



Technical Update: Stream and Storm Water Sampling Results

- Sampling Methods
- Contaminants in Streams and Stormwater Outfalls
- Estimating Contaminant Concentrations
- Summary and Next Steps

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Cooperative Storm Event Monitoring

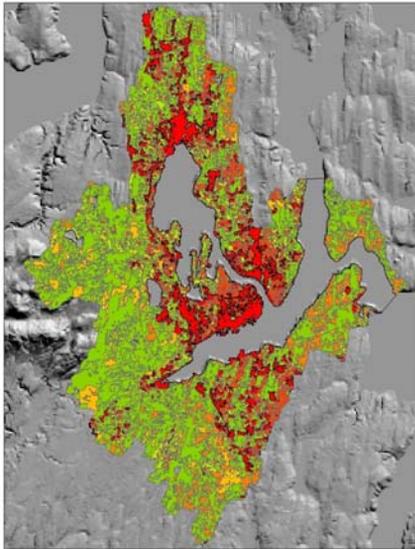


Cooperating with Cities
and County to:

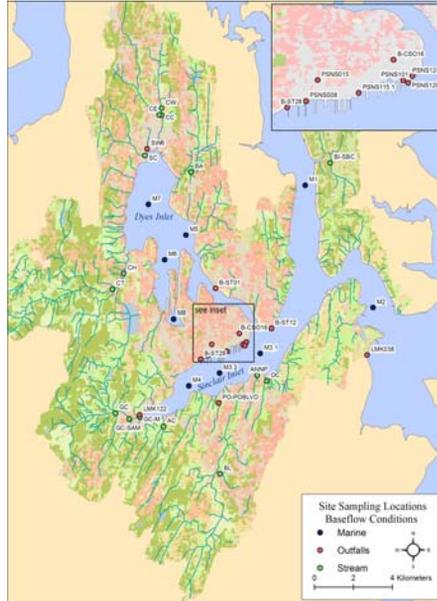
- Sample representative storm events
- Collect data on hydrology and water quality parameters
- Relate landuse to environmental quality
- Quantify loading from the watershed into the receiving waters of the Inlet
- Support TMDLs

Sampled:

n = 16:68 Streams and 18:87 Stormwater Outfalls
ranging from 2 to 9,634 acres

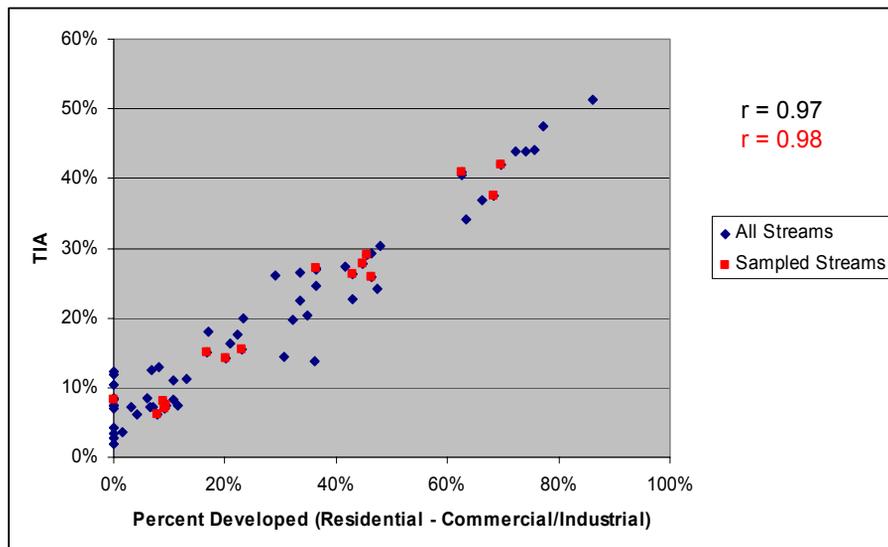


Total Impervious Area (TIA)

