OCCURRENCE and DISTRIBUTION of TRACE-METAL-CONTAMINATED SEDIMENTS, ASHUELOT RIVER, KEENE, NEW HAMPSHIRE

Timothy ALLEN and Erin BURNS
Geology and Environmental Studies,
Keene State College
Keene, NH 03435-2001
tallen@keene.edu

Given the history and geography of the Ashuelot River in southwestern New Hampshire, Keene State College students have been assessing the concentrations of toxic trace elements (As, Pb, Cu, Ni, Cr, and Zn) in sediments from the river.

Lead, Copper, and Nickel were all found at relatively high total concentrations in bulk sediment—exceeding toxicological thresholds (Buchman, 1999), in some cases significantly—at one or more sampling sites within the city of Keene.

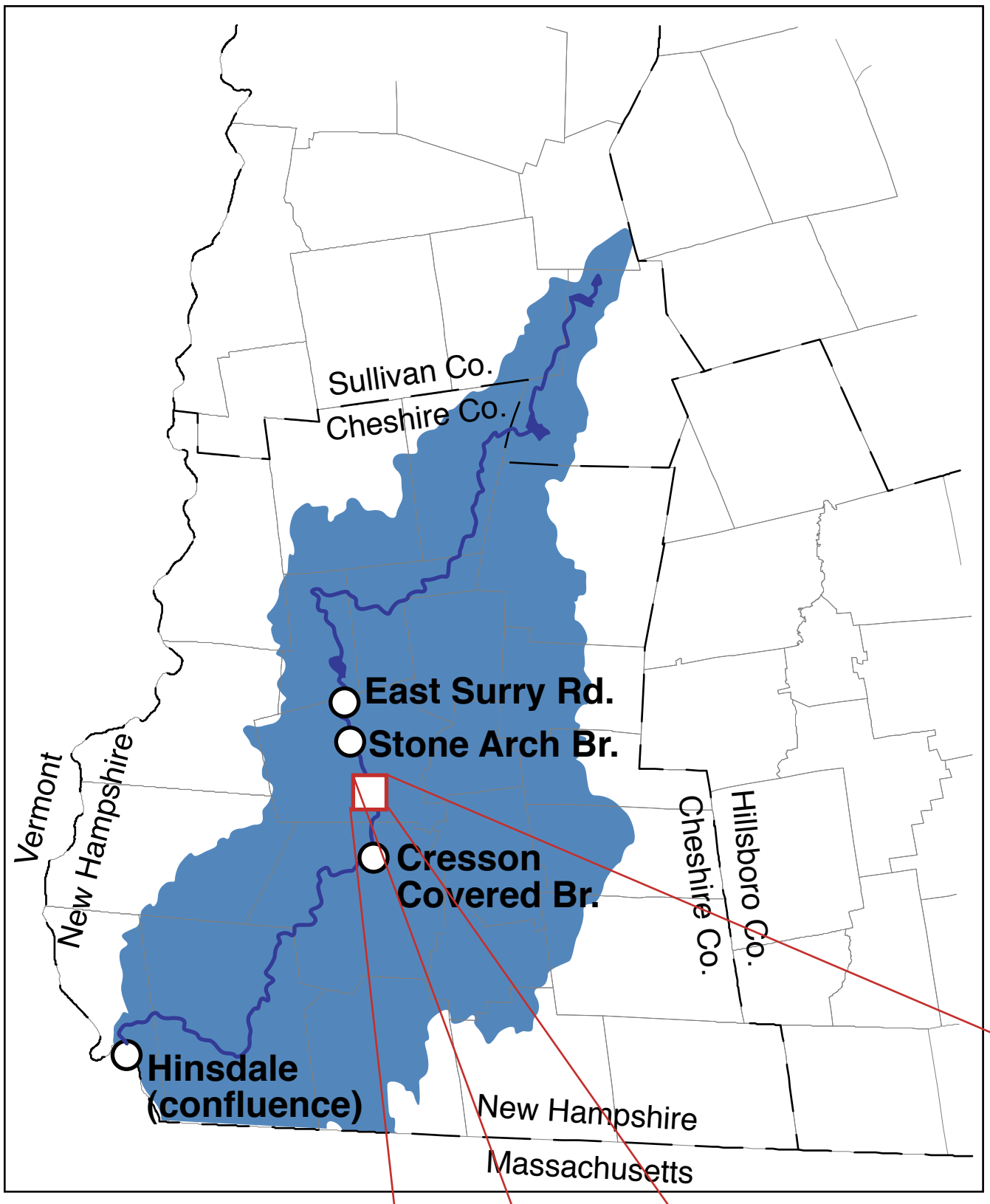
Following initial reconnaissance "grab" sampling (Allen *et al.*, 2003), we have mapped out the extent and distribution of contamination at two selected sites. This work suggest that the occurrence of contaminated sediments is wide-spread, but we do not as yet understand the pattern of distribution in relationship to the pattern of stream flow and sediment transport in this meandering river system. For example, the highest Lead concentrations are found on the outsides of the river bends, while sediment deposition would be expected to occur on the insides of the river bends.

