

Assessment of Water Column data collected in response to a fly ash release on the Delaware River



Delaware River Basin Commission

DELAWARE · NEW JERSEY
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UNITED STATES OF AMERICA

Delaware River Basin Commission

John R. Yagecic, P.E.

June 19, 2006

Executive Summary

- Ash basin leak at PPL's Martin's Creek power plant August 23rd-27th, 2005 released ~100 million gallons of ash and water into the Delaware River;
- The States of PA & NJ requested that DRBC compile and assess water column data from agencies and PPL;
- The results of this effort are as follows:

Arsenic

- Some apparent exceedance of PA human health arsenic criteria immediately after the release in the vicinity of the release. These exceedances are not observed upstream of the release.
- Apparent signature of release observable downstream but below PA arsenic criteria.

Executive Summary (continued)

Lead

- Apparent exceedances of PA and NJ lead criteria immediately after release in the vicinity of the release.

Aluminum

- Some short term local exceedance of PA aluminum criteria from release, but background and high flows account for most of the observed concentration.

Manganese

- Manganese concentrations appear to be background concentrations.

Executive Summary (continued)

Copper

- Short term copper exceedances of PA criteria at release and downstream.

Selenium

- Selenium concentrations appear to be background concentrations.

Mercury

- Mercury data almost completely below reporting limits.

Brief Background

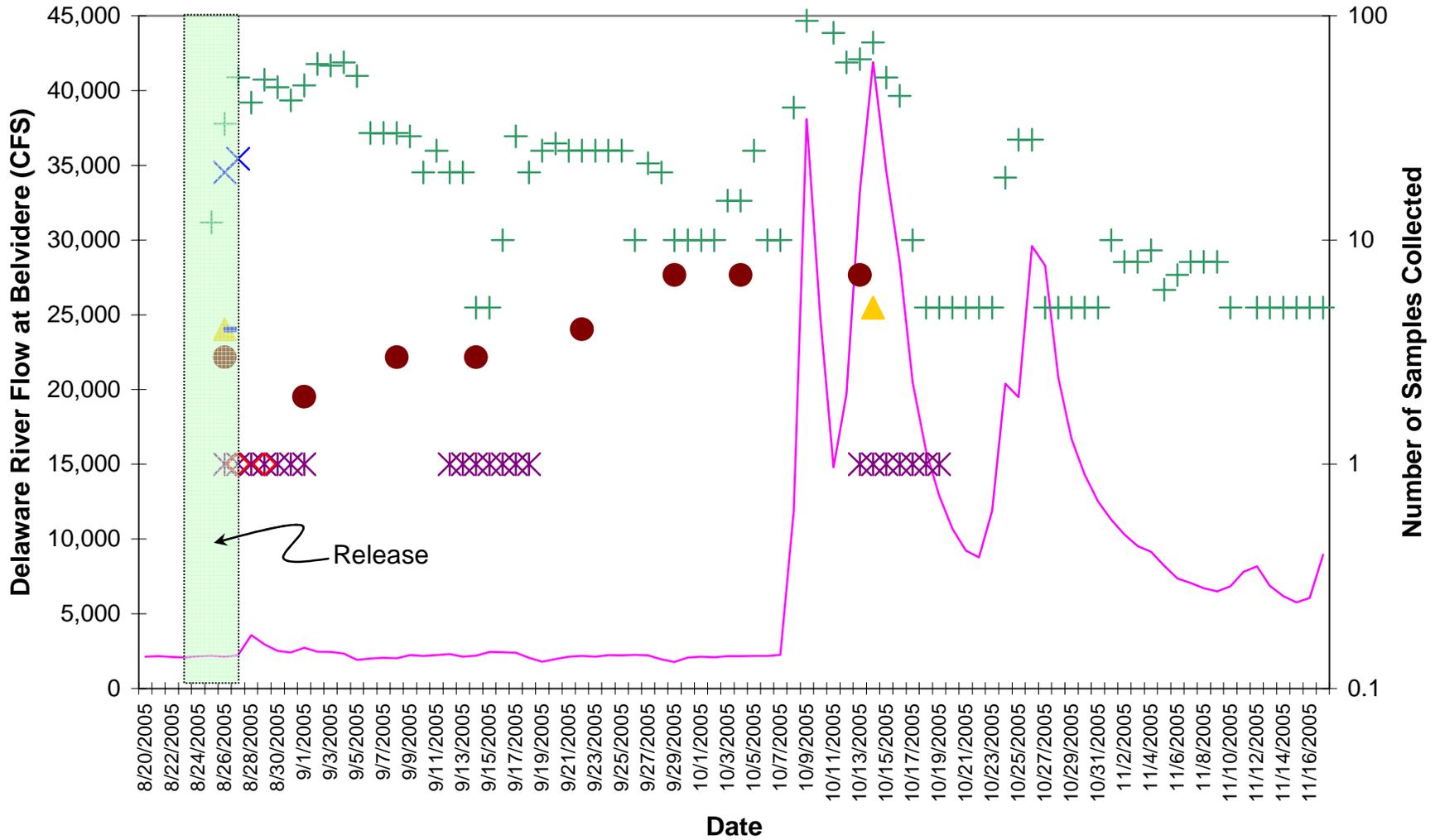
- Ash basin leak at PPL's Martin's Creek power plant August 23rd-27th, 2005 released ~100 million gallons of ash and water into the Delaware River;
- Agencies and PPL met at DRBC on November 3, 2005 to review data collected up to that point;
- DRBC agreed to compile and assess data from agencies and PPL;
- Agencies and PPL agreed that DRBC and PPL should perform separate but parallel assessments;
- Agencies and PPL previewed DRBC draft assessment on March 2, 2006. Recommended expansion of the data set and minor changes.
- This Document:
 - Results of DRBC's assessment;
 - Narrowly focused on data – not an assessment of regulatory issues.

Post-Release Water Column Sampling Effort

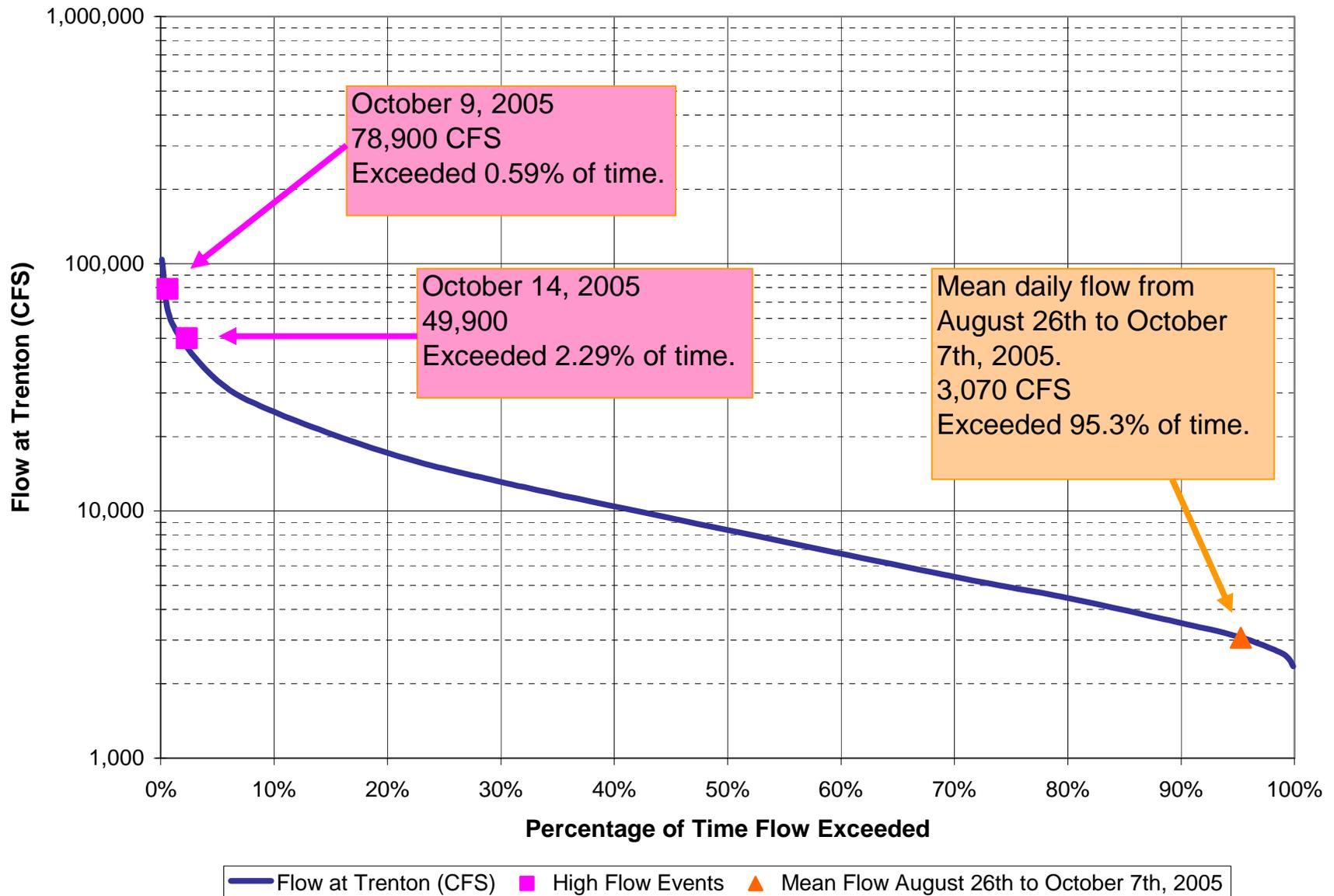
Data received by DRBC as of 12/2005

Organization	Samples Collected	Sampling Days	Locations	Analytical Parameters
PPL	>1,700	84	16	60
NJDEP	47	2	9	28
PADEP	36	8	16	up to 117
NJWSA	21	21	1	24
DRBC	9	2	4-5	30
PWD	4	1	4	5
USGS	2	2	1	10
Total	>1,819			

Post-Release Sampling Effort



Wide Range of Flows During Sampling



Criteria at the time of release

(some criteria have subsequently changed)