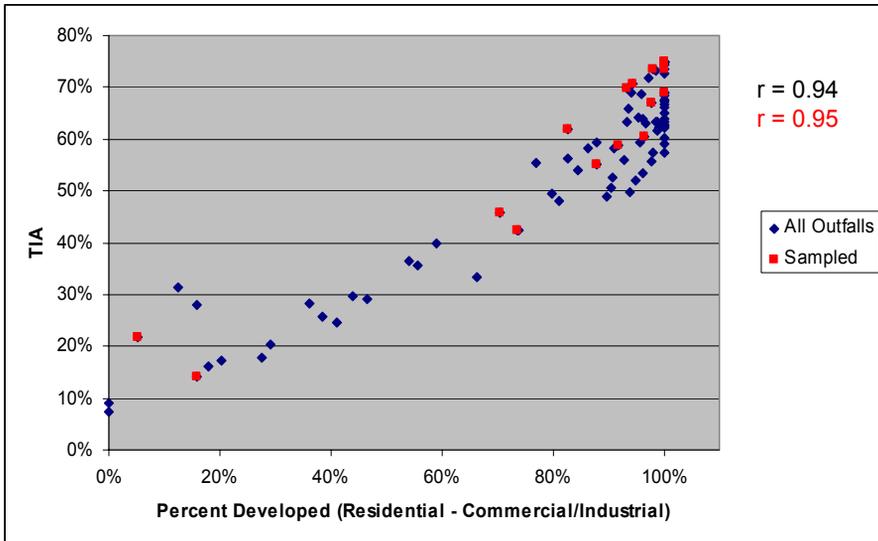


Sampled Streams in Relation to All Streams

n = 16:68 Units

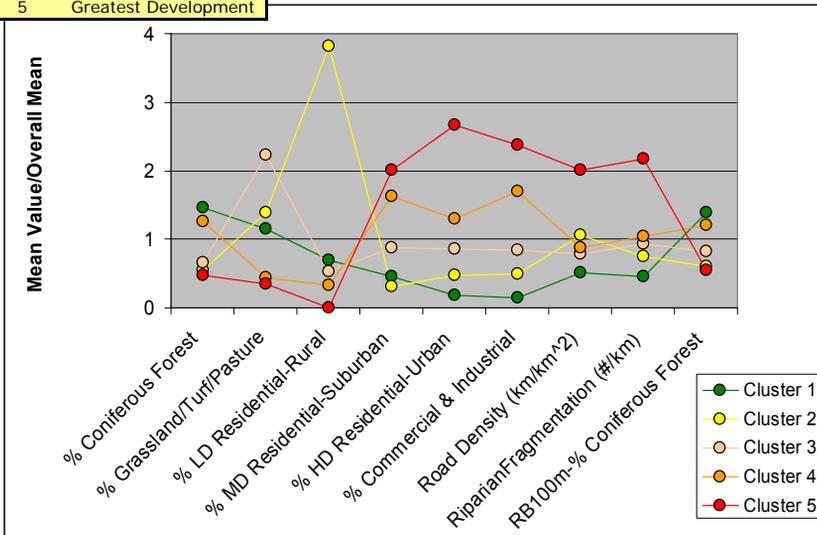


Sampled Stormwater Outfalls in Relation to All Outfalls

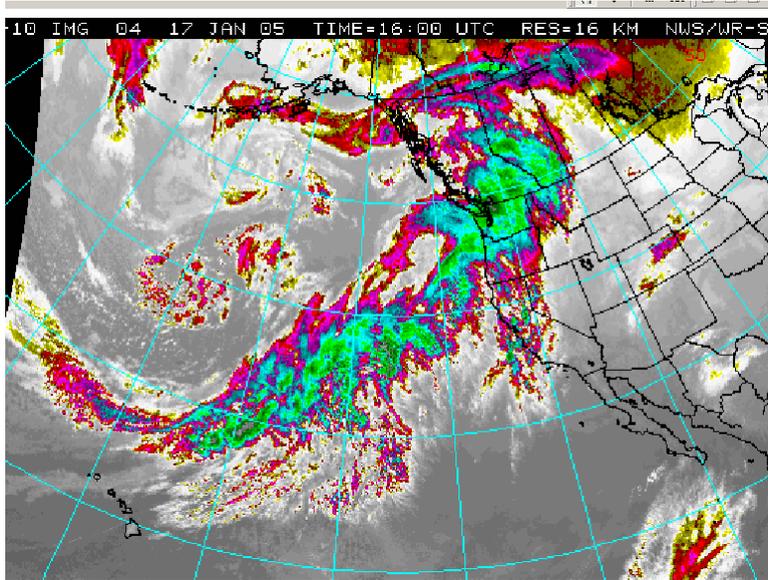


Land Use/Land Cover Clusters

Cluster	Description
1	Least Developed
2	Rural/LD Residential
3	Grass/Turf/Pasture
4	MD-HD Residential
5	Greatest Development



Storm Event Sampling



Analytes for Storm Event Sampling:

In situ

Temp, pH, conductivity, turbidity

Conventional Parameters

Alkalinity, TS, TSS, grain size, TOC, DOC

Nutrients – $\text{NO}_3 + \text{NO}_2$, NH_3 , TN, TP

Metals

Total - Al, As, Cd, Cr, Cu, Pb, Hg, Ag, Zn

Dissolved – Cd, Cu, Pb, Ag, Zn

Polycyclic Aromatic Hydrocarbons (PAHs)

15 (parent) PAH compounds

Phthalates – 3 compounds

Polychlorinated Biphenyls (PCBs)

20 congeners and Aroclor 1268

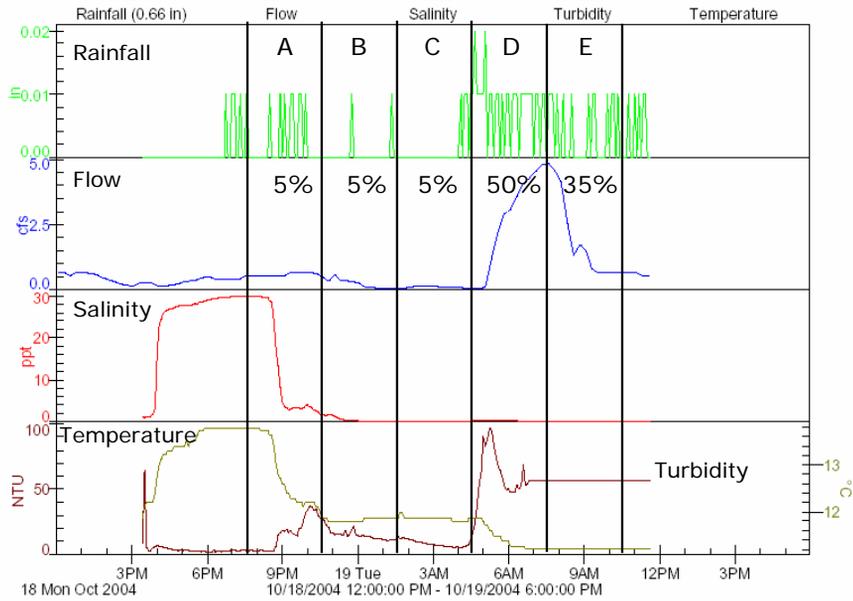
Pesticides – Chlorinated, Organo-Phosphorous, and Nitrogen-based (106 compounds)

Herbicides – 24 compounds

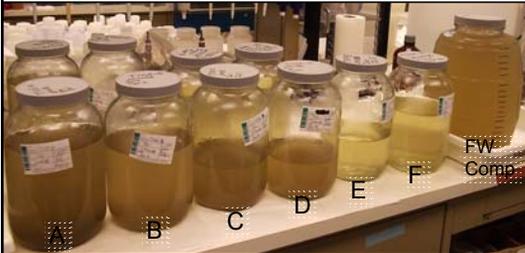
Typical Storm Event

LMK122

Storm #: 18-19 October 2004



Compositing and Analysis



Storm Event Mean Composites (EMCs):
Storm Drains = Flow Weighted
Streams = Equal Weighted
Grabs = Average of Grabs



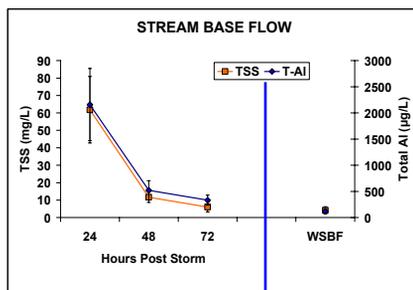
Types of Samples

Event Mean Concentrations (EMC) for

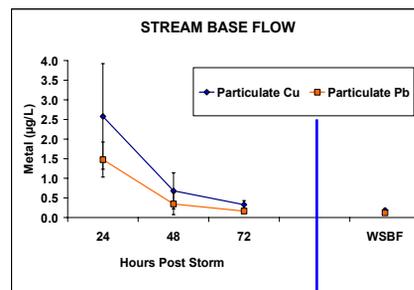
- Dry Season Base Flow (DSBF)
- Wet Season Base Flow (WSBF)
- Small Storms (rain < 0.5 in.)
- Medium Storms ($0.5 \leq$ rain < 1 in.)
- Medium Large Storms ($1 \leq$ rain < 2 in.)
- Large Storms \geq 2 in.

