Characterization of Ambient PCB Background Conditions in Surface Waters of the Pajarito Plateau, NM

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Sediment Management Work Group Fall Sponsors' Forum

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Santa Fe
United States of America
State Boundary
Road
River
National Capital
State Capital
City or Town
0 300 KM
0 300 Miles
©2007 Geology.com
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
MEXICO
CANADA
U.S.A.


PAJARITO PLATEAU
Los Alamos
Rio Grande
Sante Fe
Albuquerque
Google

Development of Background Threshold Values for Storm Water Runoff on the Pajarito Plateau, New Mexico, 2020 Revision

FINAL

Prepared for

N3B
Los Alamos National Laboratory
Los Alamos, New Mexico

October 14, 2020

Prepared by: Windward environmental LLC

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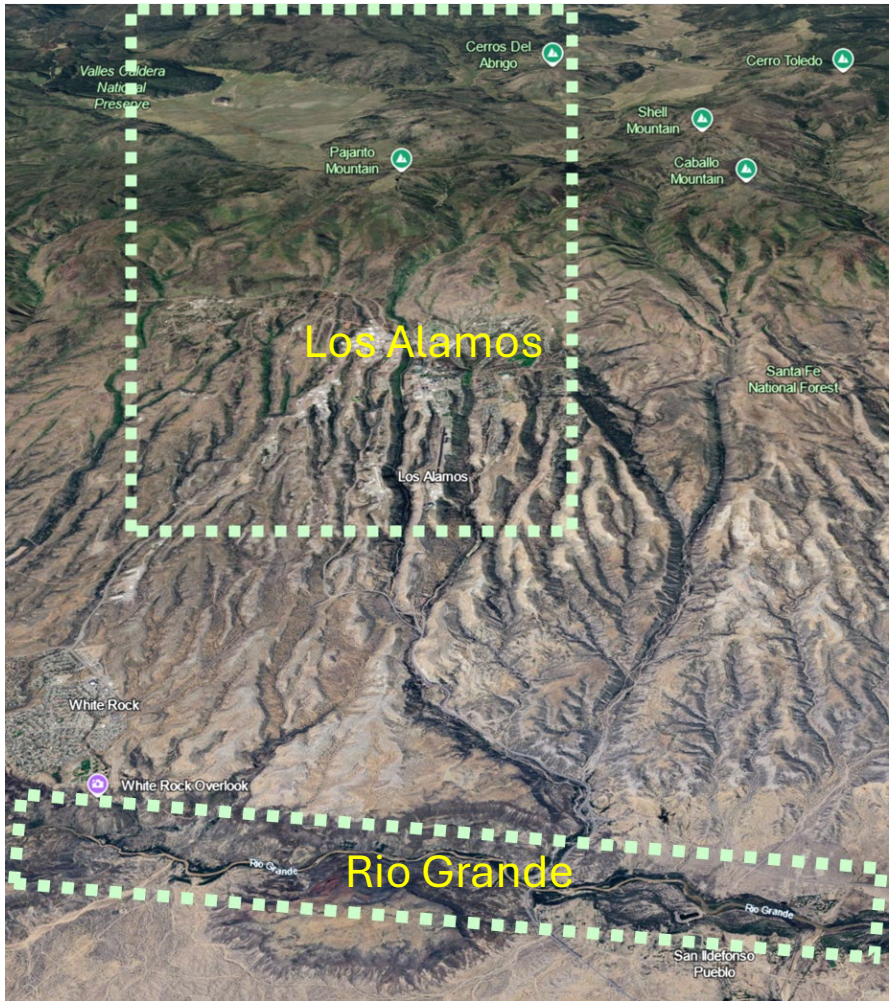
Pollutant of Concern	BTV Developed?	Sample Preparation Method		
		Filtered	Unfiltered	10-µm Filtered
2,3,7,8-TCDD	N		X	
Aluminum	Y	X	X	X
Antimony	Y	X		
Arsenic	Y	X		
Benzo(a)pyrene	Y		X	
Boron	Y	X		
Cadmium	N	X		
Chromium	Y	X		
Cobalt	Y	X		
Copper	Y	X		
Cyanide, total recoverable	N		X	
Cyanide, weak acid dissociable	N		X	
Gross alpha radiation	Y		X	
Hexachlorobenzene	N		X	
Lead	Y	X		
Mercury	Y	X		
Nickel	Y	X		
PCBs (total)	Y		X	
Pentachlorophenol	N		X	
Radium (226 and 228)	Y		X	
Selenium	Y		X	
Silver	N	X		
Thalium	N	X		
Uranium	Y	X		
Vanadium	Y	X		
Zinc	Y	X		