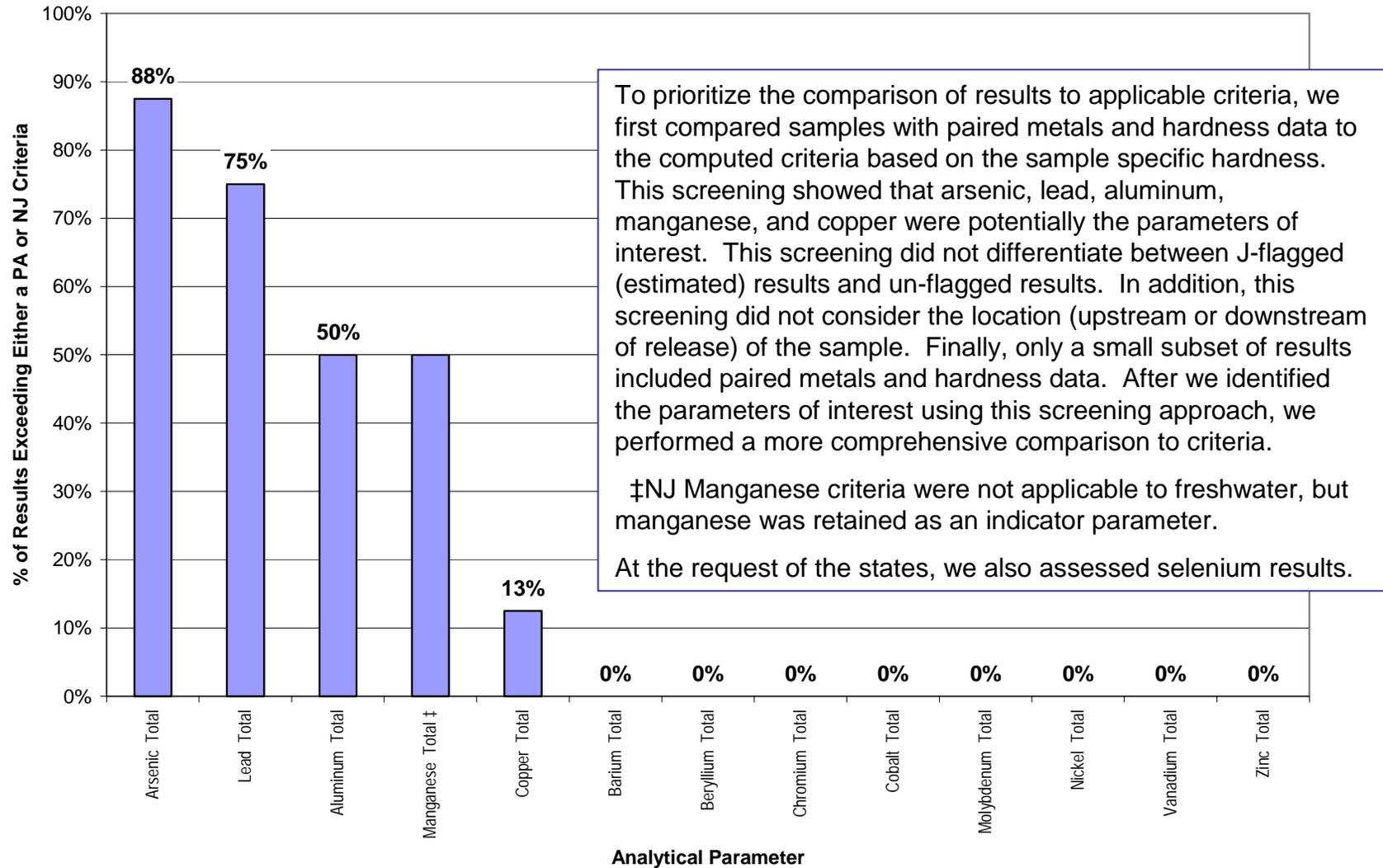
Pennsylvania

- Chapter 16. Water Quality Toxics Management Strategy – Statement of Policy;
- CCCs, CMCs, and Human Health Criteria.
- Governing (most stringent) PA criteria;
 - Human Health for arsenic;
 - CCC for all others.

New Jersey

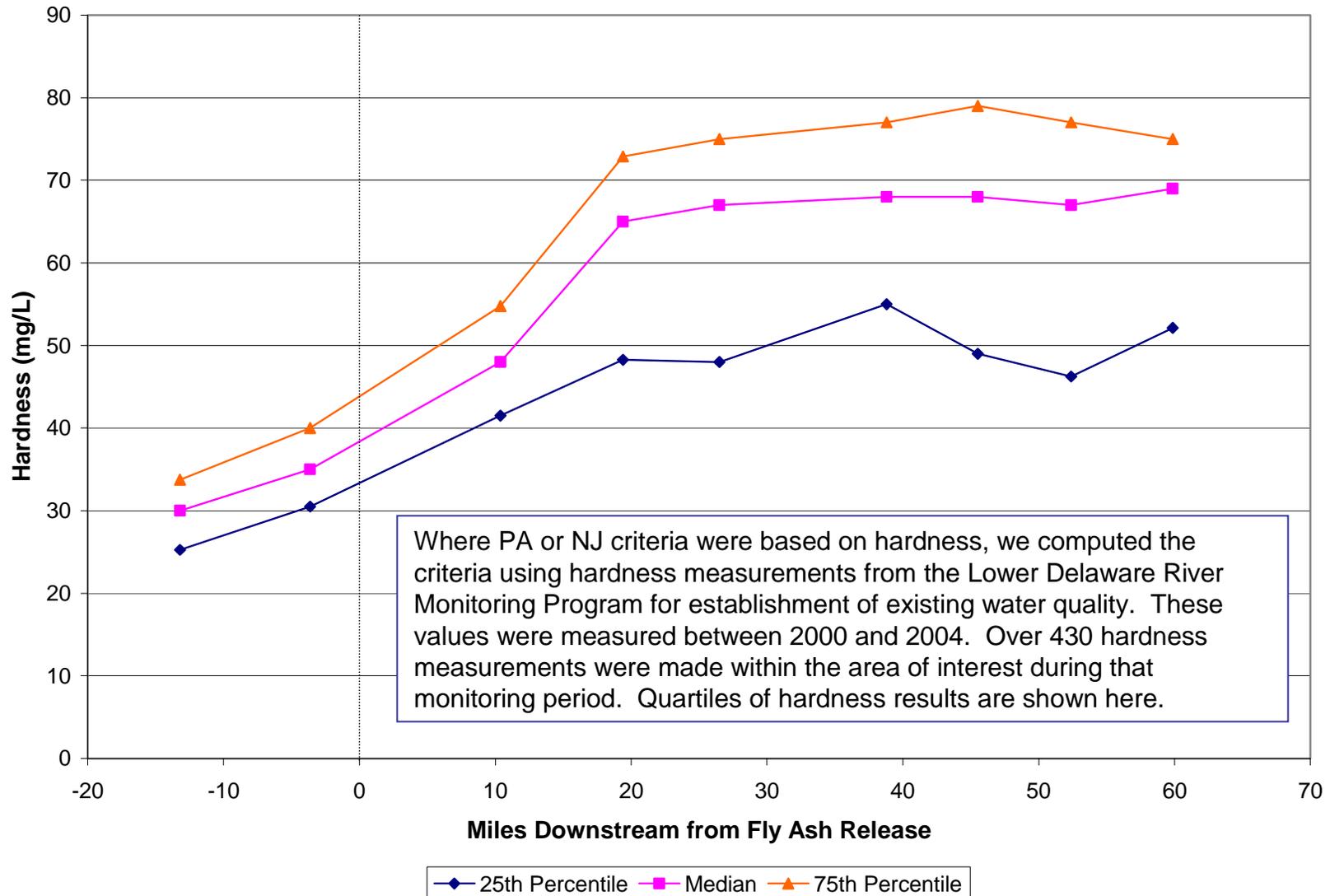
- Surface Water Quality Standards N.J.A.C. 7:9B (June 2005);
- For the Delaware River, NJ defers to DRBC criteria where DRBC have criteria;
- Where DRBC doesn't, use FW2-NT criteria for non-saline waters.

Prioritization of Analytical Parameters*

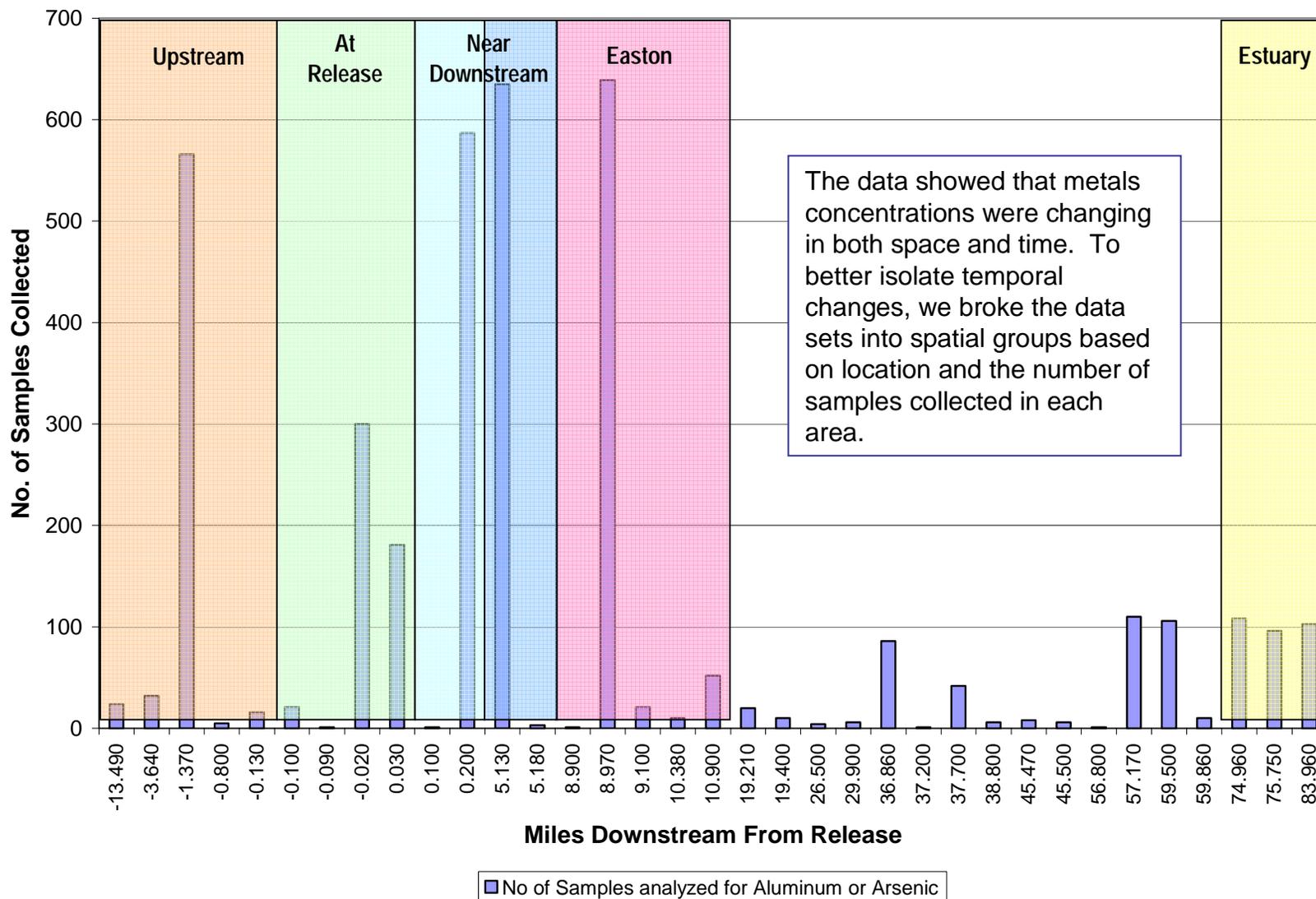


*For prioritization only – not for regulatory purposes

Hardness Ranges from Lower Delaware Existing Water Quality Study



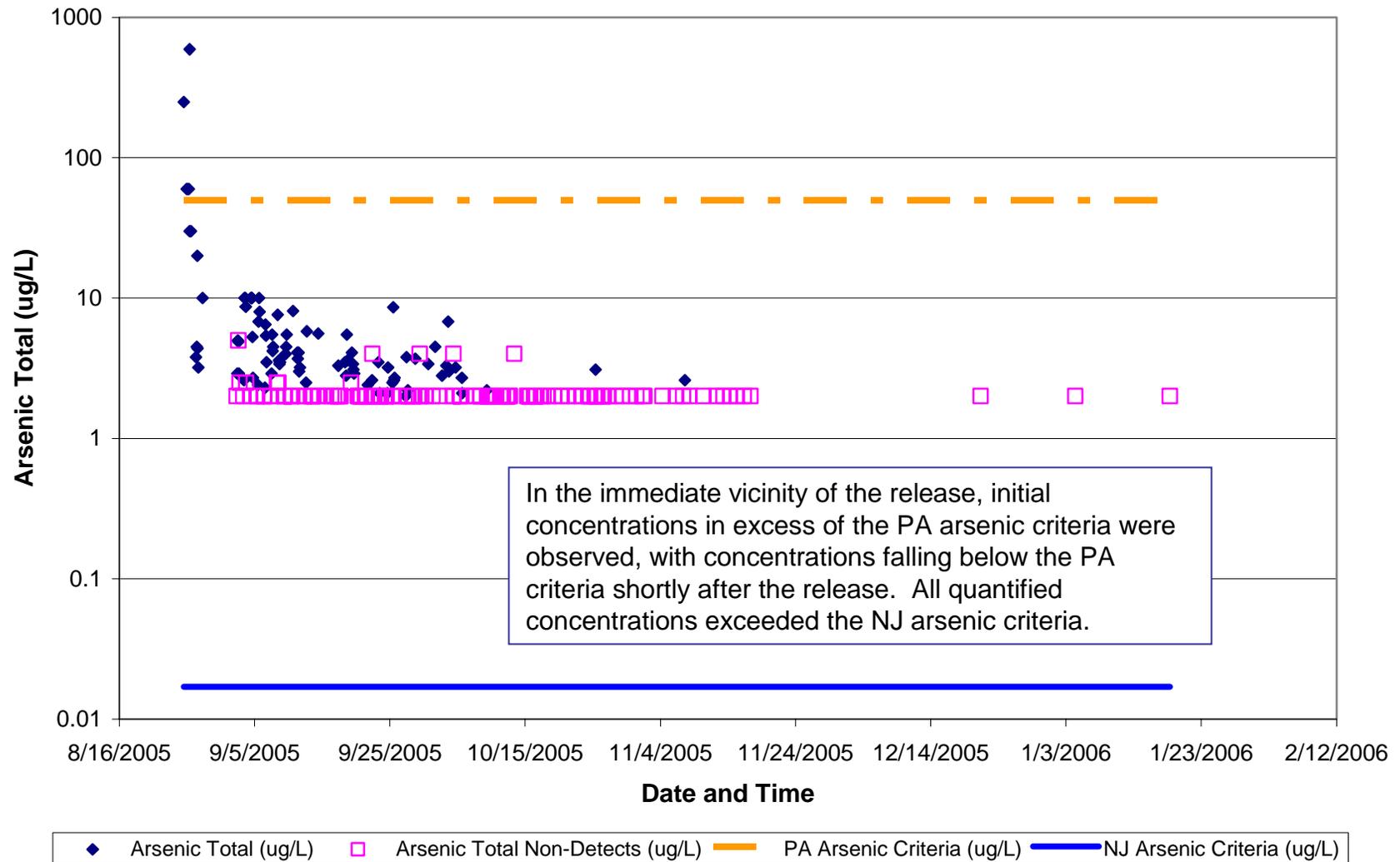
Spatial Grouping of Results based on Arsenic and Aluminum Samples