Wet Season Base Flow (WSBF)

- 6 Streams sampled following large storm.
- Baseflow defined as >72 hours following storm.

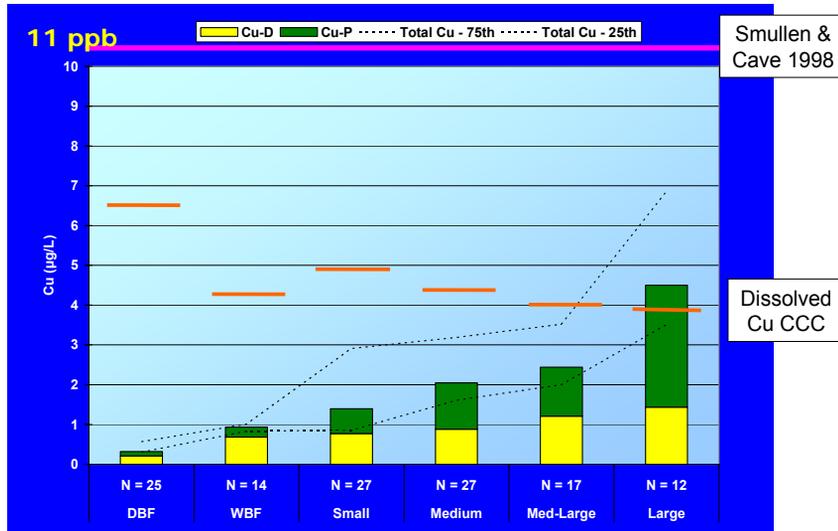


Total Suspended Solids (TSS) and Aluminum (Al)



Metals Copper (Cu) and Lead (Pb)

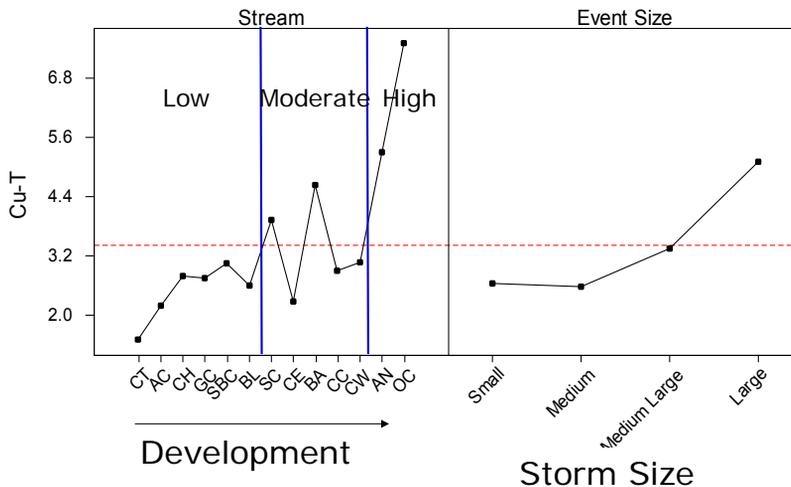
Median EMCs for Cu in Streams



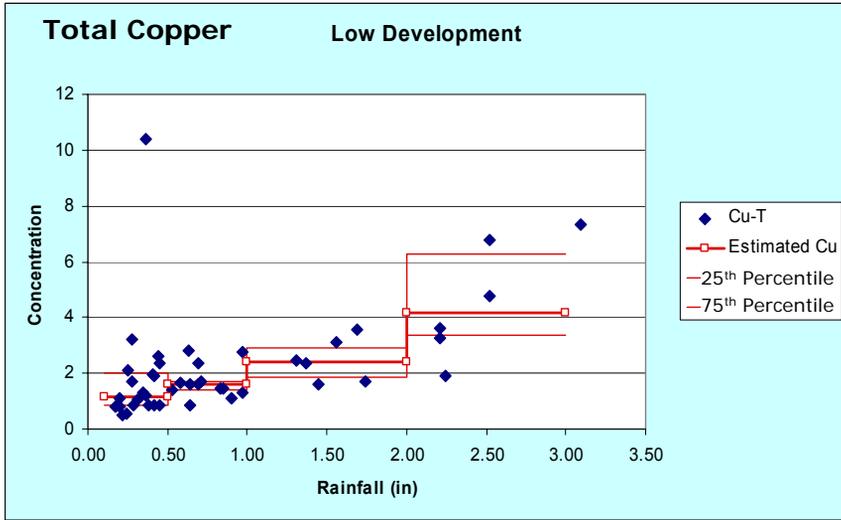
Relationship Between EMC and Storm Characteristics

