

# 2008 South River Floodplain Study

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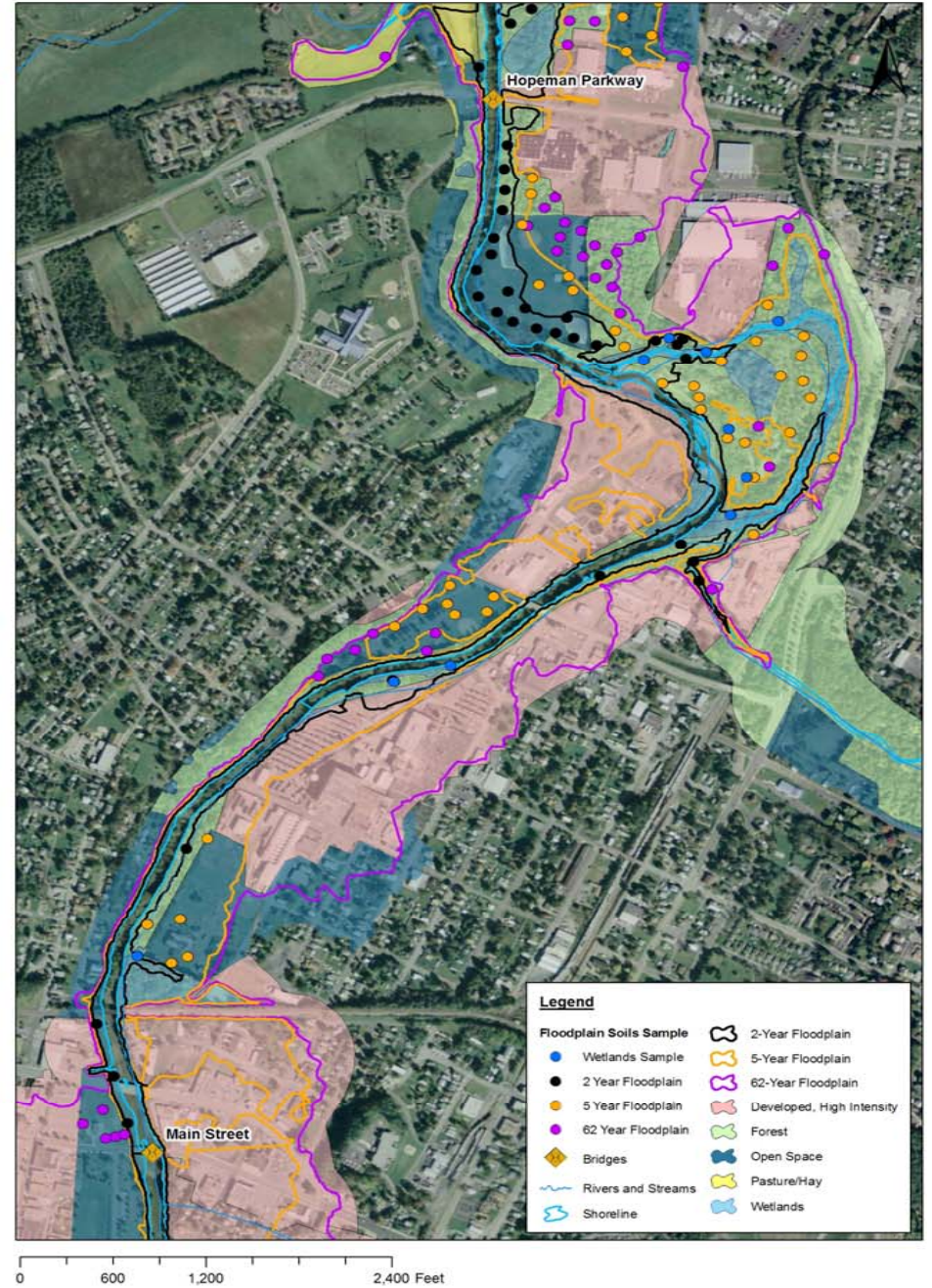
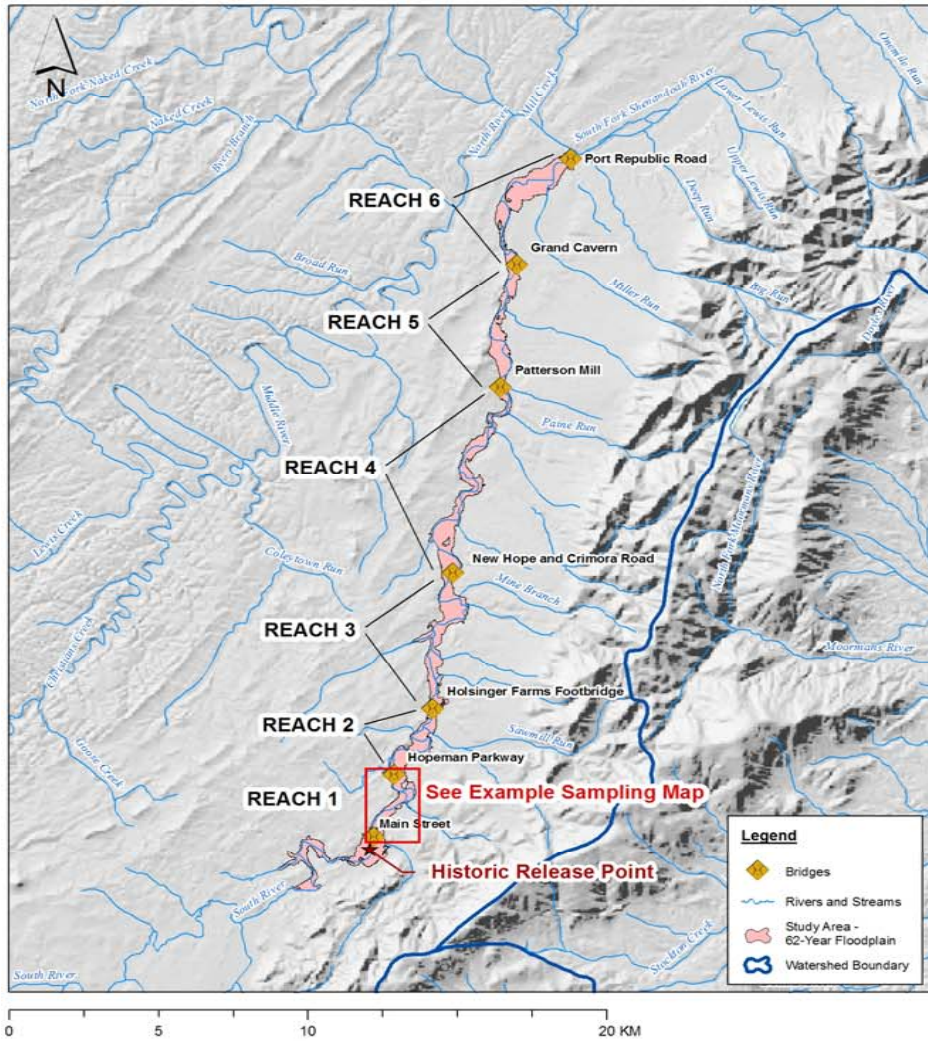
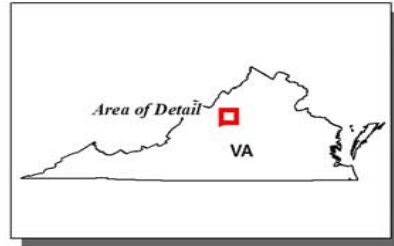
# Objectives