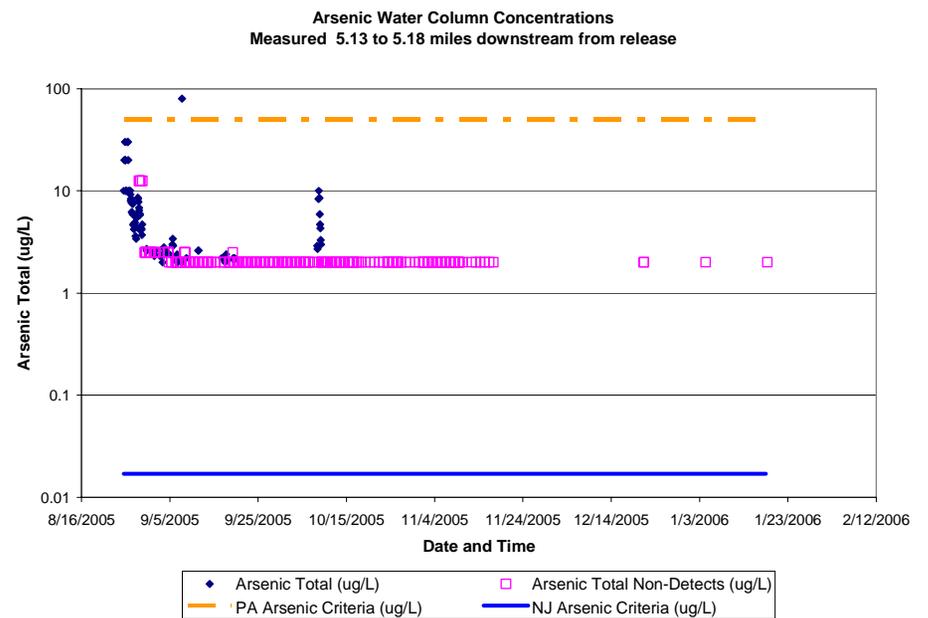
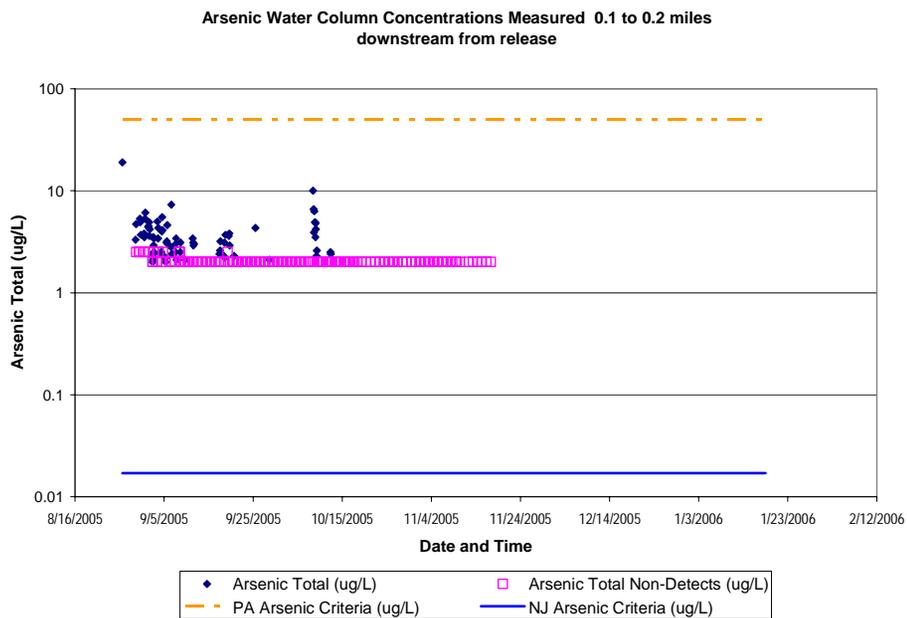
Arsenic Results

Arsenic Concentrations at Release

Arsenic Water Column Concentrations Measured in the immediate vicinity of the Release



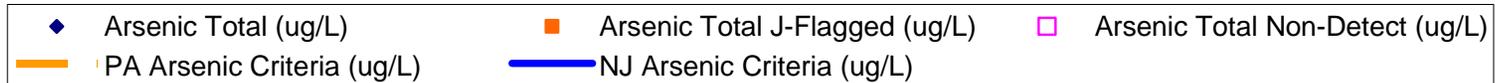
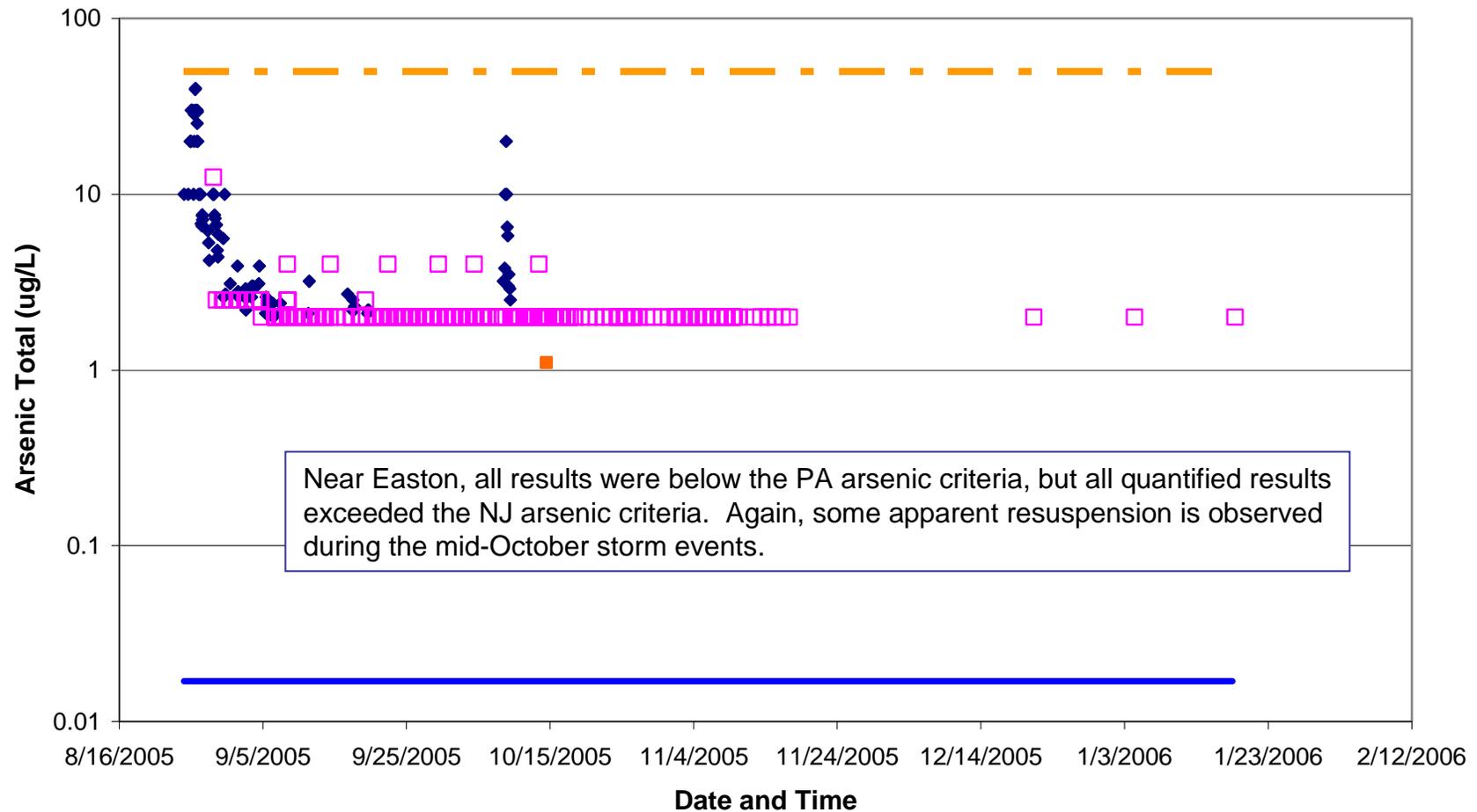
Arsenic Concentrations near Downstream



A comparison of time series arsenic measurements at two downstream ranges shows that most results were below the PA arsenic criteria, but all quantified results exceeded the NJ arsenic criteria. Both plots suggest resuspension of settled arsenic during the mid-October storm events.