For all storm samples, n = 64 to 85

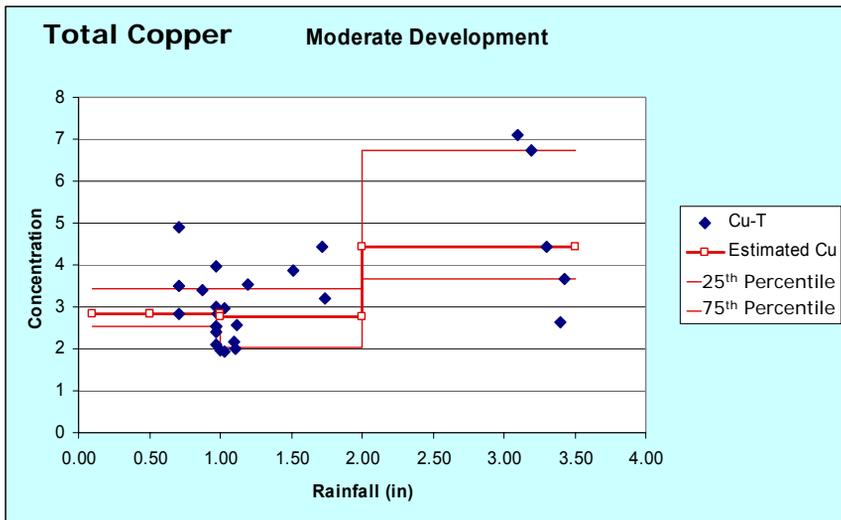
Event Size
 Small < 0.5 in
 Medium < 1 in
 Medium Large < 2 in
 Large >= 2 in



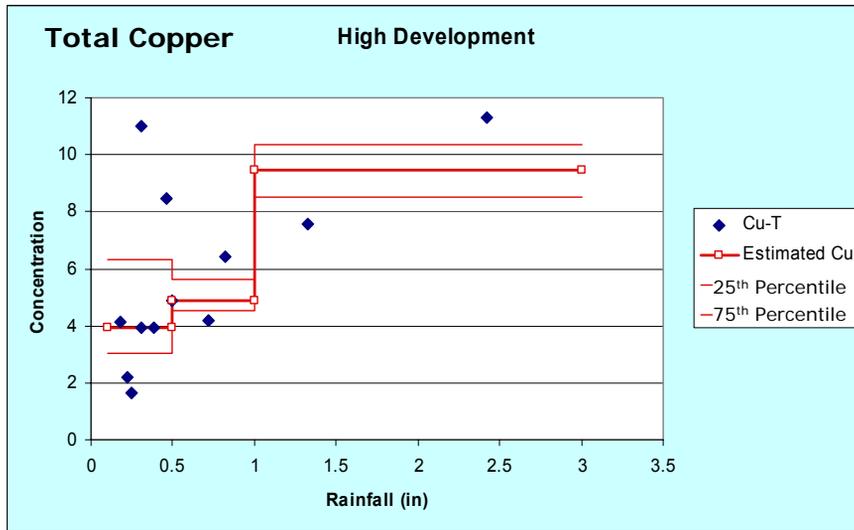
Loading Function for Copper in Streams with Low Development



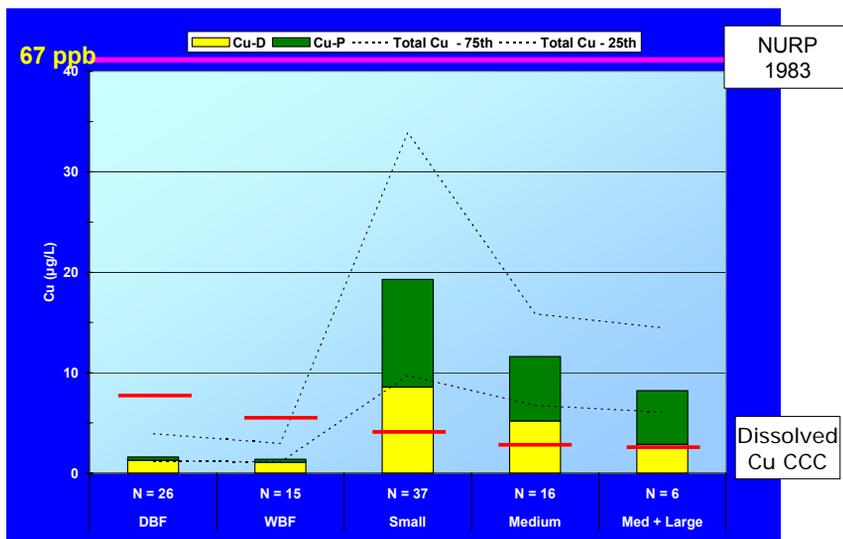
Loading Function for Copper in Streams with Moderate Development