- Determine the spatial distribution of mercury in the floodplain soils.
- Develop understanding of floodplain soils as a source of mercury to the South River.
- Determine to what extent the mercury concentrations in floodplain soils changes spatially under similar and differing land use conditions.
- Develop an understanding of relationships between soil mercury concentrations and soil depth, elevation relative to river and distance from river.
- Further develop current understanding of relationship between mercury concentrations and particle size or associations with various size particles.
- Determine if wetland areas are sources of methylation.
- Provide valuable information for other projects examining mercury in the South River ecosystem.

# Experimental Design

- Stratified random sampling design used to determine sampling locations from the plant at Waynesboro to the confluence of the South River with the North River to form the South Fork of the Shenandoah River at Port Republic, which is approximately 25 river miles from the plant.
- Sampling plan
  - Bridge crossings denoted six river “reaches”
  - Three flooding frequencies and four land-use types within each river reach
    - Three flooding frequencies: 0 to 2, 2 to 5, and 5 to 62 year
    - Four land-uses: wetlands, open space, forest, pasture, and cropland.
  - 30 samples per reach and flooding frequencies with at least 10 samples by reach and inundation area for a particular land use (top three by land area)
  - Soil samples collected from the surface to 0.5 ft depth and 0.5 to 2.5 ft depth composite.
  - Additionally, 10 wetland samples/reach (pseudo-randomly chosen)

# South River Study Area and Reach 1 Sample Locations



# Sampling Method

- Soils samples collected using hand auger.
- Samples collected in 0.5 ft intervals. 0-0.5 ft and 0.5-2.5 ft samples analyzed. Samples archived as 0.5 ft intervals.
- Samples homogenized and composited by laboratory.
- Total of 618 stations sampled.
- Samples collected from mid-February to mid-April.
- Sixty (60) stations located in wetlands and sampled in April for MeHg along with THg.
- 4326 samples archived at SRST office.
- 2700 man hours spent on project.