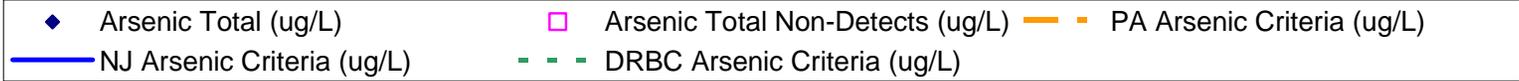
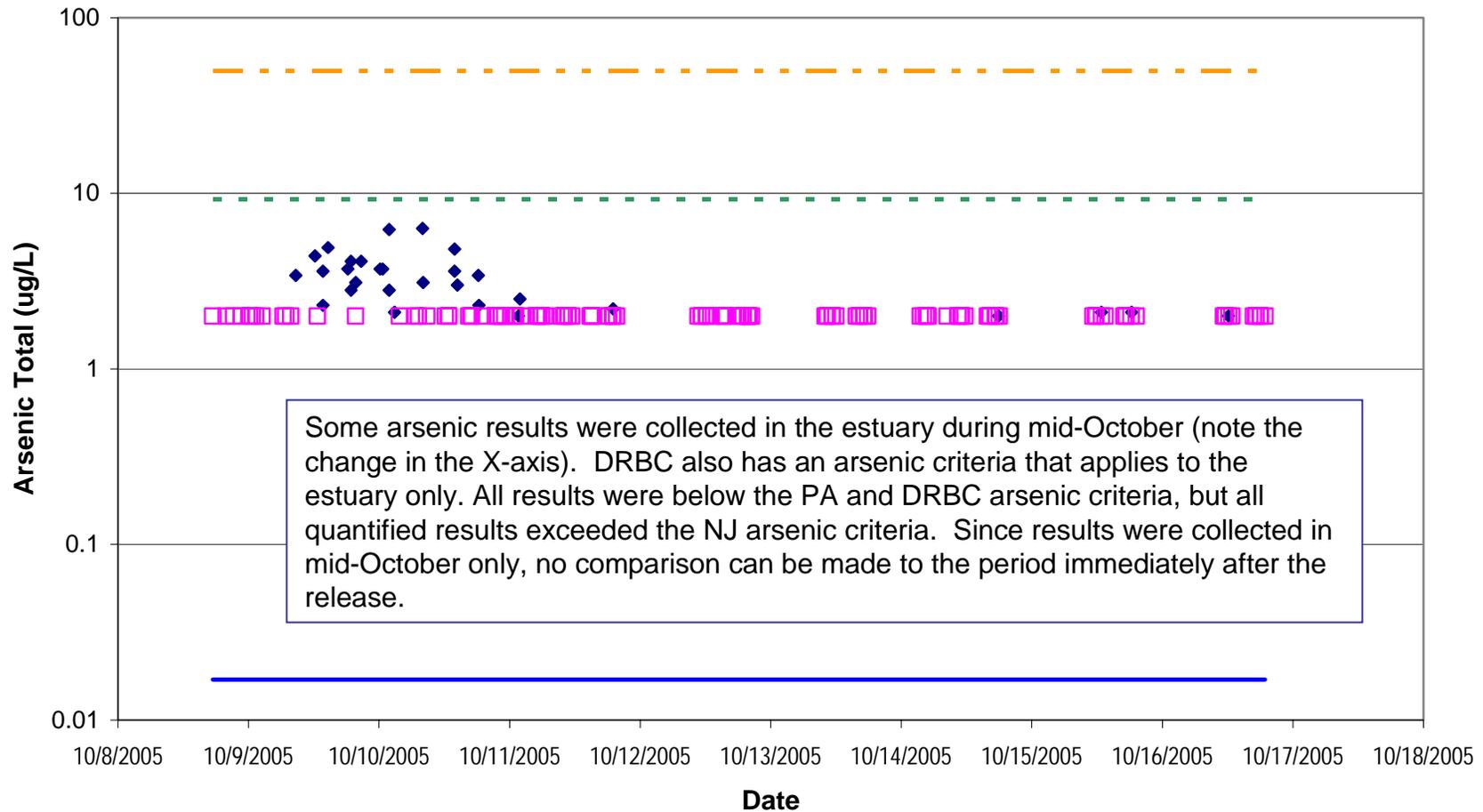
Arsenic Concentrations near Easton

Arsenic Water Column Concentrations Measured between RM 8 and 11 (Easton)



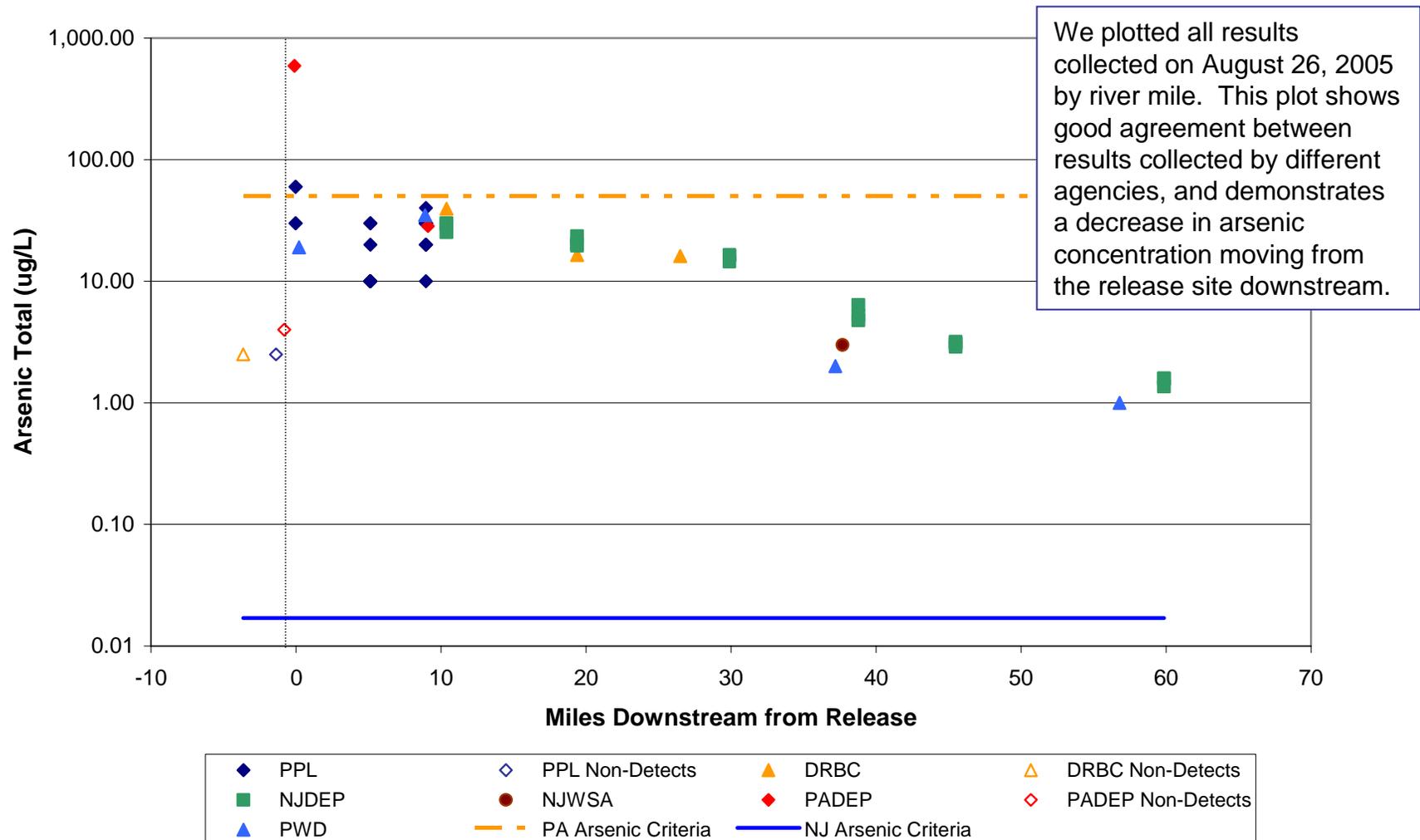
Arsenic Concentrations in Estuary

Arsenic Water Column Concentrations Measured in the Estuary



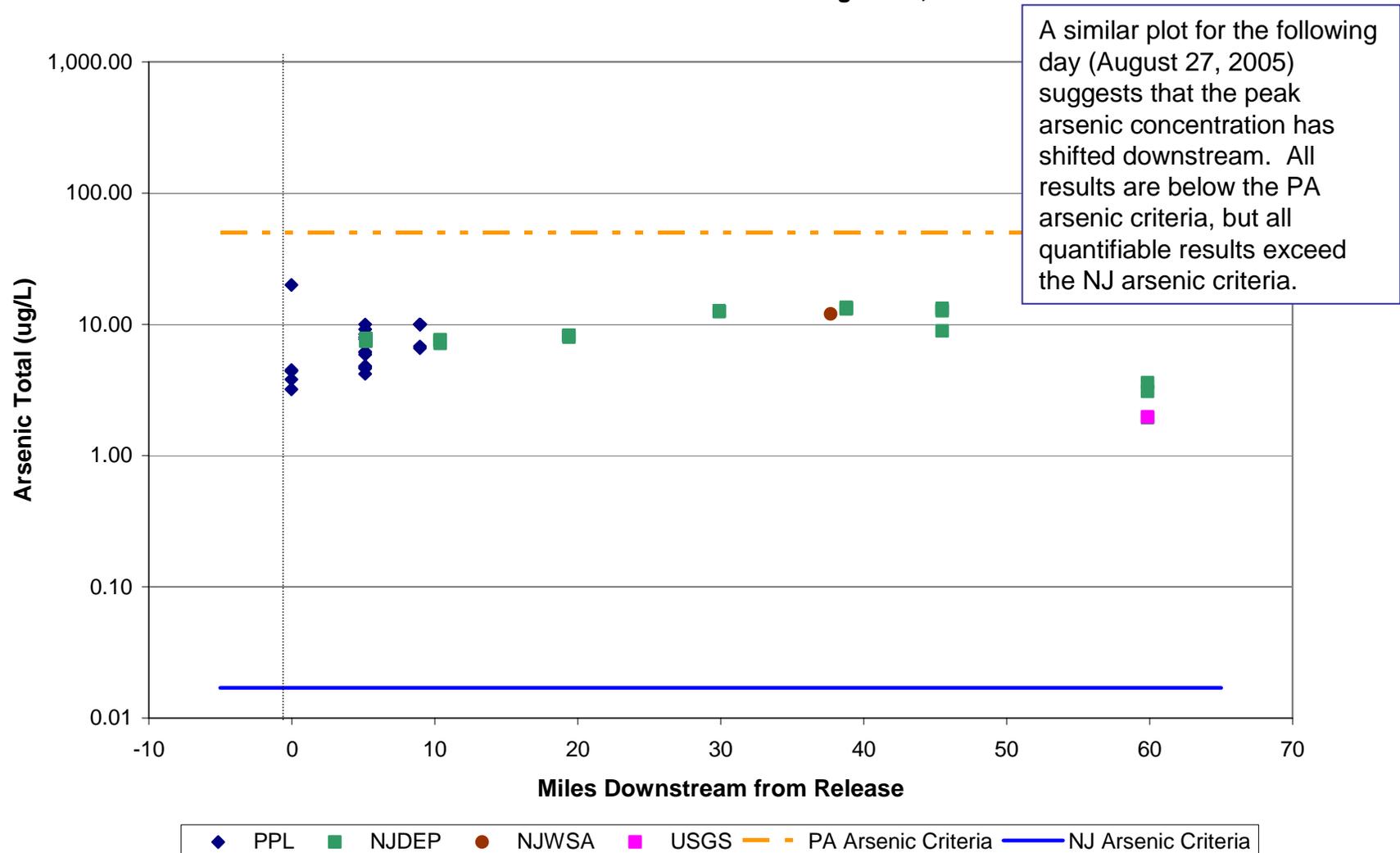
Arsenic Concentrations by Distance from Release, August 26, 2005