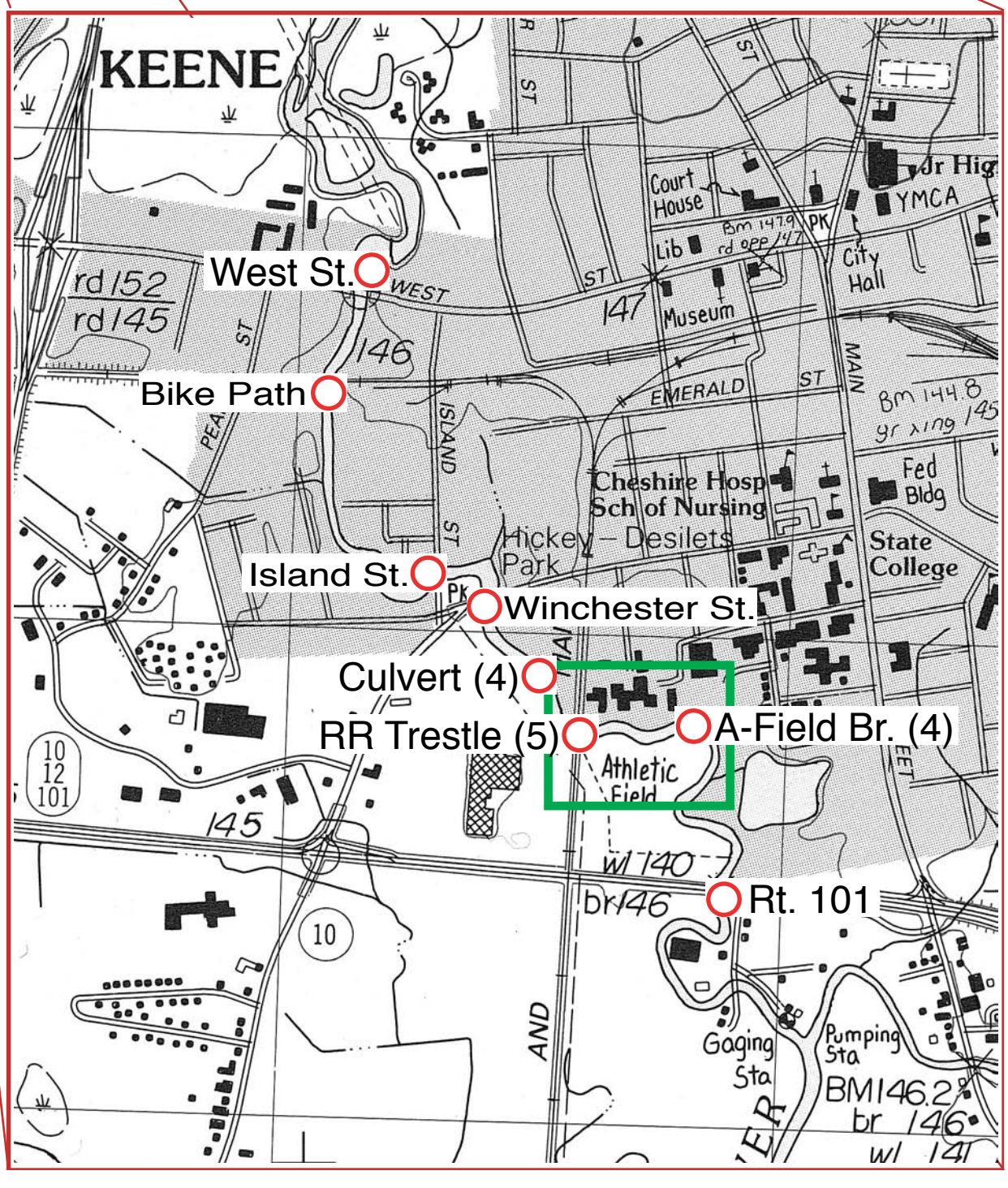
Additional work has also been done to begin assessing how these metals are hosted within the sediments.