# Sample Analysis

- Total mercury (THg)
- Methylmercury (MeHg) at wetland soil surface samples only
- Moisture content
- Grain size
- Organic carbon (Loss of Ignition)

# Data Analysis

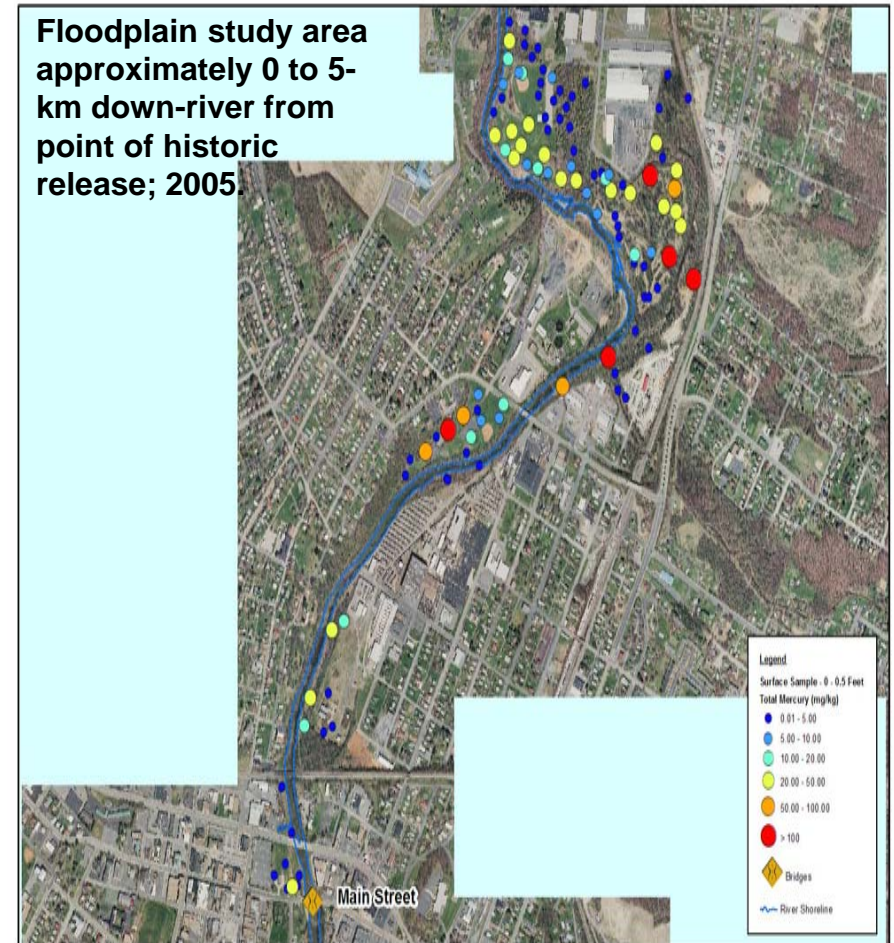
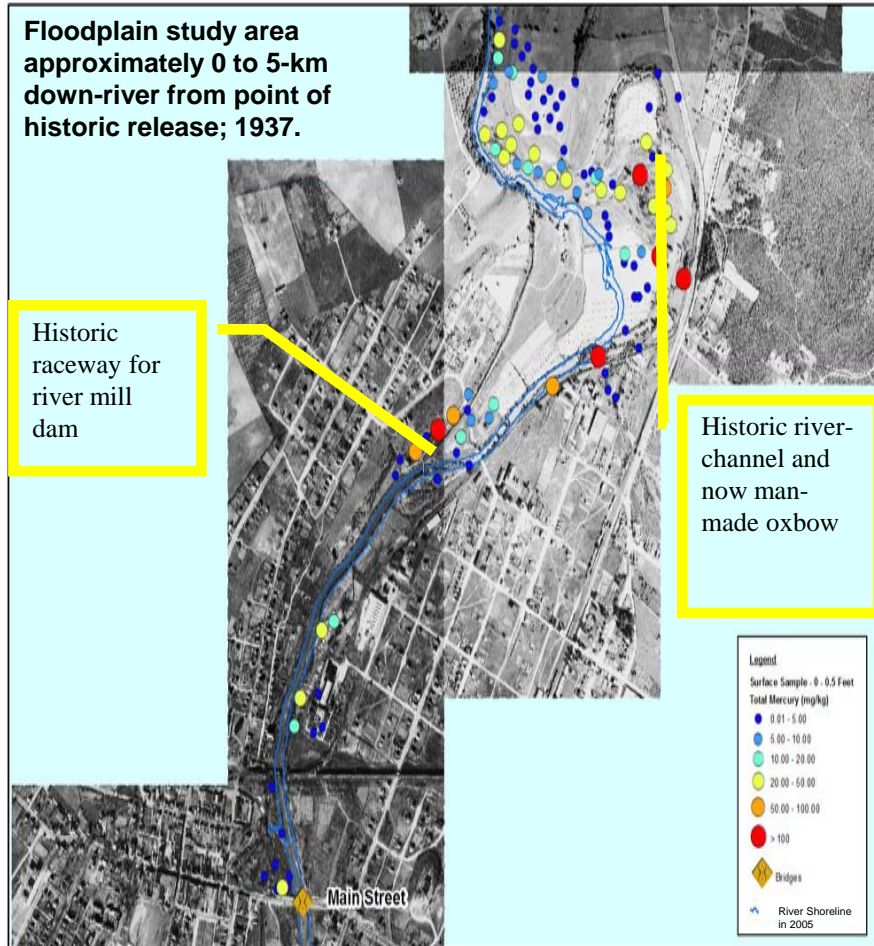
Data set evaluations included:

- THg results compared with the EPA Direct Content Residential Soil Screening Value
- Evaluation of results using historic aerial photos
- Normality, Outliers, Variance Homogeneity
- THg data set grouped by six bridge reaches for ANCOVA testing using:
  - Floodplain area (flooding frequency)
  - Land use
  - Distance from river channel centerline
  - Elevation
  - Percent clay
  - Percent silt

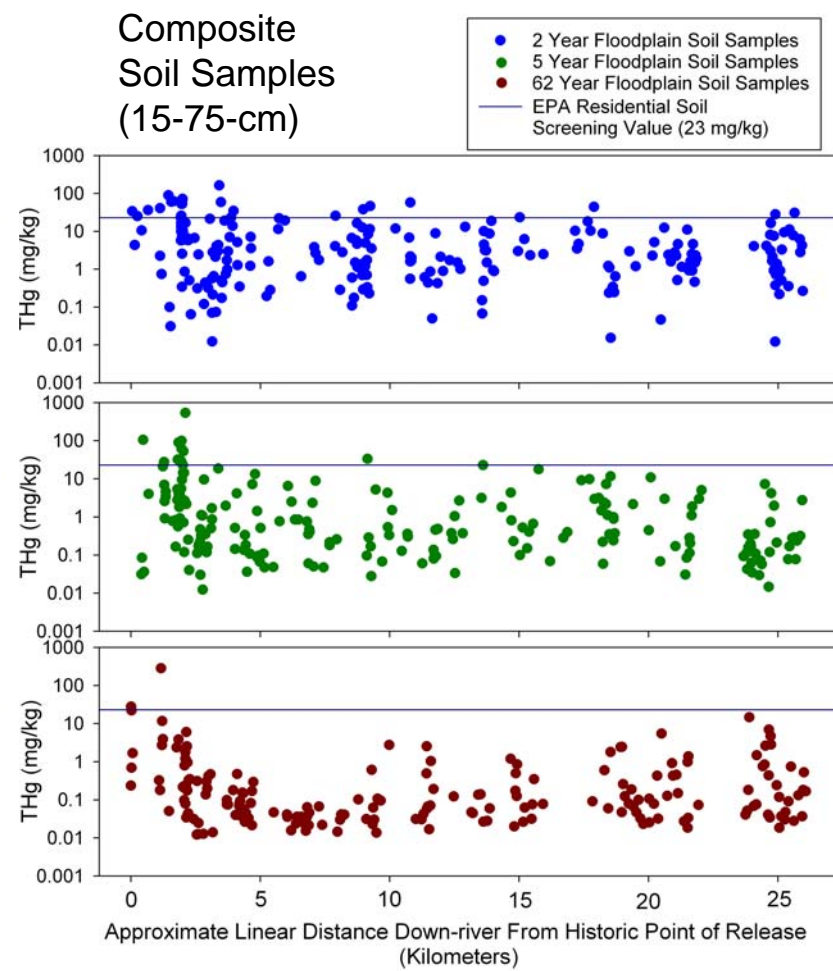
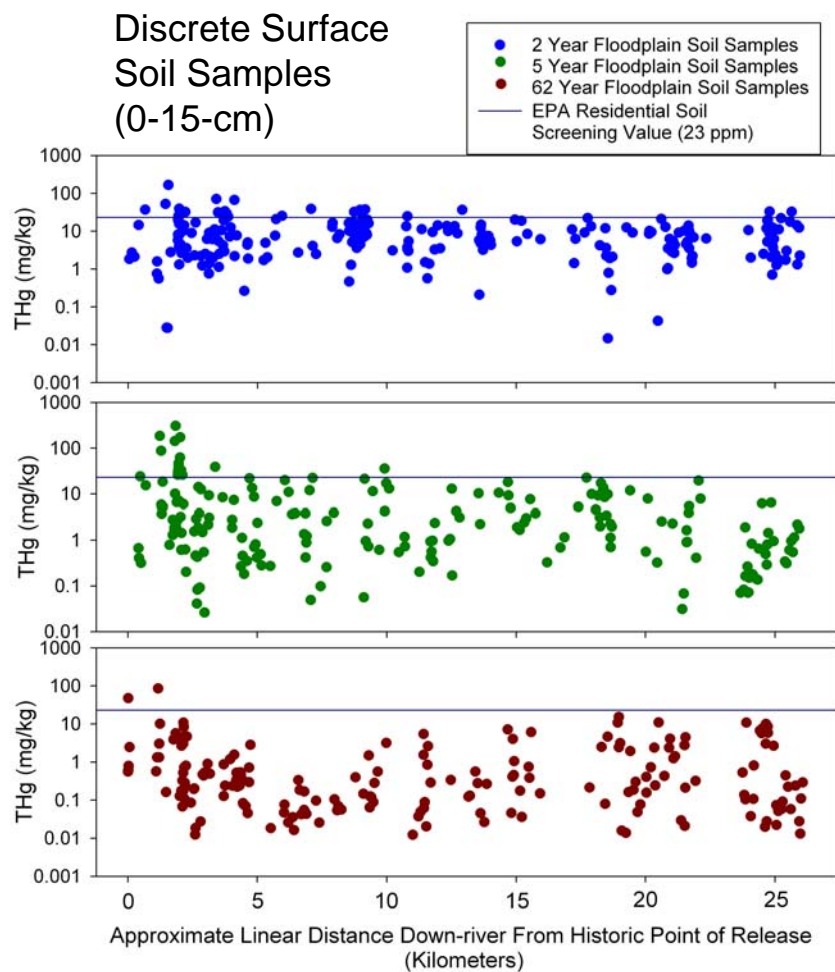
# Results



