
Trichloro	61.32	-46.79
Tetrachloro	169.76	-100.57
Pentachloro	44.72	74.97
Hexachloro	3.78	77.54
Heptachloro	0.97	26.27
Octachloro	1.11	7.04
Nonachloro	0.05	1.73
Decachloro	0.21	0.17
TOTAL	280.31	70.28

Draft-preliminary data

Next Steps to Consider

- Add homolog mass balance analysis to Limo Tech scope for 2015 Synoptic Sampling report.
- Use homolog analysis to inform potential modifications to PMF analysis.
- Evaluate needs and potential for data formatting prior to providing for PMF analysis.
  - For example would data provided in DRBC type Access Database reduce cost of PMF analysis.
- SRRTTF consider additional low flow field work in Trent to Greene reach.