https://ext.em-la.doe.gov/IPS/Home/Reports?Length=4

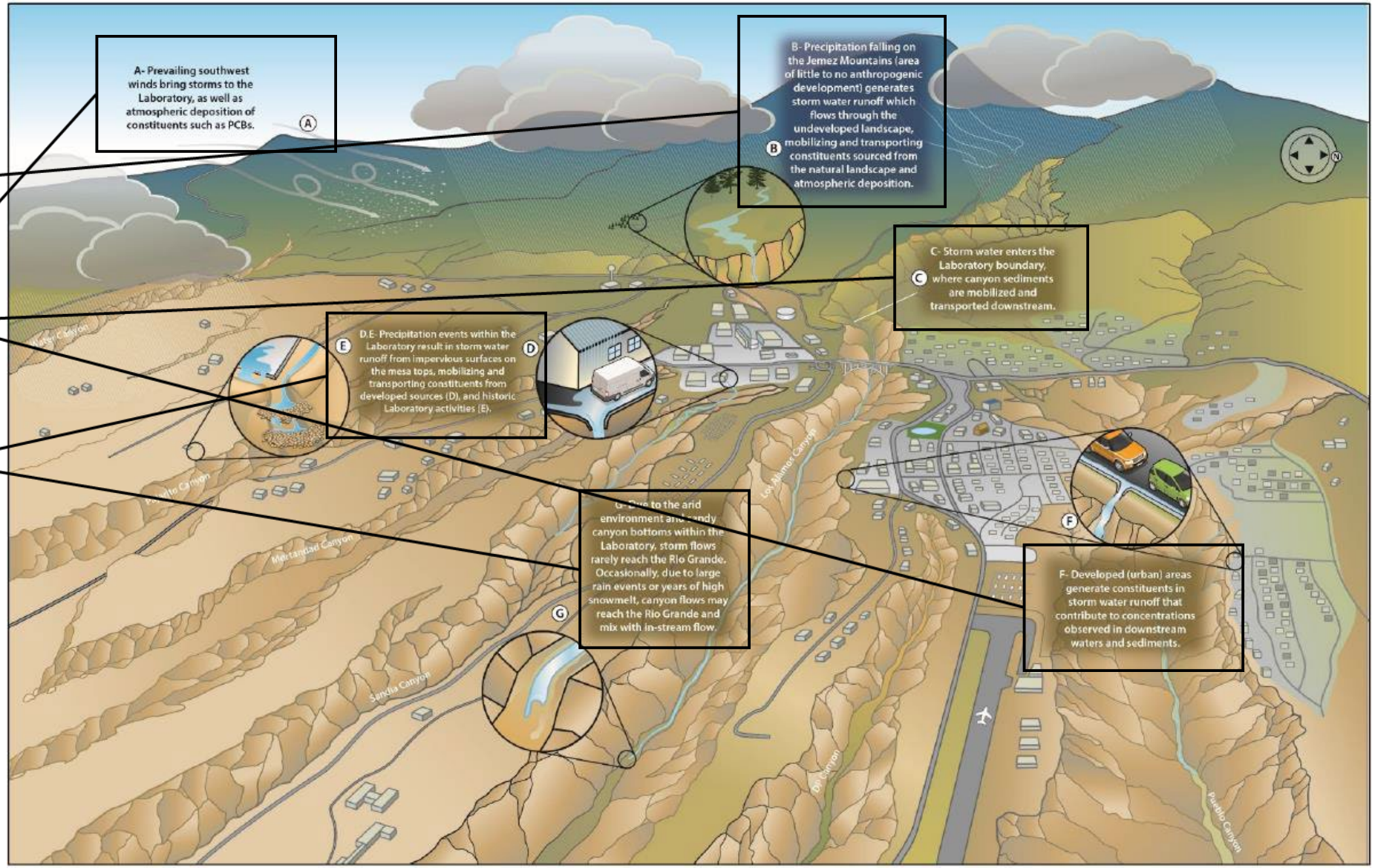
PCB Background Concentrations Exceed Water Quality Criteria



- Numerous Los Alamos National Lab (LANL) stream segments are 303(d)-listed for PCBs.
- The Rio Grande and other tributaries also are 303(d) listed for PCBs.
- Rio Grande PCB TMDL is at the top of the state's to-do list.
- PCB criterion (0.64 ng/L) based on 17.5 g/day fish consumption, 10^{-5} lifetime excess cancer risk.