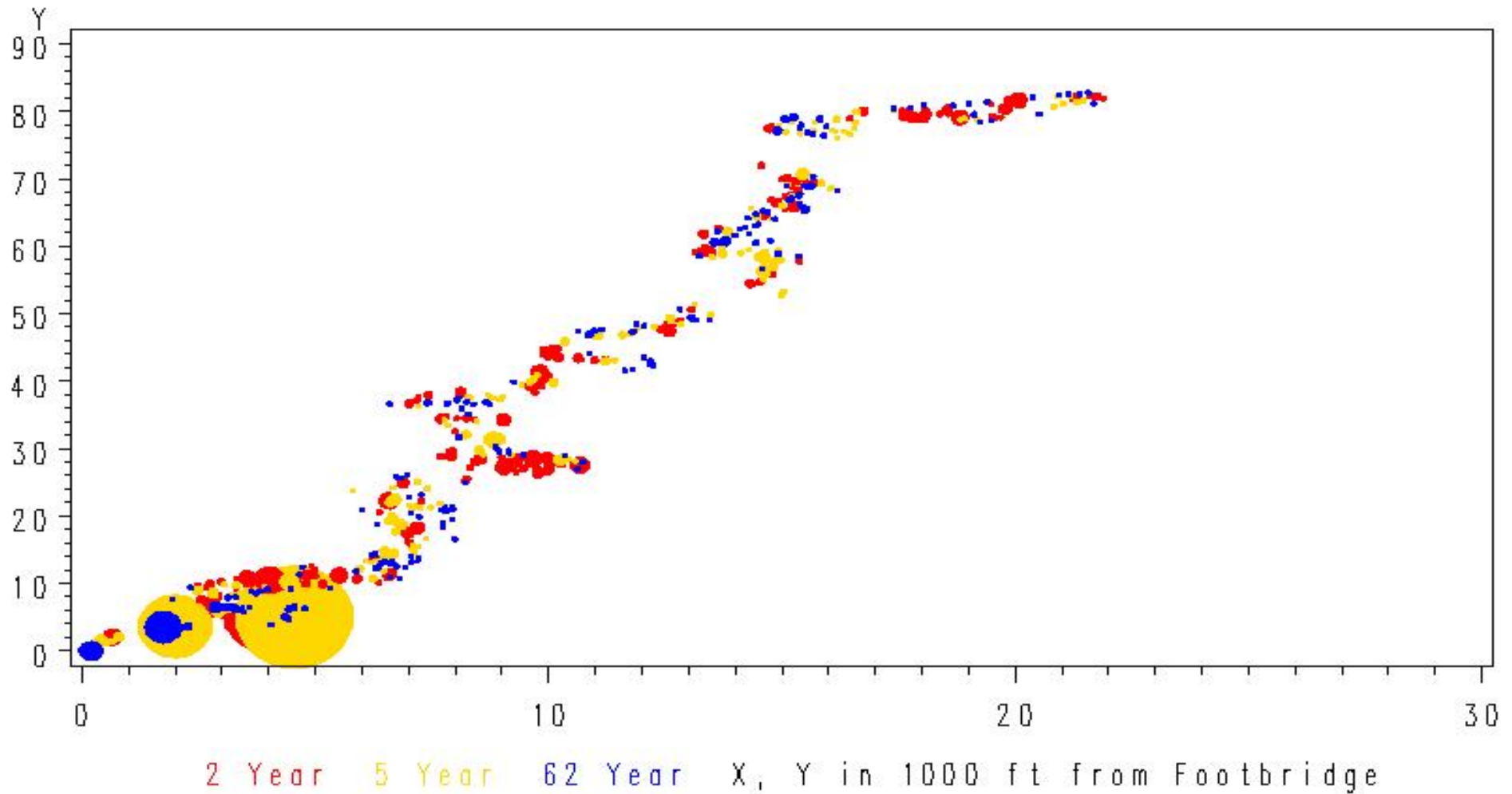
Evaluation of soil data overlaid on 1937 and 2005 aerial photos indicates historic mill dams and river channels (now a man-made river oxbow) influenced mercury deposits in soils along Reach 1.