Sample Sites

Sediment sampling sites from Allen *et al.*, 2003.

The area studied in the present work is outlined by the green box below.



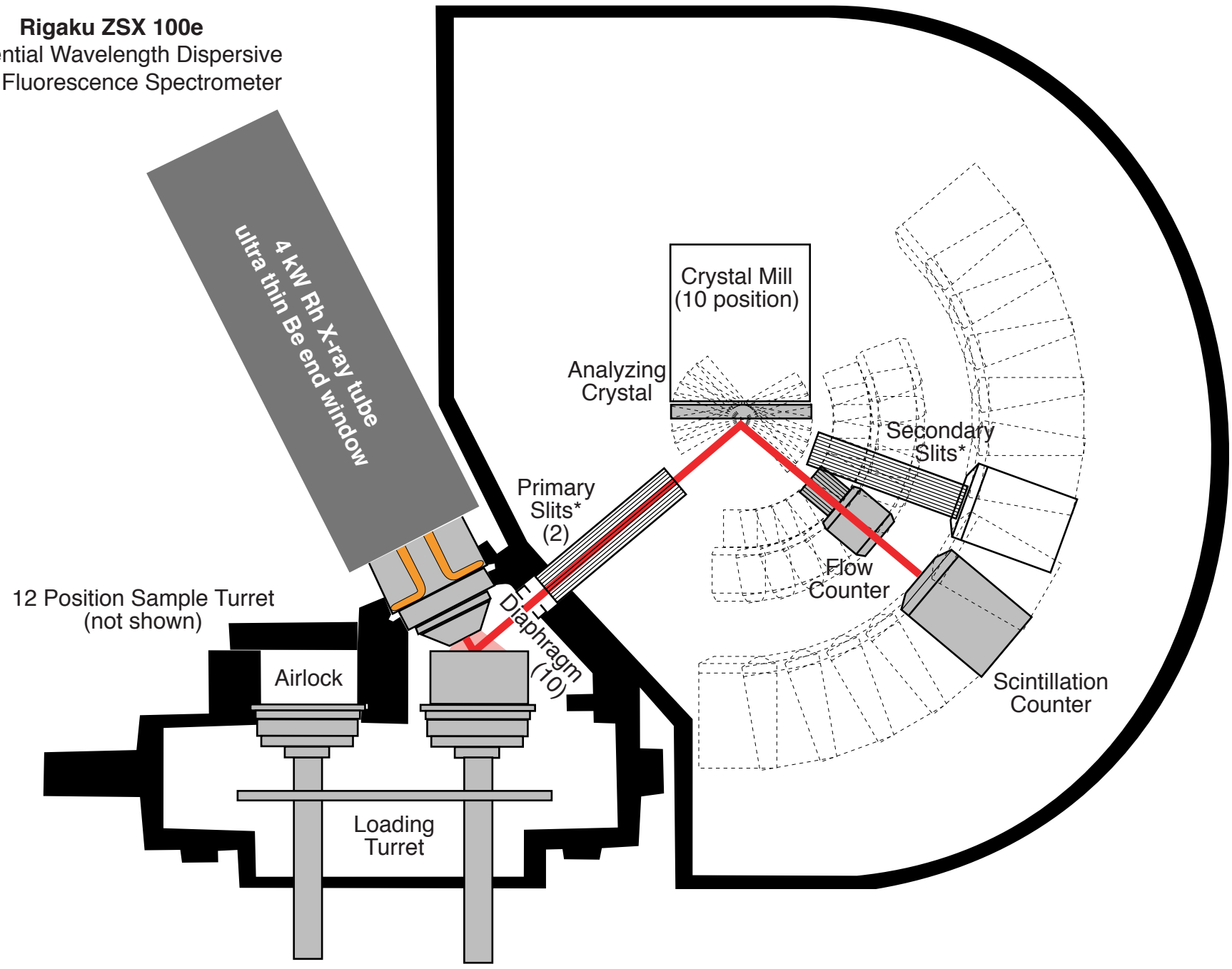


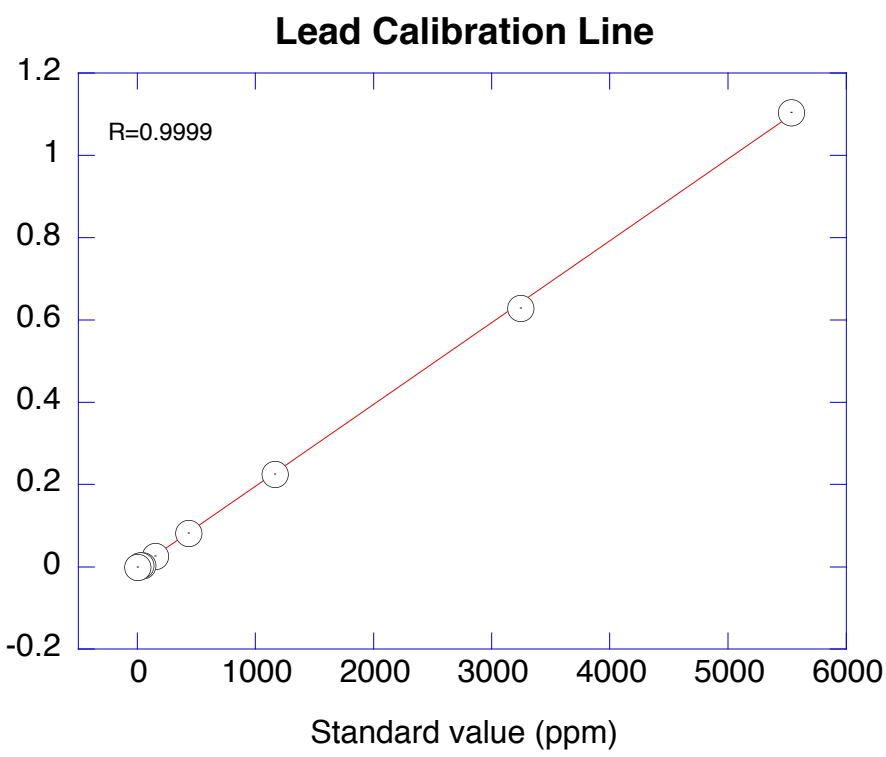
Methods

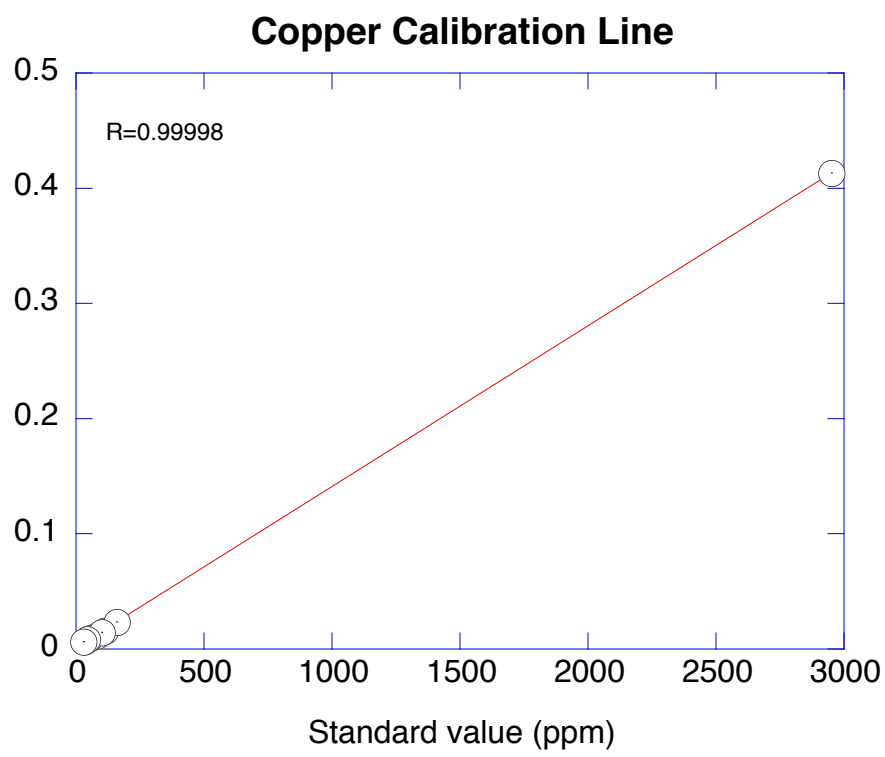
Samples were collected with a bucket auger, oven dried at 105°C, and passed through a 2 mm sieve. A split was pulverized in a tungsten carbide planetary ball mill, and an aliquot of the resulting powder mixed with binder and pressed into a pellet.