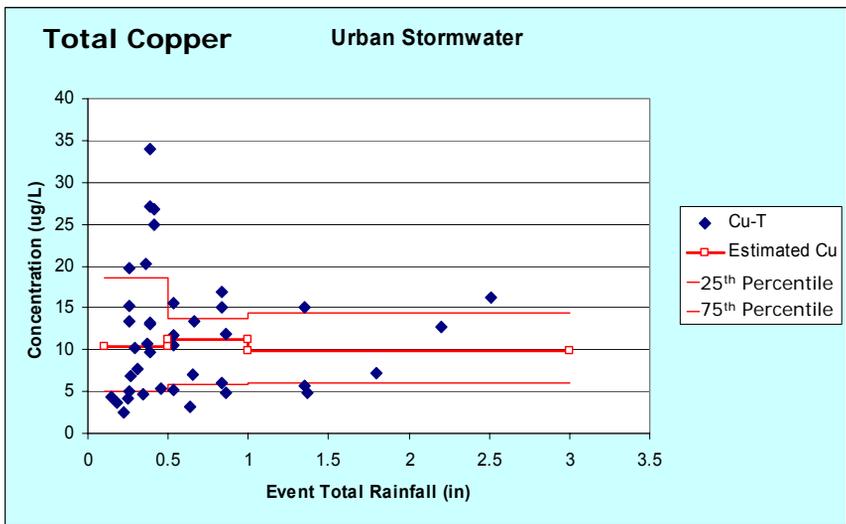
Loading Function for Copper in Streams with High Development



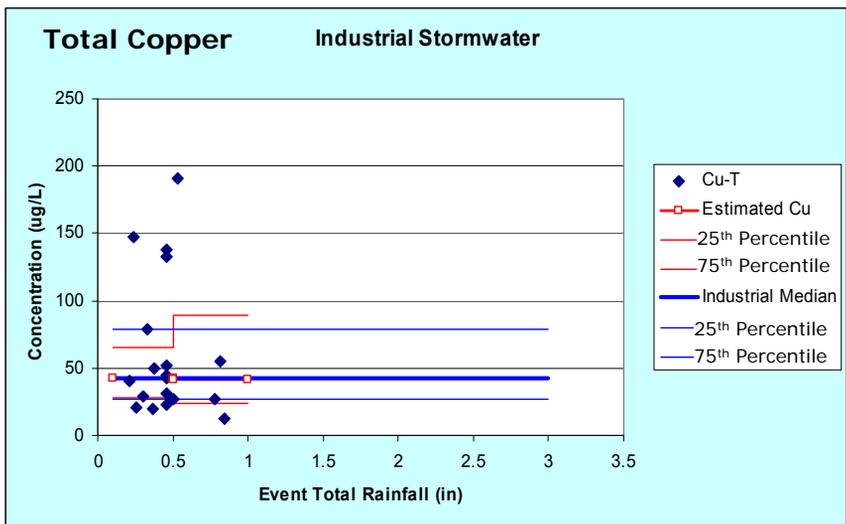
Median EMCs for Cu in Outfalls



Loading Function for Copper in Urban Stormwater



Loading Function for Copper in Industrial Stormwater



Summary

- Streams returned to baseflow conditions approximately 72 hours following a large storm event.
- Event Mean Concentrations in streams **increased** with level of development and storm size.
- Event Mean Concentrations in outfalls **decreased** with storm size and Industrial outfalls had higher concentrations than Urban outfalls.
- Event Mean Concentrations in streams can be estimated based on the level of development and the amount of rainfall.
- Event Mean Concentrations for Urban and Industrial outfalls should be predicted as a constant input due to limited data.

Next Steps

- Draft Technical Report in review
- Complete final report (Dec 2007)
- Calculate loads from watershed for input into the model (concentration x flow)
- Run model simulating Copper loadings into Sinclair and Dyes Inlet (June 2008)
- Provide data and technical information to Puget Sound Partnership