# THg Concentrations in Floodplain and Wetland Soils



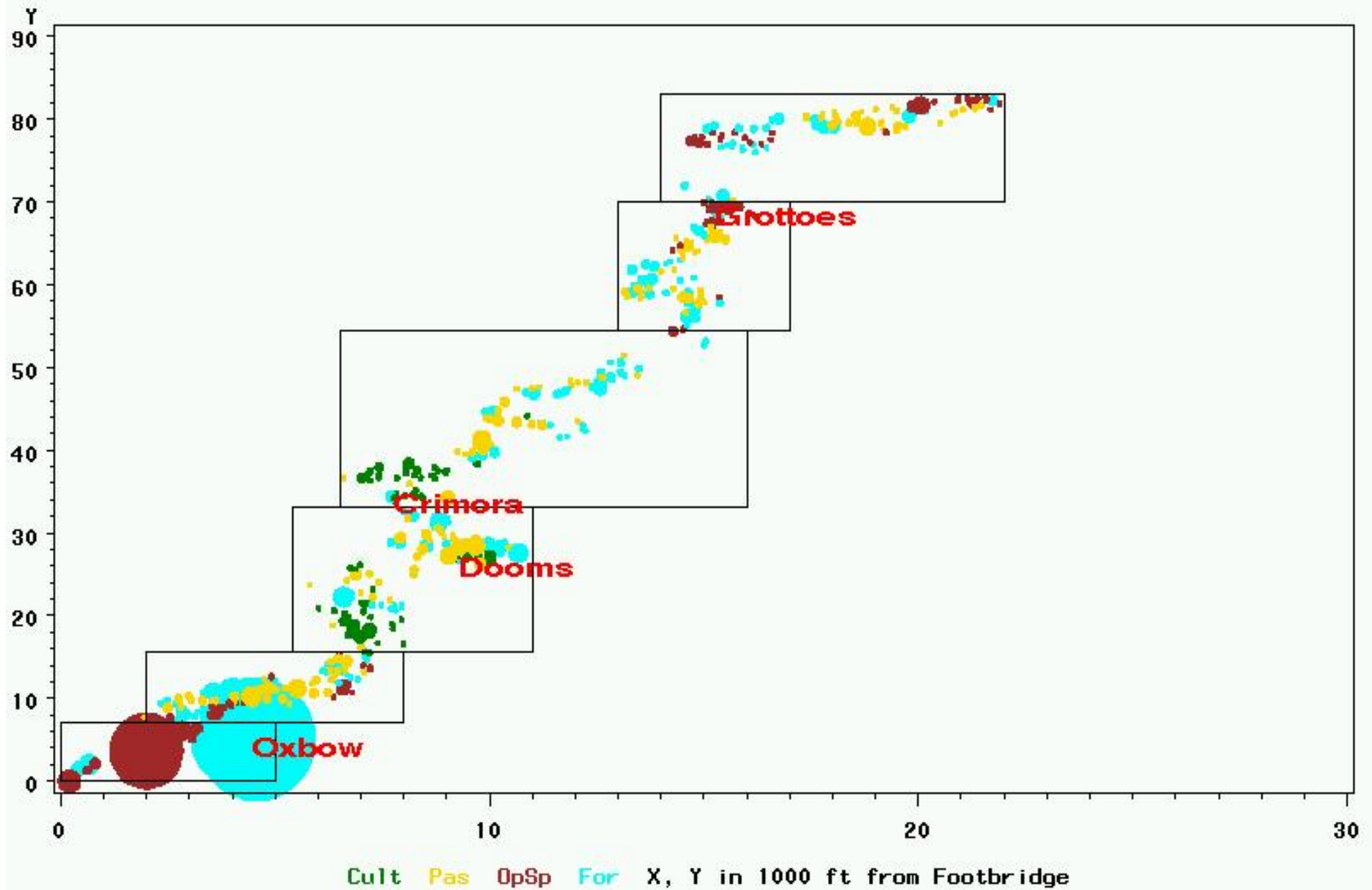
# THg Distribution: Floodplains



**Size of dot proportional to THg level, except minimum size (10ppm) used for visibility. Scatter follows physical location of samples. X and Y are NAD 83 State Plane coordinates, adjusted to zero at footbridge.**

# THg Distribution: Landuse

Showing River Reaches



# Statistical Evaluations

ANCOVA Results for Surface Soil Data Set - Log(THg)						
Effect	Reach					
	1	2	3	4	5	6
Floodplain area (flooding frequency)		***	***	***	***	***
Landuse	**	*				**
Floodplain area & Landuse			***			
Distance from river channel (centerline)		*	***			***
Elevation	***	***			**	
Percent clay		*				
Percent silt	**	***	**		**	***