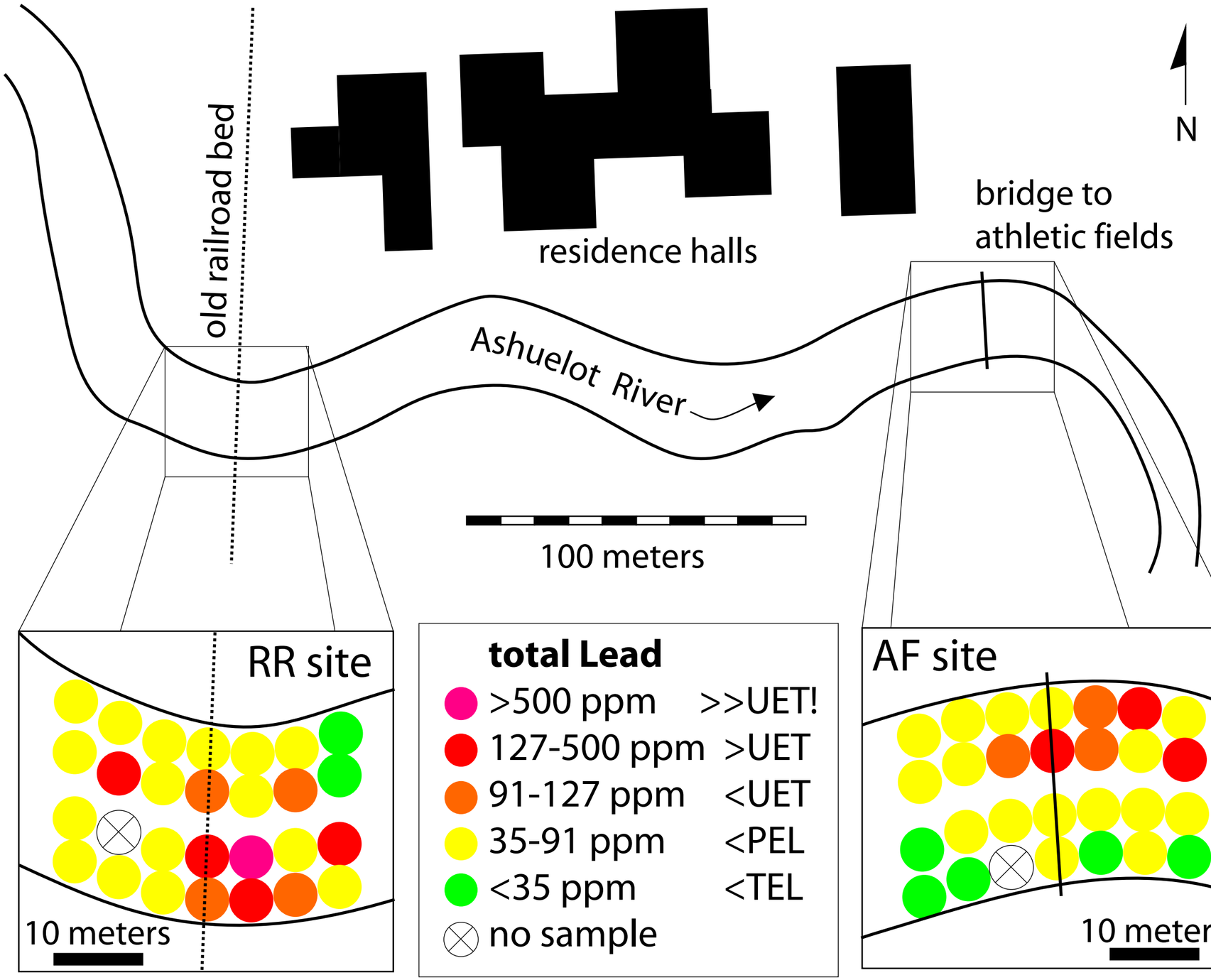
Pressed powder pellets were analyzed by Wavelength-Dispersive X-ray Fluorescence Spectrometry, with measured intensities ratioed against the Compton Scattering peak. Calibrations were done with USGS and NIST Standard Reference Materials.