CSM

B – Precipitation falling on the Jemez Mountains (area of little or no anthropogenic development) generates storm water runoff which flows through the undeveloped landscape, mobilizing and transporting constituents sourced from the natural landscape and atmospheric deposition.



Irresistible Force

- Church et al. (2022) Table S1 provides a non-exhaustive review of PCB concentrations in precipitation on the Pajarito Plateau and around the world.
  - PCB concentrations in precipitation exceed water quality criteria
  - Precipitation alone can put surface waters out of compliance.
- Historical release of PCBs has resulted in pollution driven by a combination of anthropogenic and natural processes (e.g., waste incineration and atmospheric transport).
- Natural processes driving PCB cycling (wind and water currents, species migrations) operate on a global scale.
- It is appropriate to consider PCB background “natural” to the extent that it is attributable to natural processes that move PCBs across jurisdictional boundaries.


Gaging station, Upper Pueblo Canyon

Immovable Object

- Two intractable conditions in New Mexico's water quality standards:
  1. **20.6.4.10.D(2) NMAC**: Site-specific criteria cannot replace HH-OO aquatic life criteria
     - Criteria "must fully protect human health when organisms are consumed from waters containing pollutants".
  2. **20.6.4.10.G NMAC**: The (Water Quality Control Commission) may adopt site-specific criteria equal to the concentration resulting from the natural background where… that concentration supports the level of aquatic life and wildlife habitat expected to occur naturally at the site. A determination of natural background shall… document the presence of natural sources of the pollutant (and) document the absence of human sources of the pollutant or quantify the human contribution.