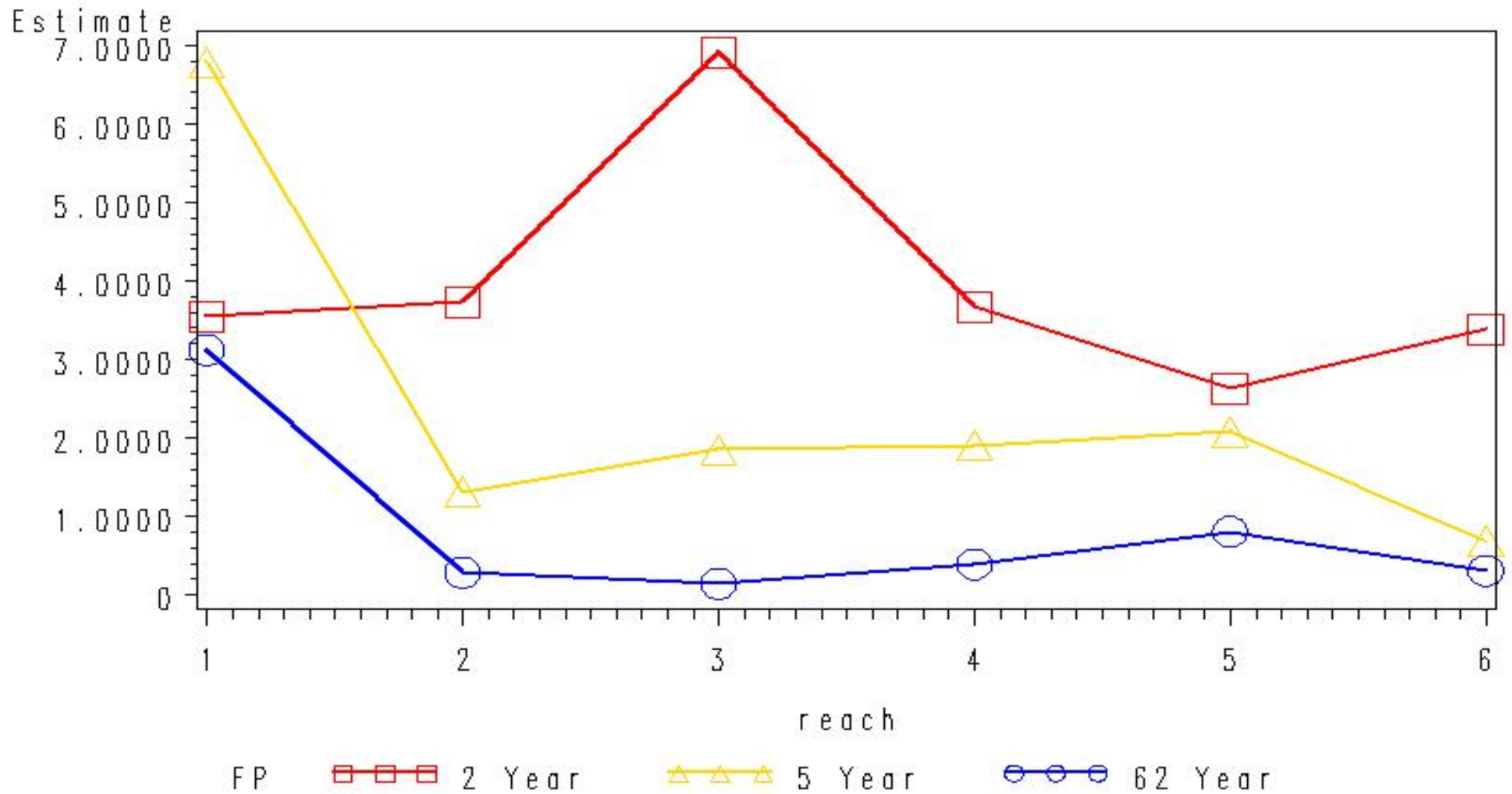
## Significance

\* < 0.1

\*\* <0.05

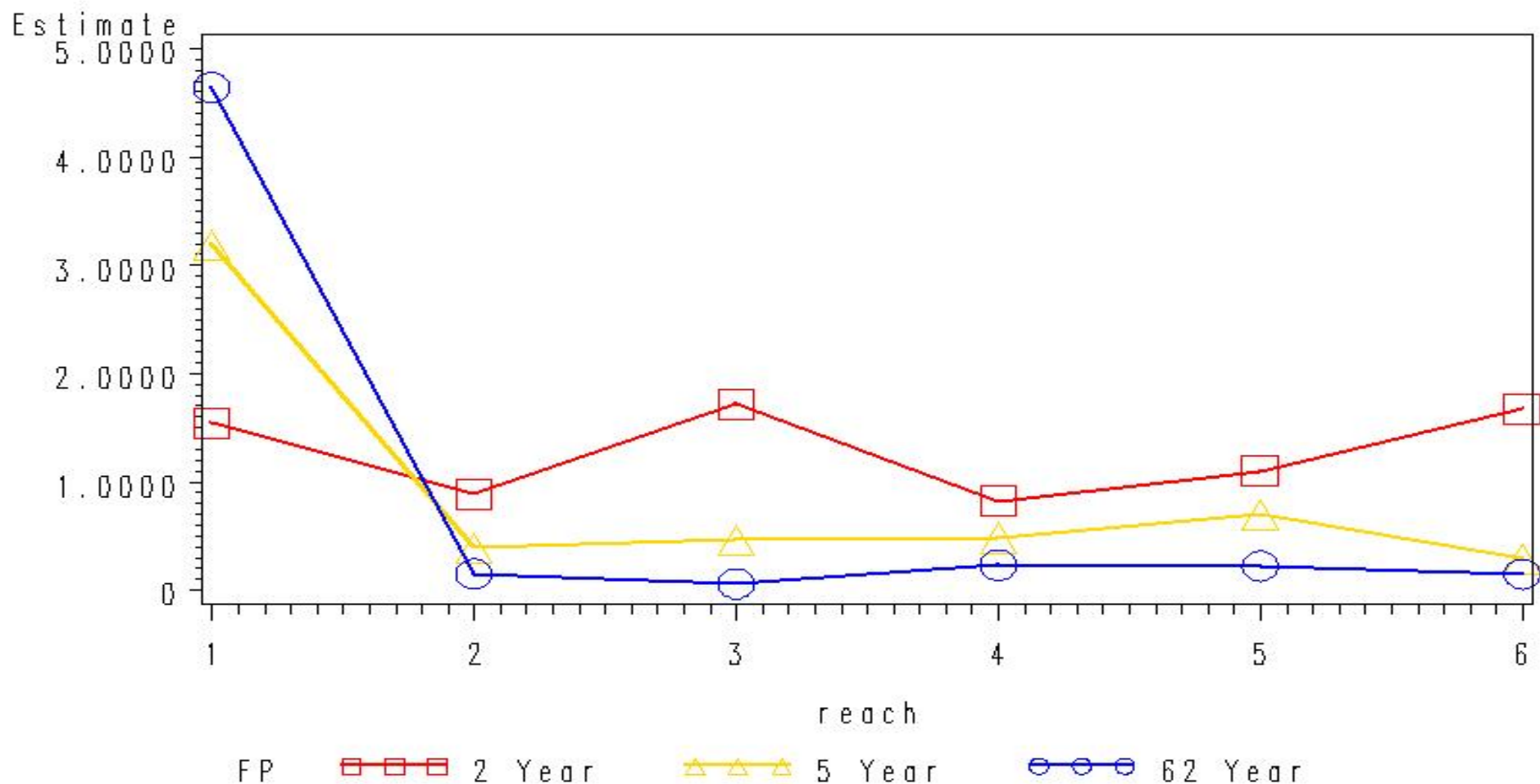
\*\*\* <0.01

# THg in Surface Samples by FP



**Spike in reach 3, 2-Yr FP corresponds to Dooms-Crimora spike observed in other types of samples. Small rise in reach 6, 2-Yr FP corresponds to high THg levels in Grottoes area in other types of samples.**

# THg in Composite Samples by FP



**THg averaged across landuse. Marked decrease in THg from reach 1 to 2 in 5- & 62-Yr FPs. Highest THg observed in 2-Yr FP except R1.**

# Summary/Conclusions

- THg tends to decrease as distance from the river increases.
- THg tends to decrease as elevation above the river increases.
- Increasing silt % and, less importantly, decreasing clay % are associated with increased THg.
- Increased organic material in the soil (LOI) associated with higher levels of THg.
  - LOI and particle size appear to represent the same relationship to THg
- THg levels higher in 2 year floodplain than 5 or 62.
  - Except reach 1: highest THg levels in 5 year floodplain.
  - Reach 1 samples closer to river than in other reaches.
  - Lowest THg always observed in 62 year floodplain.
- Land use Significant
  - Highest THg in forested areas (4/6 reaches), with pasture (reach 2) and open space (reach 1) highest in other reaches.
- Land use by floodplain interaction significant in reach 3, where highest THg in:
  - Forested areas in the 5 year floodplain.
  - Pasture areas of 2 and 62 year floodplains
- Conclusions regarding the surface soils data analysis are presented and composite sample data set evaluations indicate similar conclusions.
- THg levels in wetlands not elevated above other adjacent land uses in floodplain.
- April MeHg results for wetlands ranged from 0.01- 31.8 ng/g; In-river baseline monitoring stations generally range 1X- 2X higher during winter months than maximum value for wetlands.