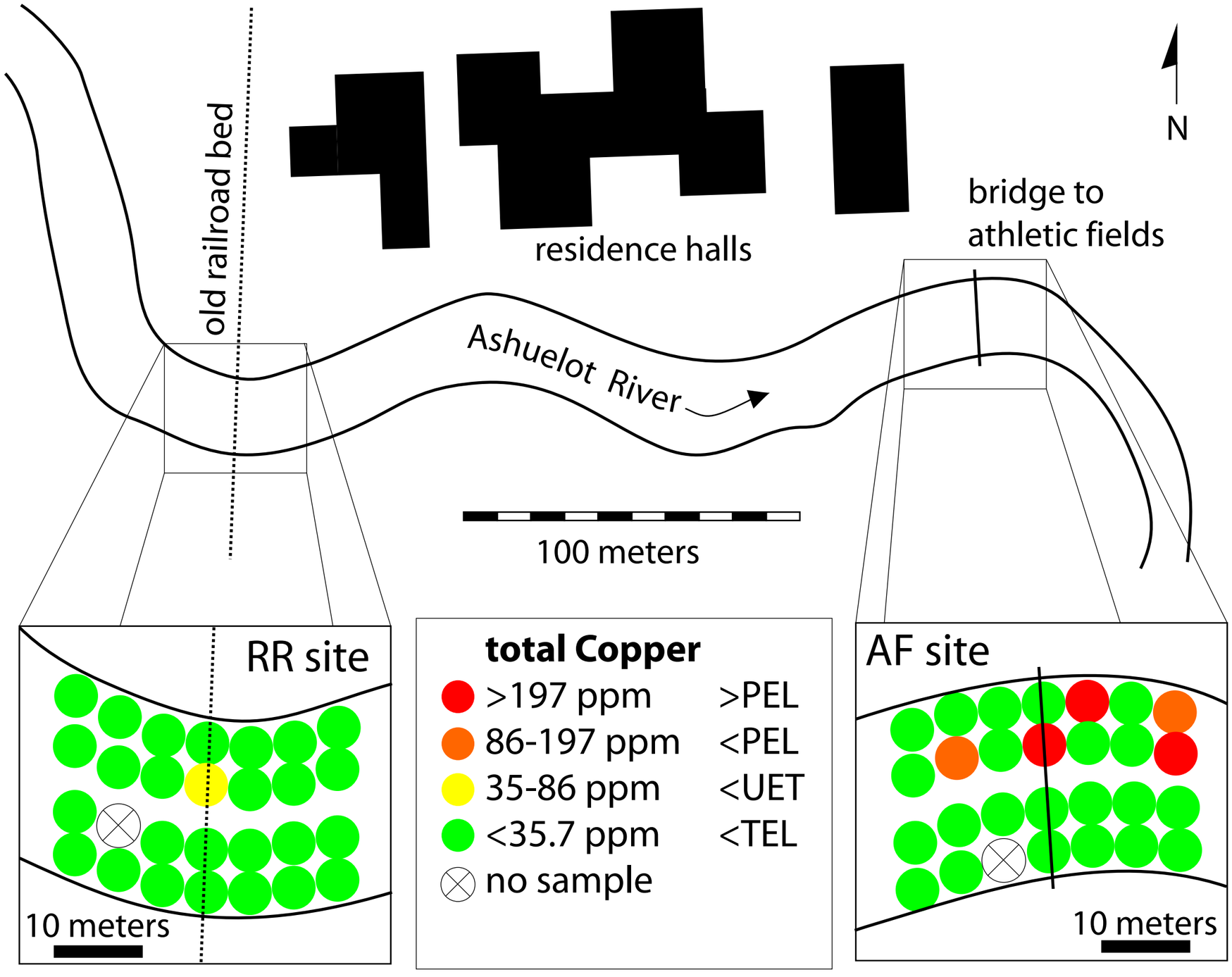
Rigaku ZSX 100e
sequential Wavelength Dispersive
X-ray Fluorescence Spectrometer








old railroad bed
residence halls
N
bridge to
athletic fields
Ashuelot River
100 meters
RR site
10 meters
total Lead
>500 ppm >>UET!
127-500 ppm >UET
91-127 ppm <UET
35-91 ppm <PEL
<35 ppm <TEL
no sample
AF site
10 meters


old railroad bed
residence halls
N
bridge to
athletic fields
Ashuelot River
100 meters
RR site
10 meters
total Copper
>197 ppm >PEL
86-197 ppm <PEL
35-86 ppm <UET
<35.7 ppm <TEL
no sample
AF site
10 meters