Arsenic Water Column Concentrations on August 26, 2005



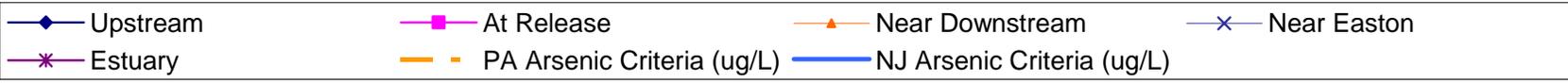
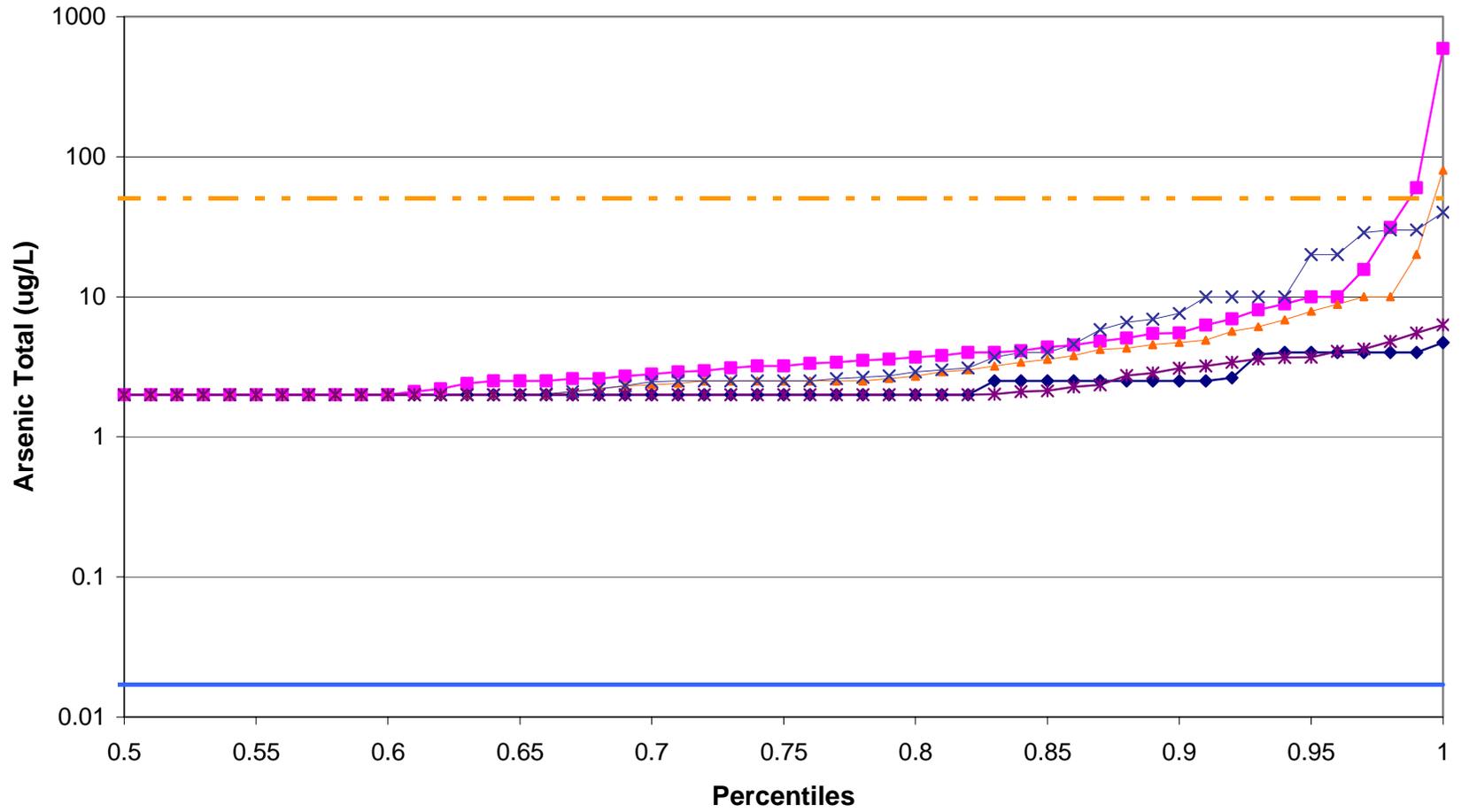
Arsenic Concentrations by Distance from Release, August 27, 2005

Arsenic Water Column Concentrations on August 27, 2005



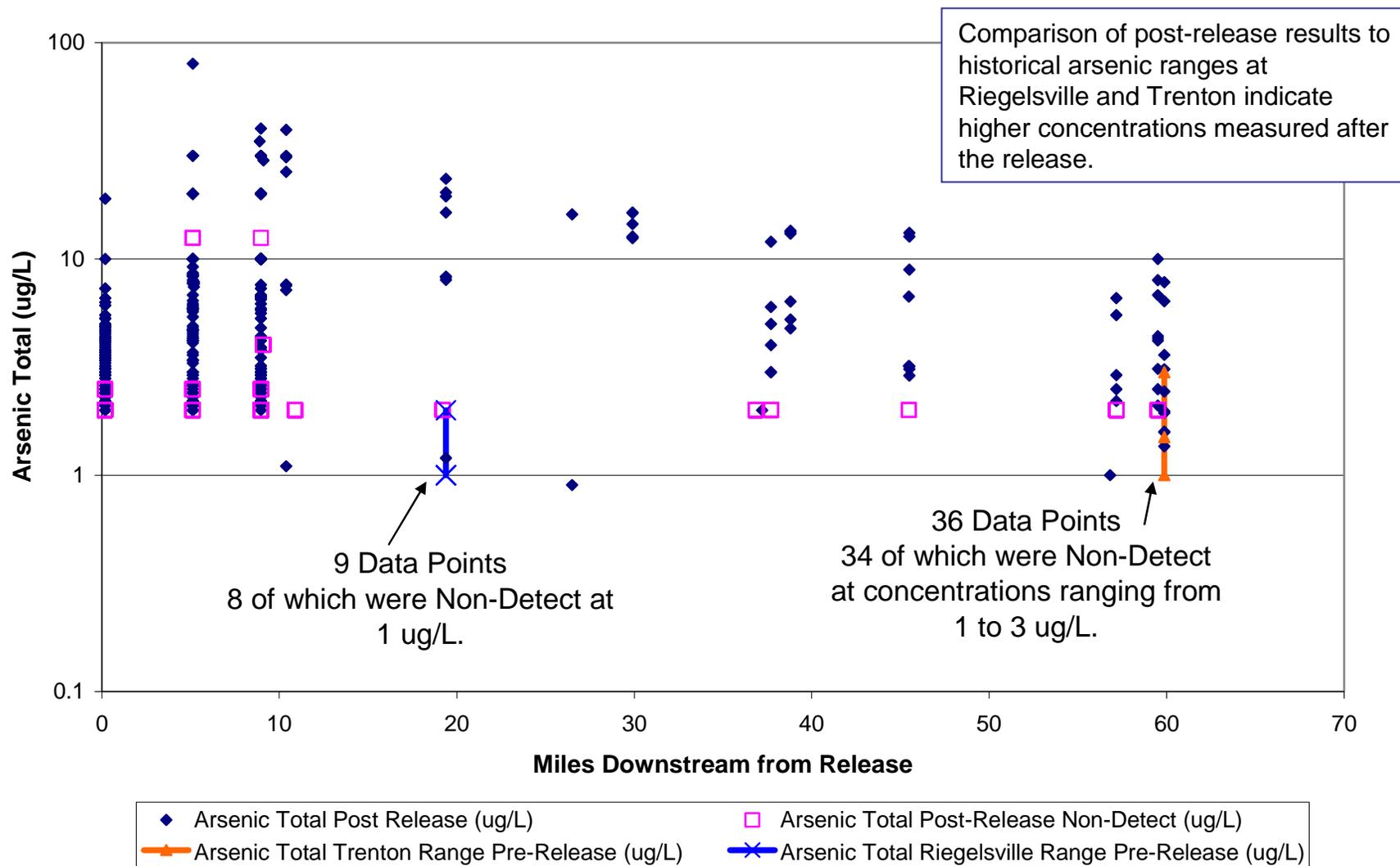
Percentiles of Arsenic Measurements

Percentiles of Water Column Arsenic Measurements from 5 Location Ranges



Comparison to Pre-Release Arsenic Data (1992-Present) found in NWIS and STORET

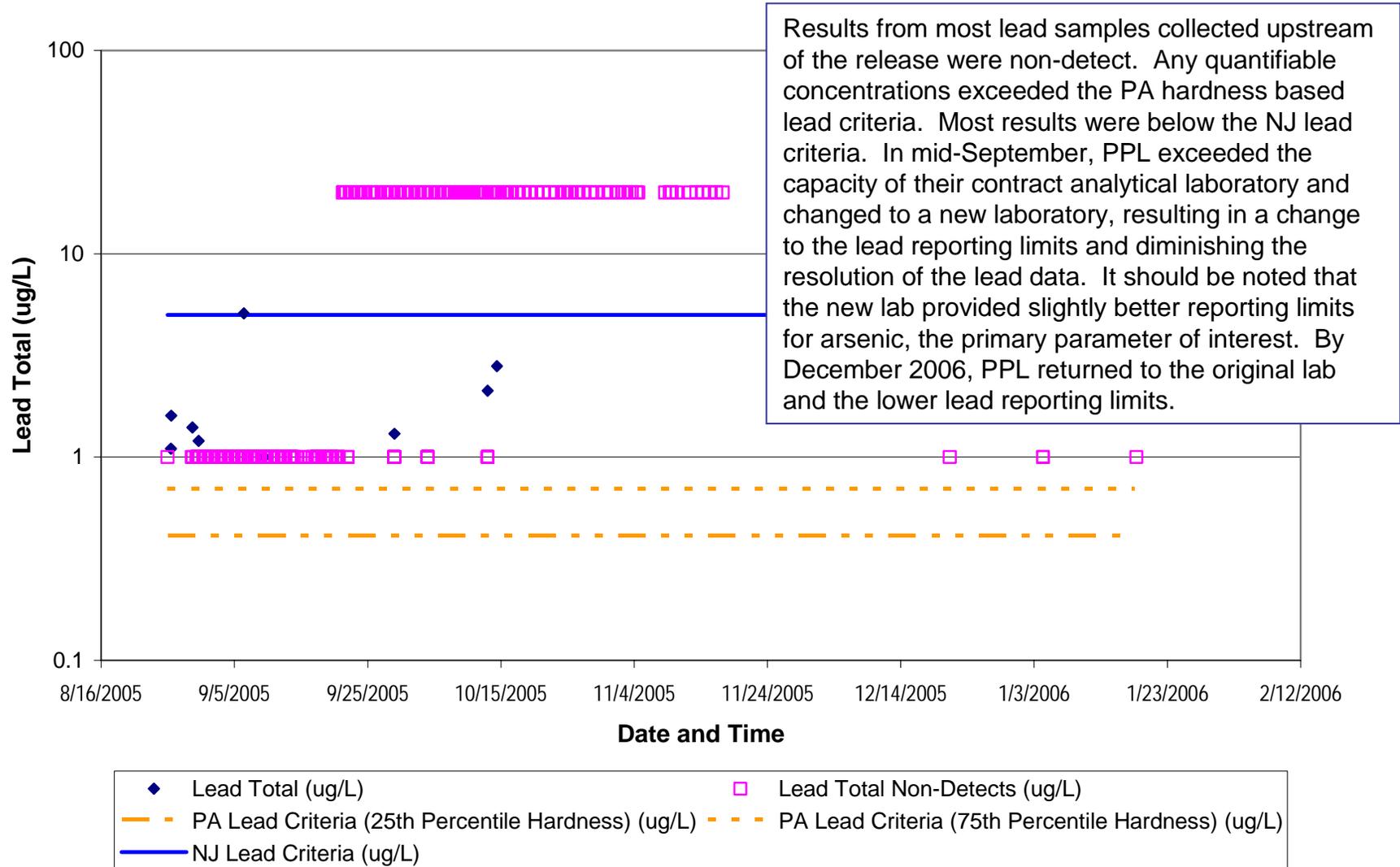
Comparison of Pre- and Post-Release Arsenic Concentrations