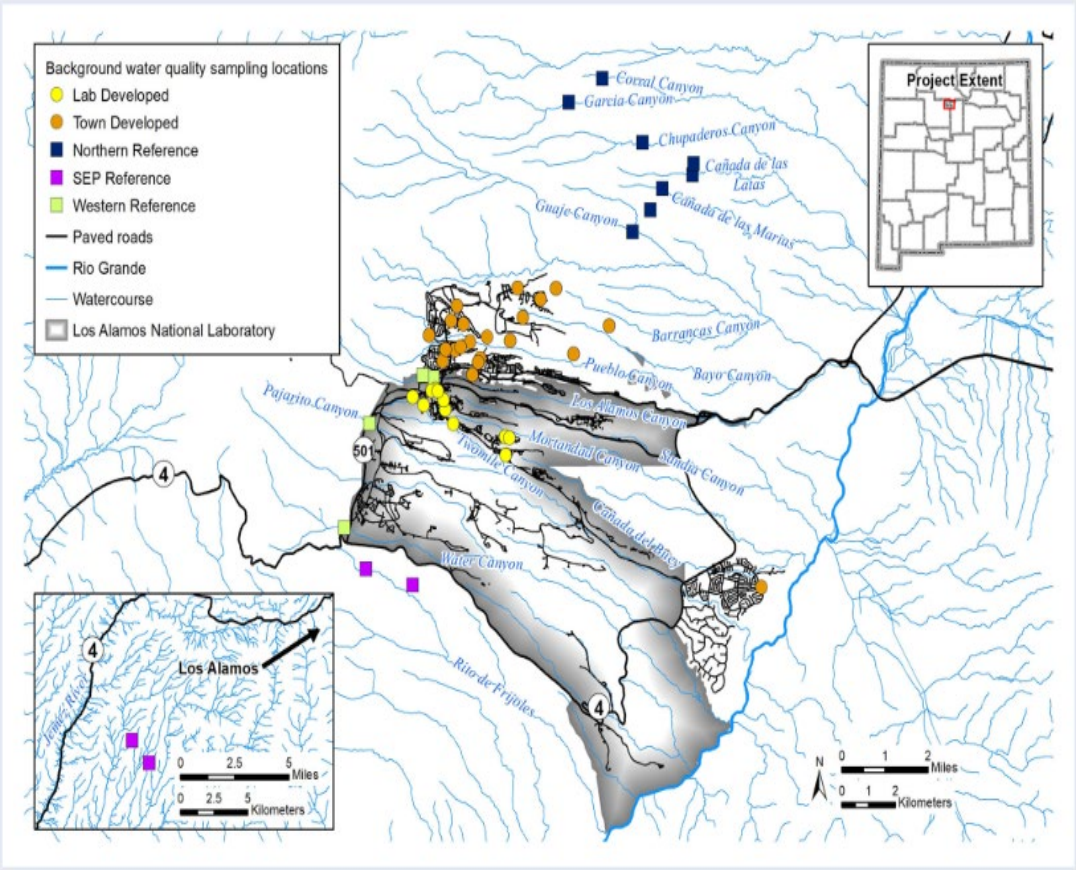

Gaging station, Upper Pueblo Canyon

So What?

- In this line of work, irresistible forces do meet immovable objects.
- We have to deal with it.
- Rigorous methods pay for themselves through the discipline they impose on environmental assessment/site characterization.
  - This is a claim, not a fact.
  - It's also the kernel of Windward's business model. I've been practicing for 34 years. It's served me well.
  - We'll eventually see how it plays out vis-à-vis PCBs on the Pajarito Plateau.