Sequential Extraction

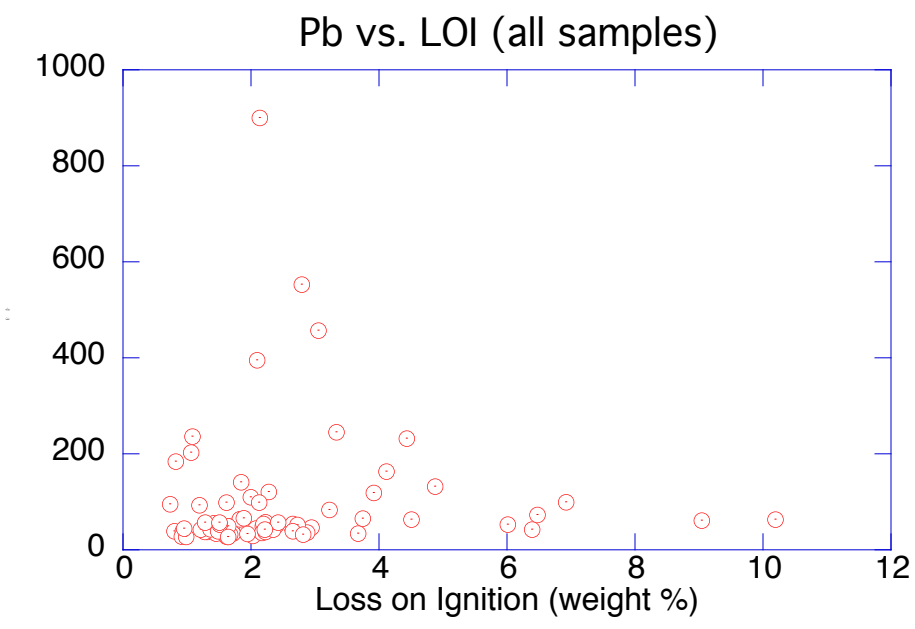
Erin followed the sequential extraction procedures of Tessier *et al.*, 1979, in an attempt to determine the speciation of lead and copper in these samples. These procedures determine (1) the exchangeable fraction, (2) fraction bound to carbonates, (3) fraction bound to iron and manganese oxides, (4) fraction bound to organic matter, and (5) the residual fraction of the trace metals. (Unfortunately, she was only able to complete the first two steps of the extraction before graduating!) The evolved liquids were analyzed by Atomic Absorption spectrometry.

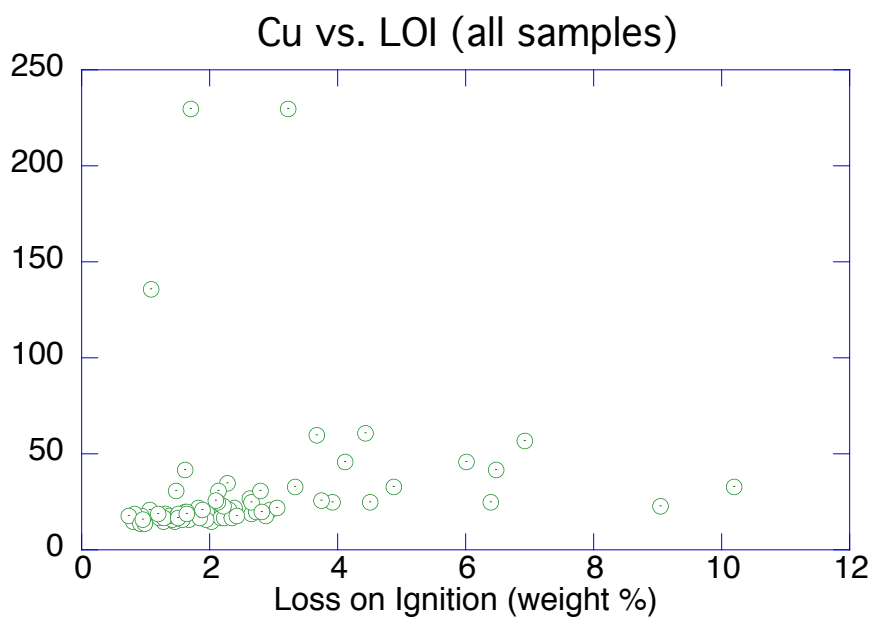
Trace Metal	**Pb**	**Cu**
Sample ID	RR-5c	AF-15a
Total (by XRF)	554	230
Exchangeable	7.77	1.60
Bound to Carbonate	1.25	1.25
Bound to Fe&Mn oxides	nd	nd
Bound to Organic Matter	nd	nd
Residual	nd	nd

all values in ppm

Loss on Ignition

Aliquots of all sediment sample powders were ignited at 1000°C for one hour and the mass change recorded. There was no correlation between extreme high trace metal concentrations and LOI, although there does appear to be a slight positive correlation between total copper content and LOI. It is assumed that most of the mass loss on ignition is due to combustion of organic matter in the sedi-