Lead Results

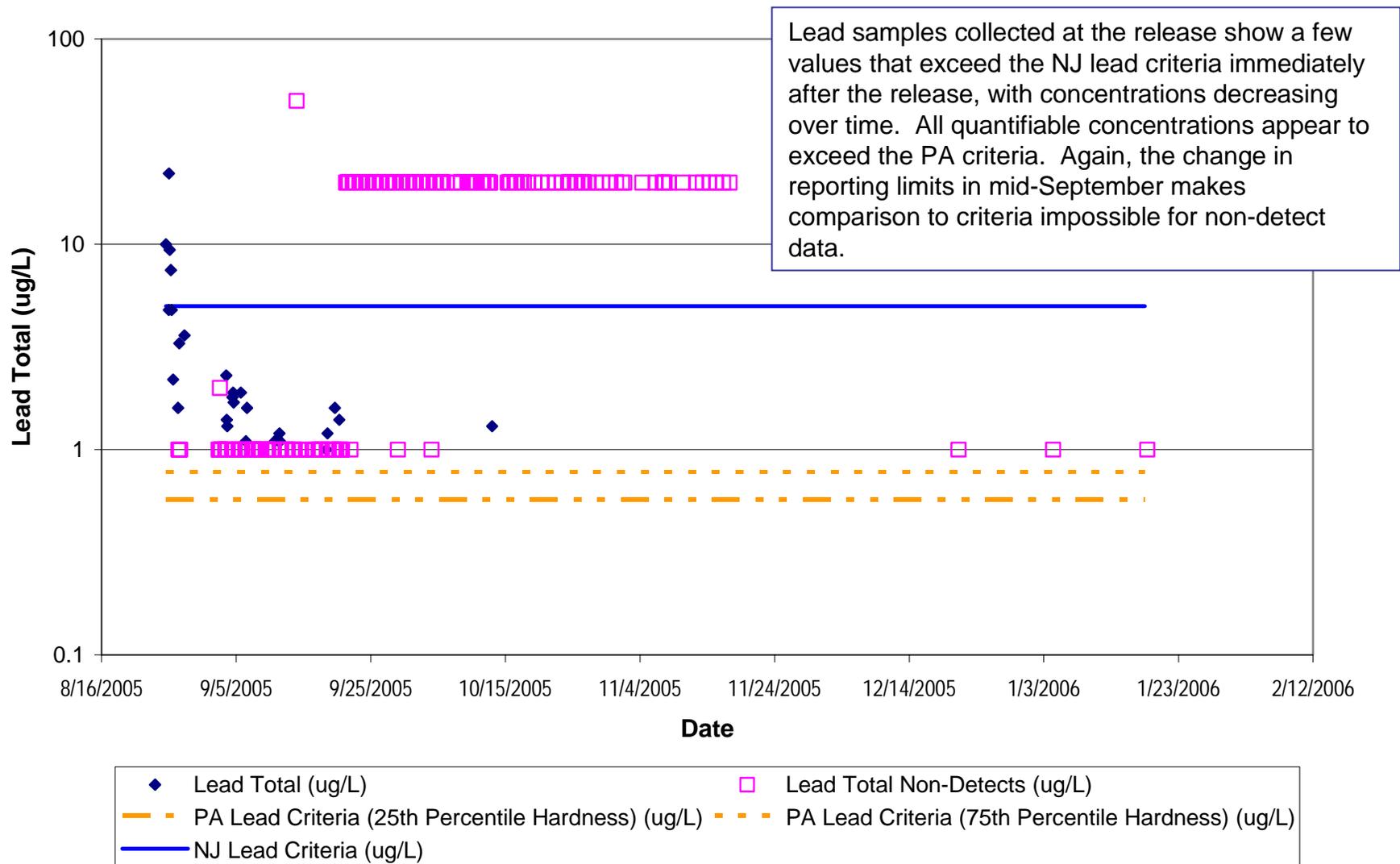
Lead Concentrations Upstream of Release

Lead Water Column Concentrations Measured Upstream of Release



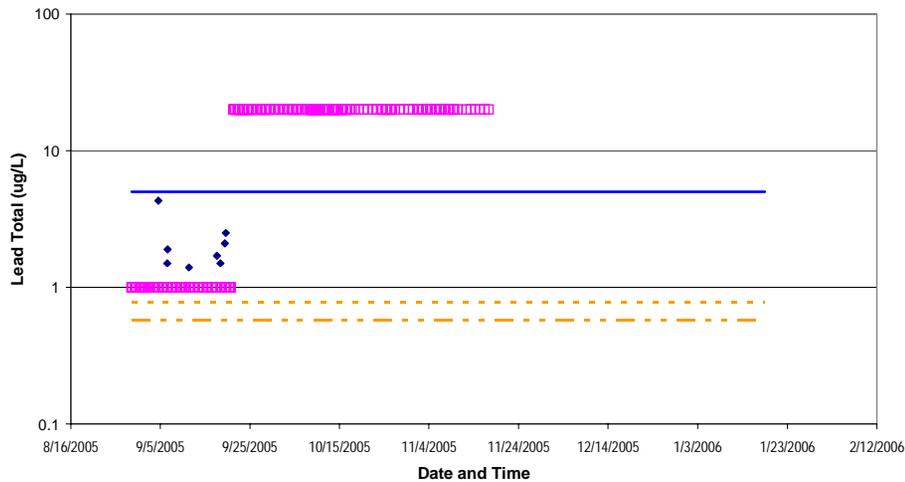
Lead Concentrations at Release

Lead Water Column Concentrations Measured in the immediate vicinity of the Release

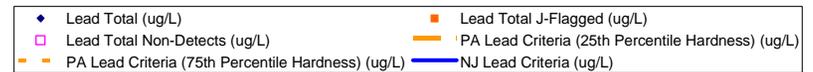
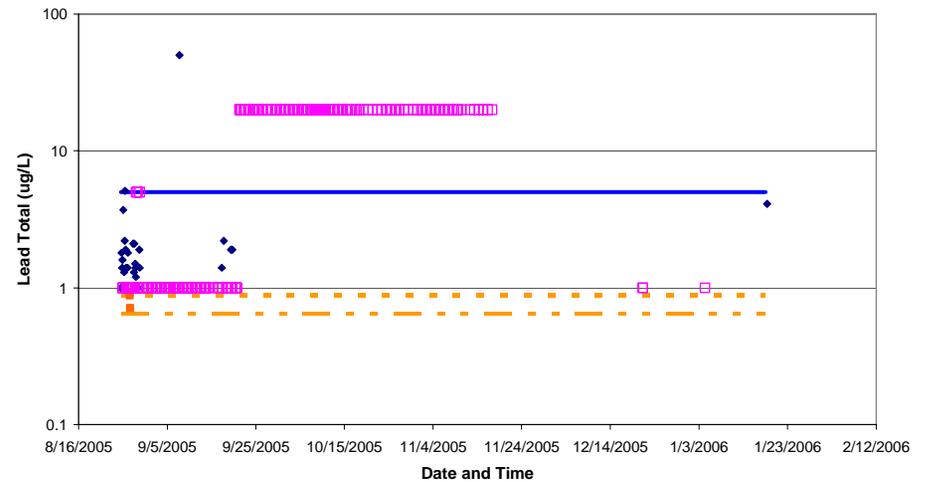


Lead Concentrations near Downstream

Lead Water Column Concentrations Measured 0.1 to 0.2 miles downstream from release



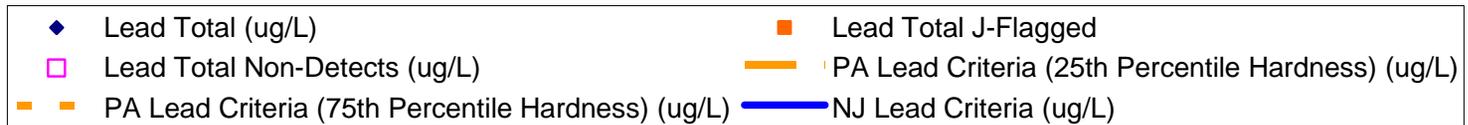
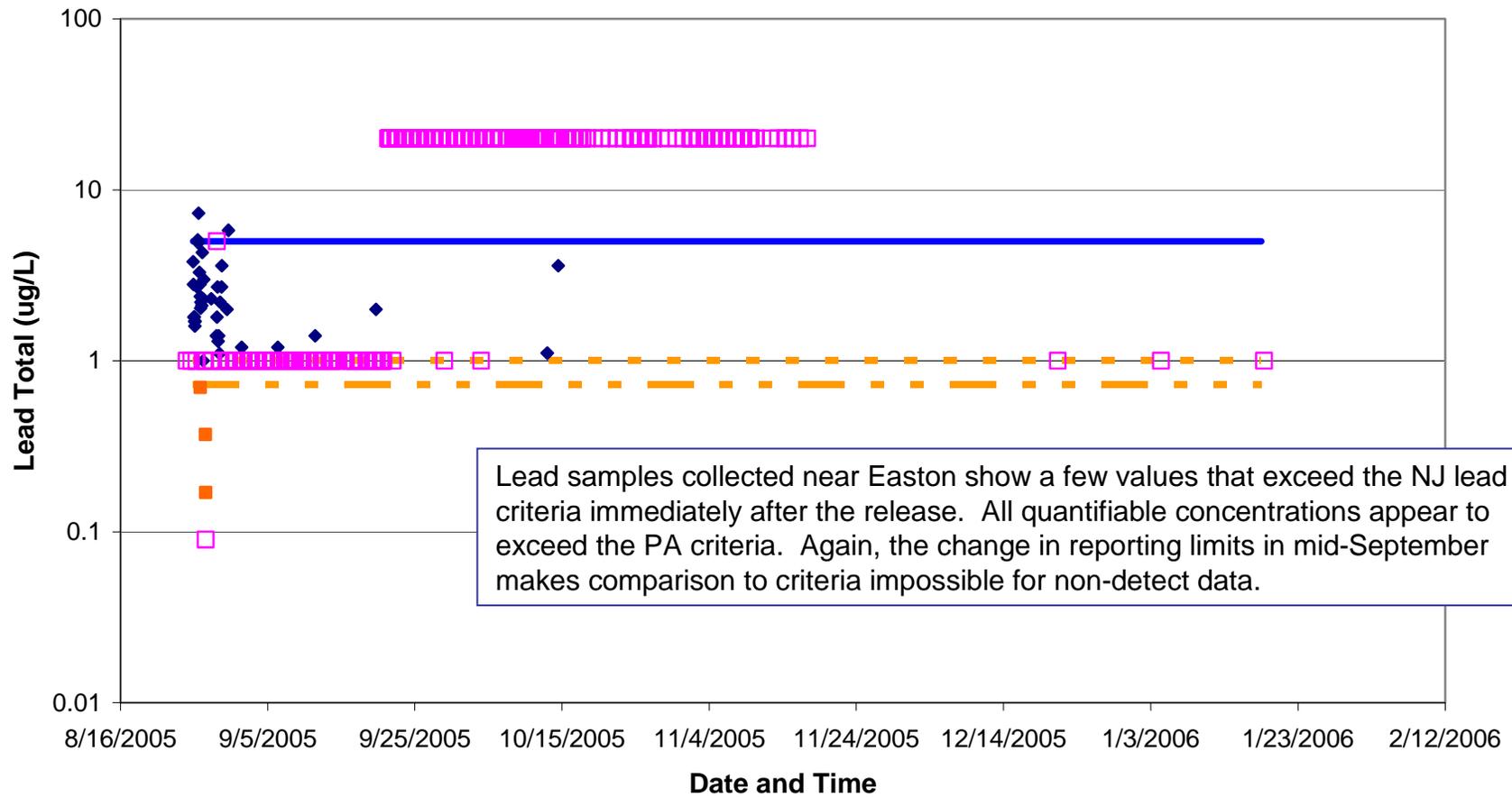
Lead Water Column Concentrations Measured 5.13 to 5.18 miles downstream from release



Lead samples collected downstream of the release are mostly below the NJ lead criteria. All quantifiable concentrations appear to exceed the PA criteria. Again, the change in reporting limits in mid-September makes comparison to criteria impossible for non-detect data.