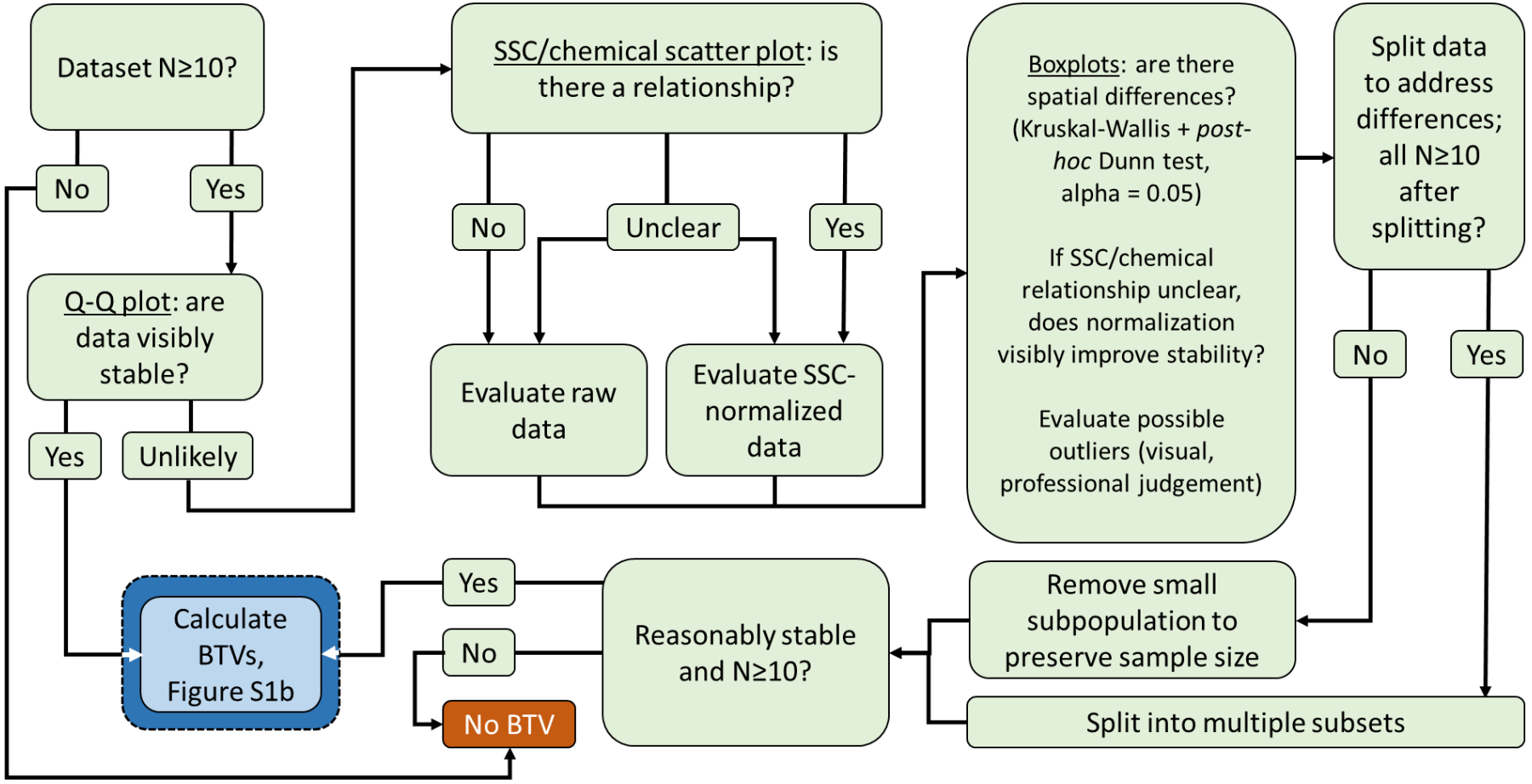

Gaging station, Upper Pueblo Canyon

Sampling & Analysis



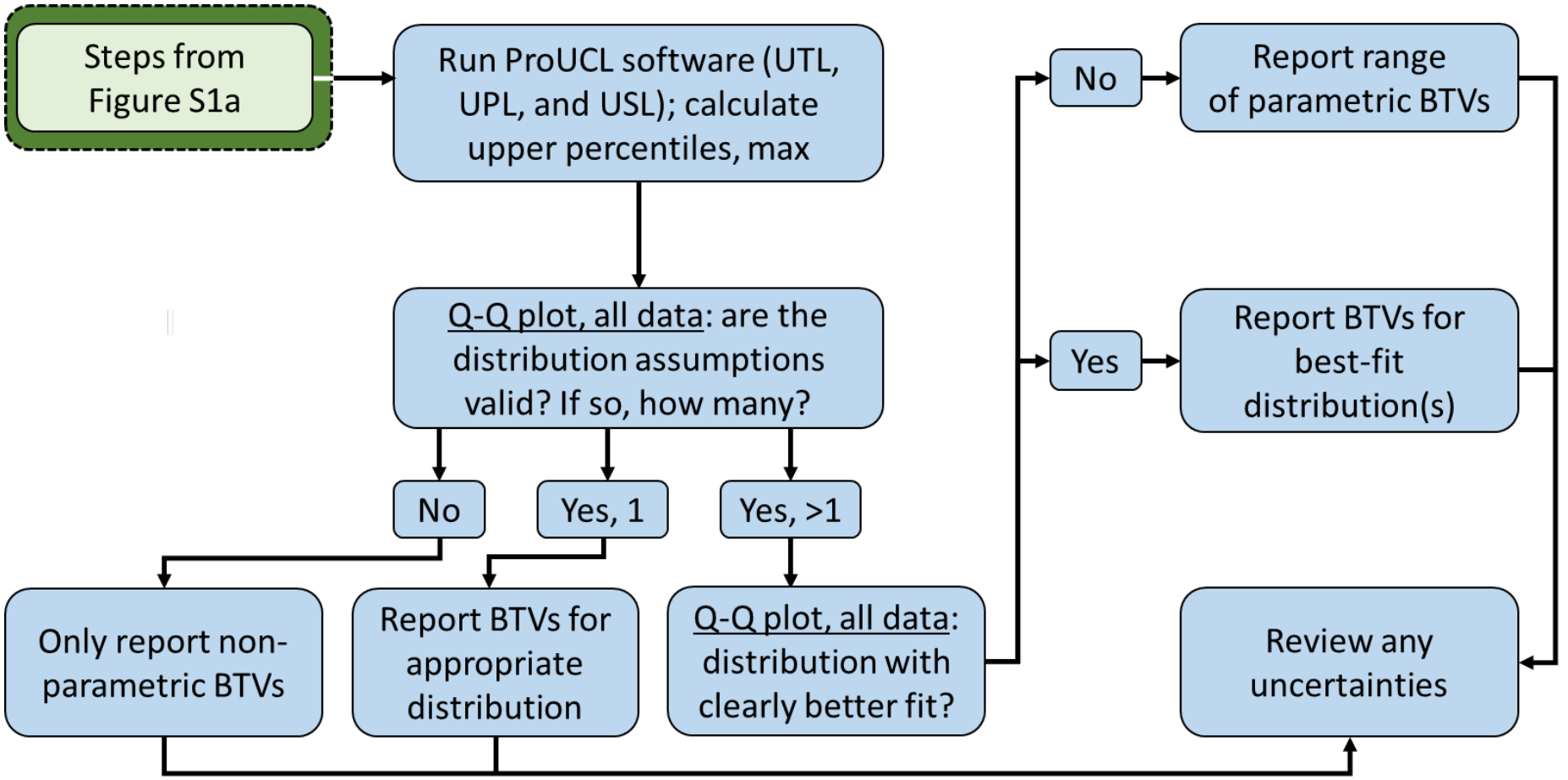
- Samples collected 2009-2018
  - 2011-2013 gap to remove samples that might have been affected by changes in quantities or qualities of particulates following the Las Cochas fire
  - Sampling timed to coincide with the rising limb of the hydrograph (first flush)
- Final dataset included 163 surface water samples
  - 53 samples from 17 undeveloped background locations
  - 110 samples from 28 developed background locations upstream of known or suspected PCB source areas
- PCB data publicly available
  - Church et al. 2022, Table S2