Sediment Toxicology

Threshold Effects Level (TEL):
- below this level, adverse affects on benthic organisms are very rare

Probable Effects Level (PEL):
- above this level, adverse effects on benthic organisms are frequently expected

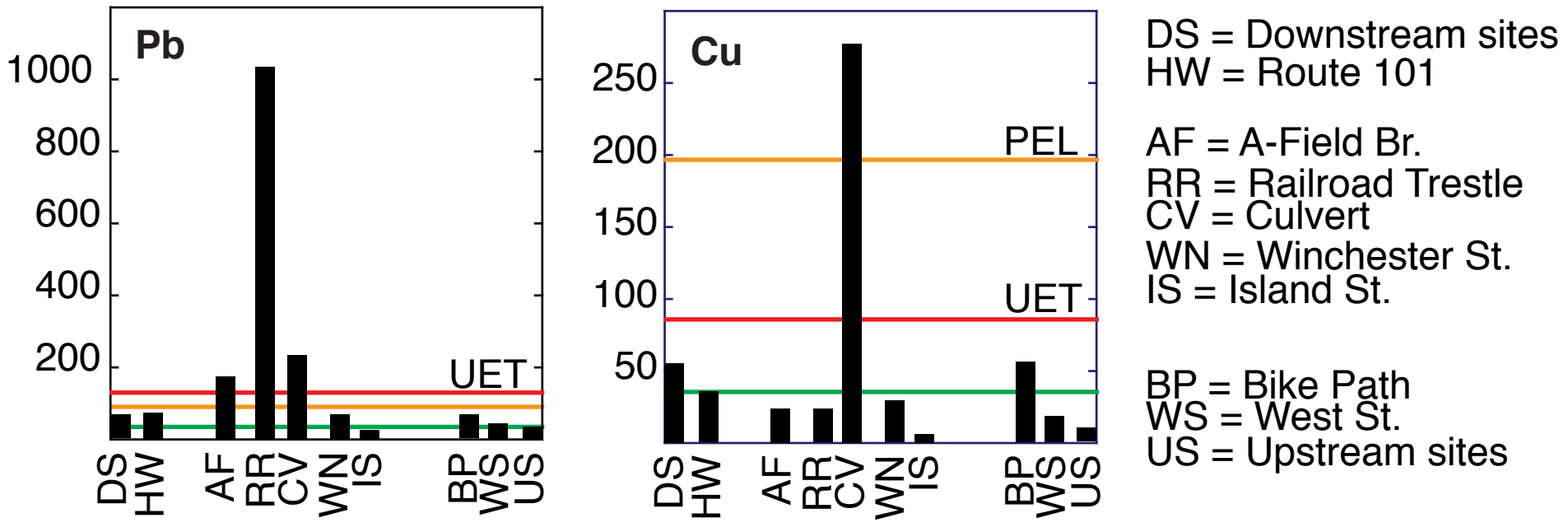
Upper Effects Threshold (UET):
- above this level, adverse effects on the benthic community are always expected

	Lead (ppm)	Copper (ppm)
unpolluted soils:		
– range:	0-700	0-700
– average:	16	17
unpolluted freshwater sediment:		
– range:	4-17	10-25
Threshold Effects Level (**TEL**):	35.0	35.7
Probable Effects Level (**PEL**):	91.3	197
Upper Effects Threshold (**UET**):	127	86*

*note that the UET for Copper is lower than the PEL!

Source: Buchman, 1999

Prior Results



Reconnaisance total Lead and Copper concentrations (ppm) in Ashuelot River sediments (Allen *et al.*, 2003), relative to respective TEL, PEL and UET values.

References

Allen, T., *Comeau, M., *Carson, H., *Hurd, E., 2003, "A Reconnaissance of the Heavy Metal Content of Ashuelot River Sediments," *Studies in New England Geography,* No. 17, 23 pages.

Buchman, M.F., 1999, *NOAA Screening Quick Reference Tables,* NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages.

Tessier, A., Campbell, P.G.C., and Bisson, M., 1979, "Sequential Extraction Procedure for the Speciation of Particulate Trace Metals," *Analytical Chemistry*, 51(7), 844-851.

Acknowledgements

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