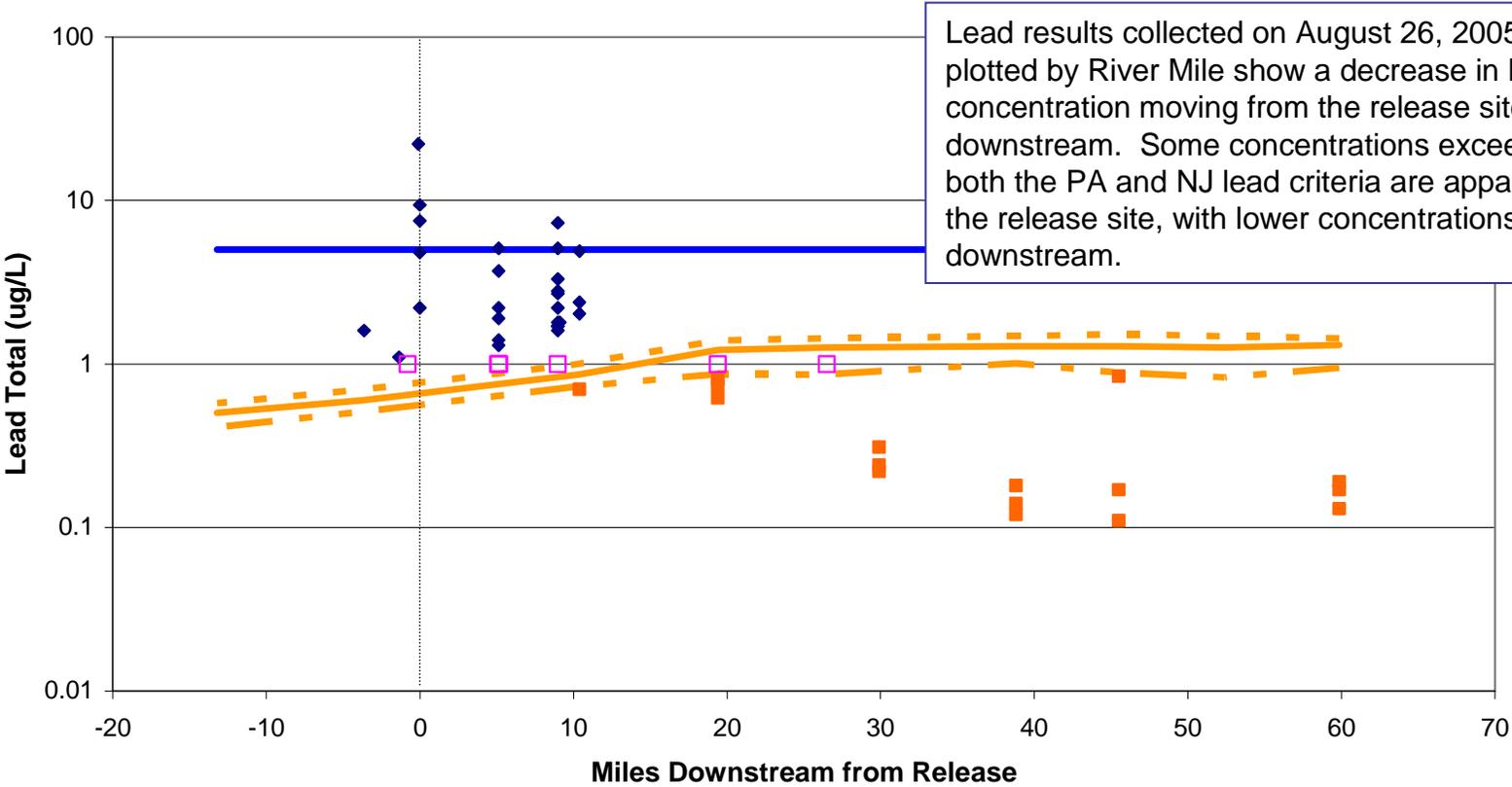
Lead Concentrations near Easton

Lead Water Column Concentrations Measured between RM 8 and 11 (Easton)



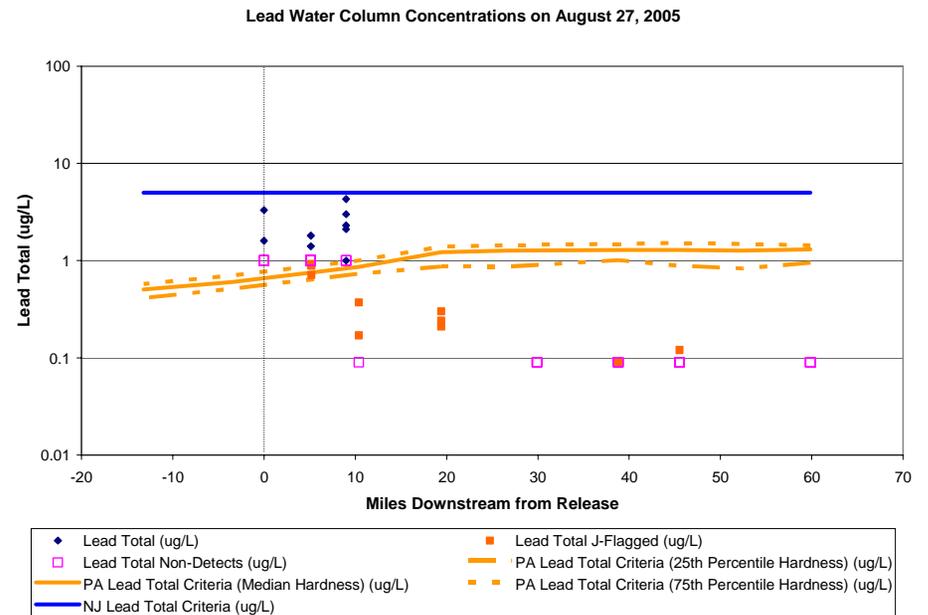
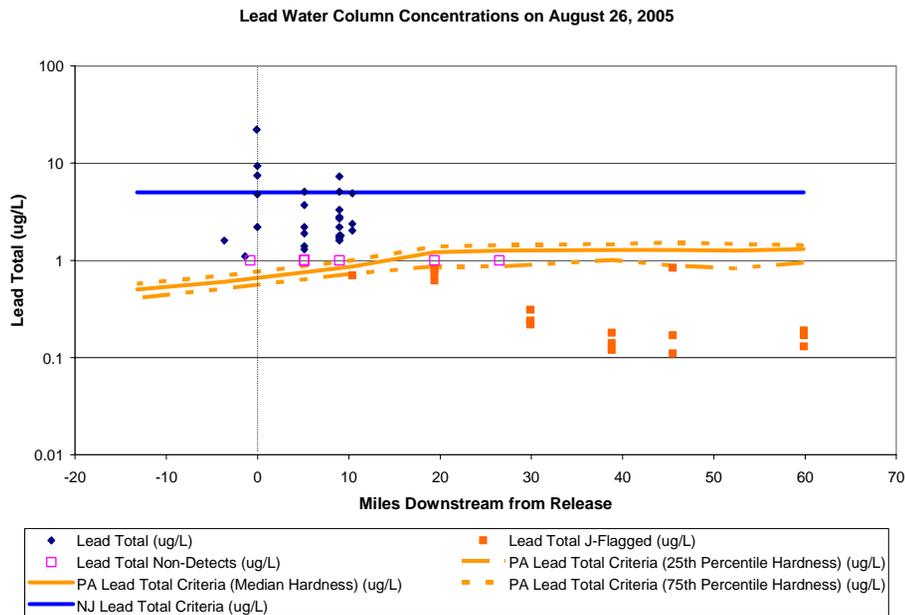
Lead Concentrations by Distance from Release, August 26, 2005

Lead Water Column Concentrations on August 26, 2005



- ◆ Lead Total (ug/L)
- Lead Total Non-Detects (ug/L)
- PA Lead Total Criteria (Median Hardness) (ug/L)
- NJ Lead Total Criteria (ug/L)
- Lead Total J-Flagged (ug/L)
- PA Lead Total Criteria (25th Percentile Hardness) (ug/L)
- - - PA Lead Total Criteria (75th Percentile Hardness) (ug/L)

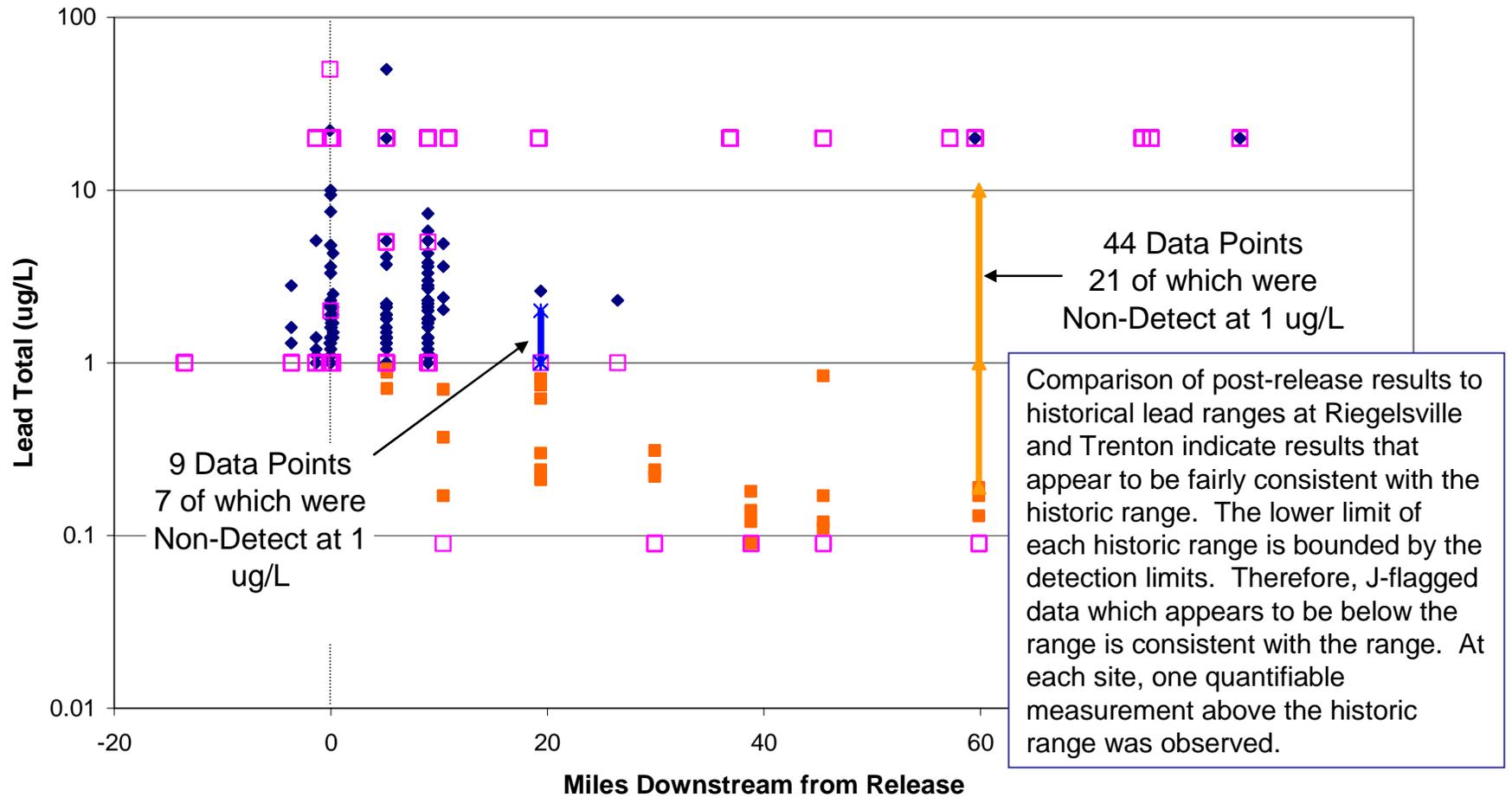
Lead Concentrations by Distance from Release, August 26 and 27, 2005



A side-by-side comparison of lead samples collected on August 26 and 27, 2005 plotted by River Mile indicates a decrease in concentration at the release site. Unlike arsenic, there is no apparent downstream movement of a concentration peak.