Background dataset development flow chart



Details about statistical analyses are presented in Church et al. (2022), Methods, BTV Development.

BTV calculation flow chart



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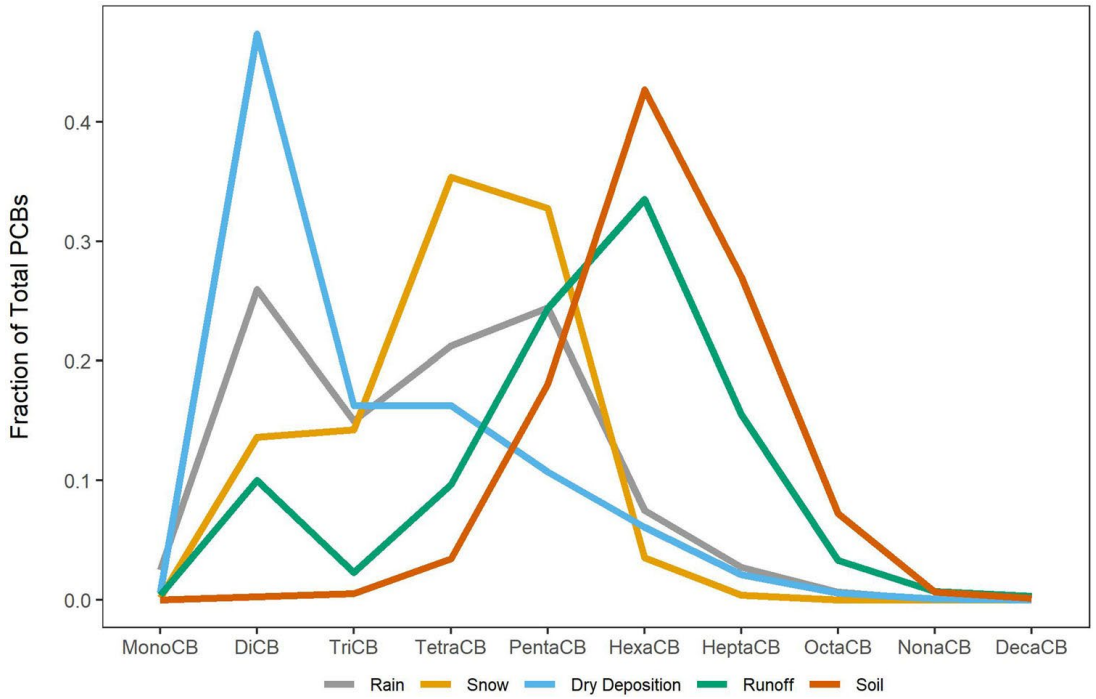
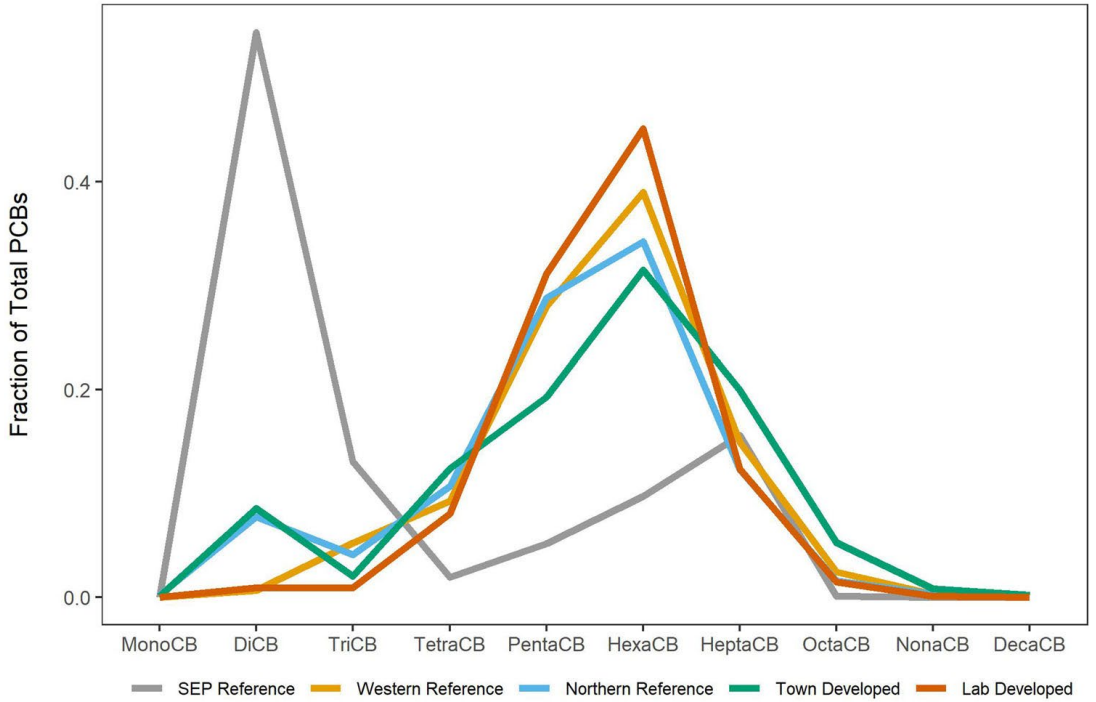
Homolog evaluation



Prevalence of DiCB in the SEP and Northern reference areas indicates a non-Aroclor source. PCB-11 is the dominant DiCB congener in many samples and an unintentionally produced PCB often observed in yellow pigments and paints (e.g., those used to mark roadways) and in flue gas and ash from hazardous waste incinerators. PCB-11 is globally distributed with disproportionate levels in the Arctic, owing to its volatility and ubiquity.



Surface water homolog patterns resemble parking lot stormwater runoff, except in the SEP reference area, where surface water resembles dry deposition with a secondary signal resembling runoff and soil.

Results

Distribution statistic	Undeveloped (ng/L)	Developed (ng/L)	Exceedance Factor Undeveloped	Developed
95-95 UTL	58.3	43	91	67
95% UPL	26.7	30.8	42	48
95% USL	254	199	397	311
80th %ile	5.5	10.8	9	17
90th %ile	12.2	19.6	19	31
95th %ile	16.8	31.5	26	49
Maximum observed	132	128	206	200
Water quality criterion:	**0.64**			

UPL – upper predictive limit
USL – upper simultaneous limit
UTL – upper threshold limit

Conclusions

- Watersheds upstream of development and known source areas, even in a relatively remote setting, contain PCBs at levels that prevent the attainment of criteria at downstream points of compliance.
- Homolog patterns suggest that PCBs in background areas are attributable to long range atmospheric transport and deposition on soils, followed by runoff.
- Surface water PCB concentrations are enriched in heavier homologs compared to precipitation. Hypothesis:
  - Aerially deposited PCBs accumulate on soil or impervious surfaces during extended dry periods
  - Lighter PCBs evaporate while heavier PCBs remain and run off into streams during the monsoon season.
- Rigorous statistical analysis demonstrates that undeveloped and developed **BTVs exceed the applicable WQC by 1-2 orders of magnitude**.
- Legal exclusion of natural background for anthropogenic chemicals such as PCBs creates an insoluble situation (bad pun intended). A better definition of "natural" is needed.

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