Comparison to Pre-Release Lead Data (1992-Present) found in NWIS and STORET

Comparison of Pre- and Post-Release Lead Concentrations

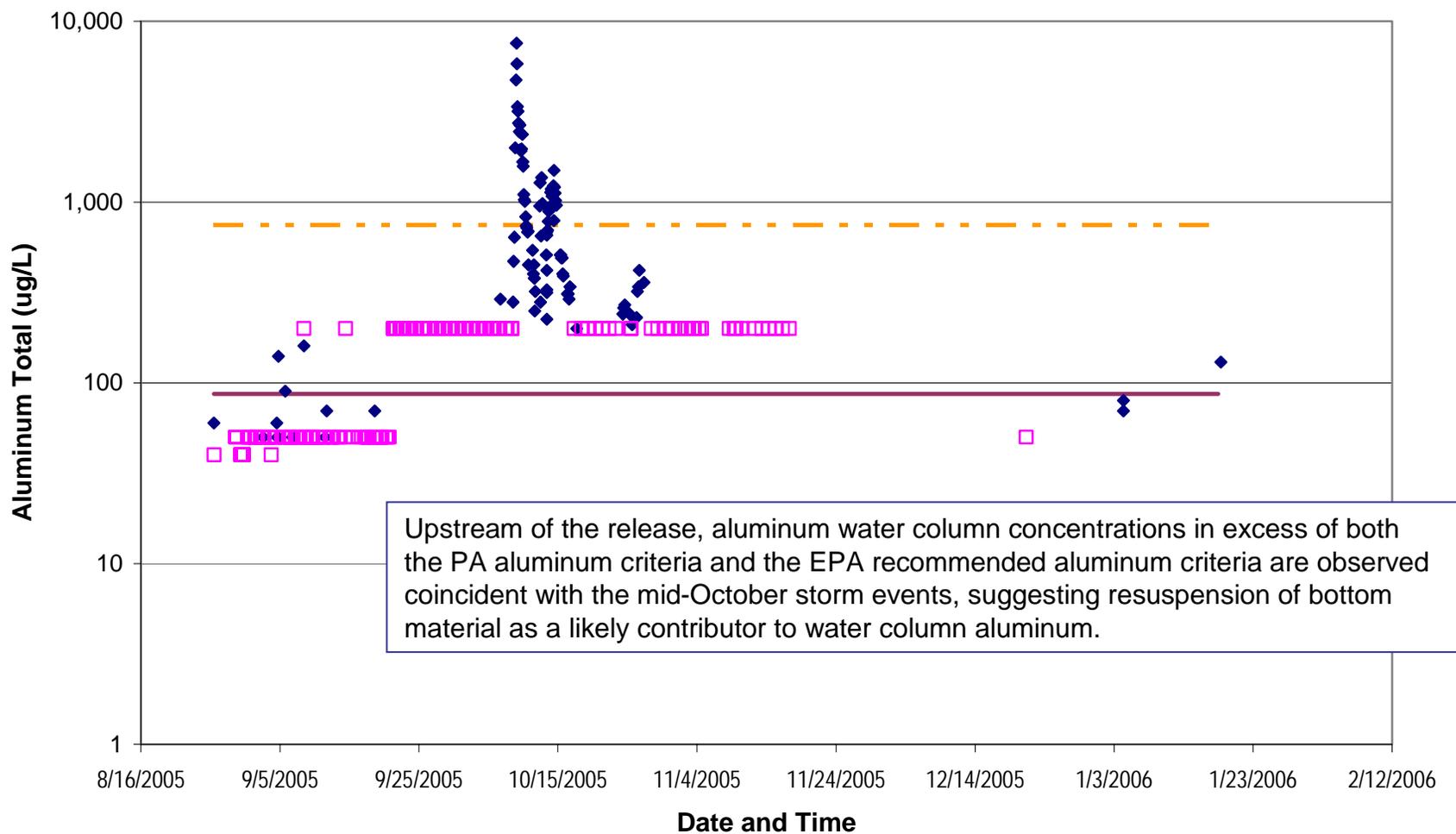


- ◆ Lead Total Post-Release (ug/L)
- Lead Total J-Flagged (ug/L)
- Lead Total Non-Detect Post-Release (ug/L)
- *— Trenton Pre-Release Range (ug/L)
- *— Riegelsville Pre-Release Range (ug/L)

Aluminum Results

Aluminum Concentrations Upstream of Release

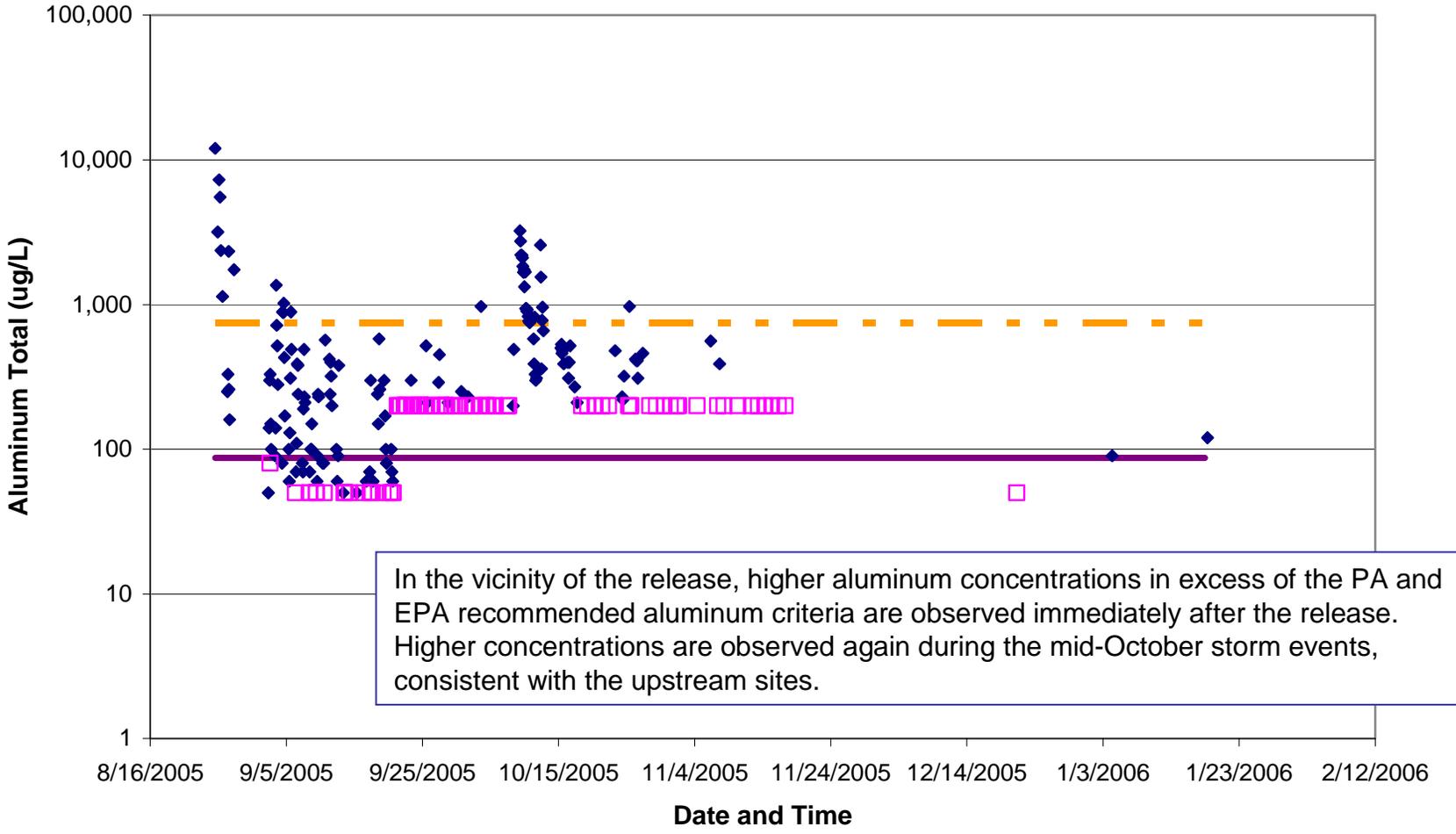
Aluminum Water Column Concentrations Measured Upstream of Release



◆ Aluminum Total (ug/L) □ Aluminum Total Non-Detects (ug/L) - - - PA Aluminum Criteria (ug/L) — EPA Criteria (ug/L)

Aluminum Concentrations at Release

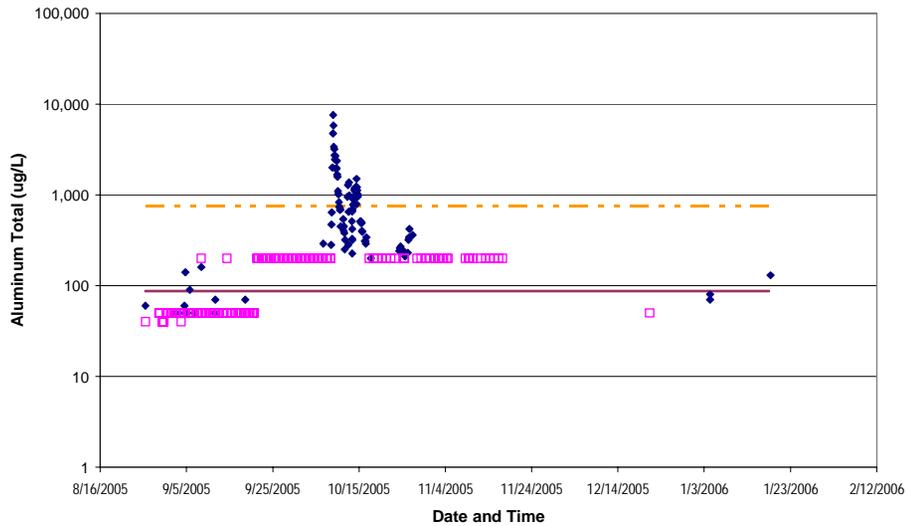
Aluminum Water Column Concentrations Measured at Release



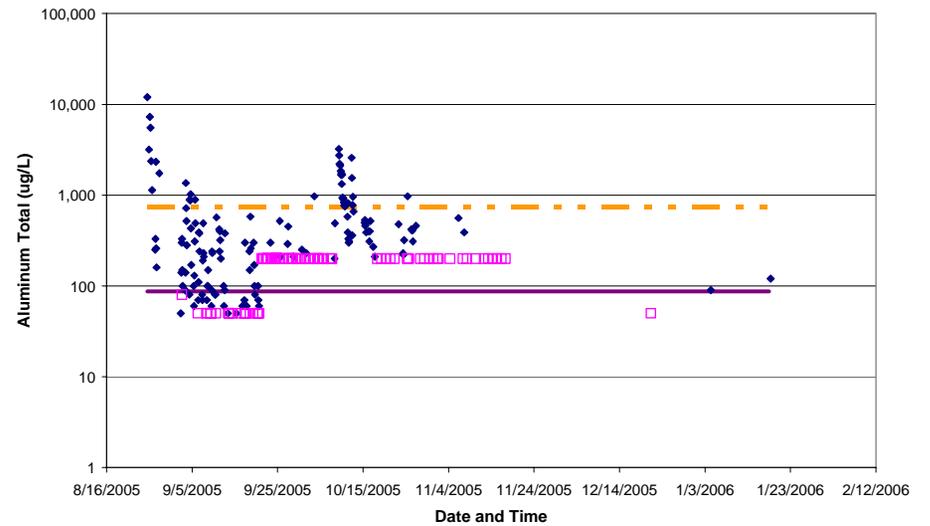
◆ Aluminum Total (ug/L) □ Aluminum Total Non-Detects (ug/L) - - - PA Aluminum Criteria (ug/L) — EPA Criteria (ug/L)

Aluminum Concentrations upstream and at release

Aluminum Water Column Concentrations Measured Upstream of Release



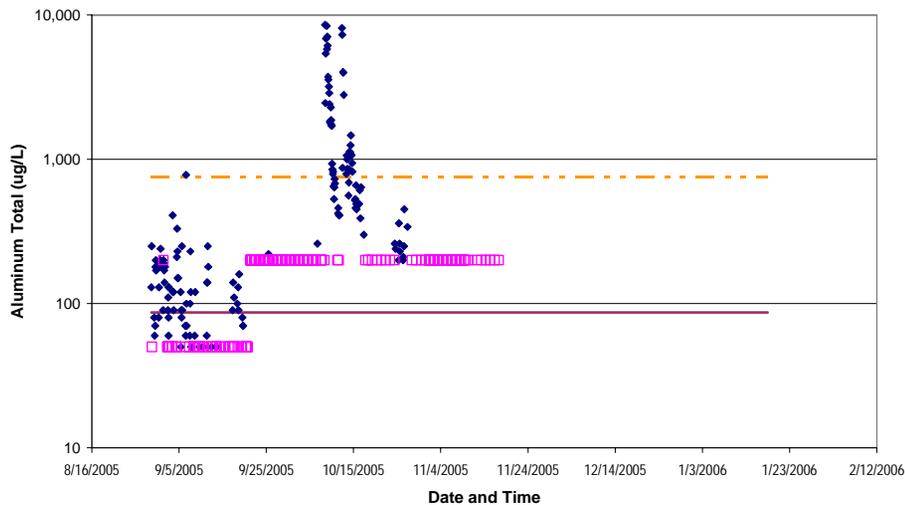
Aluminum Water Column Concentrations Measured at Release



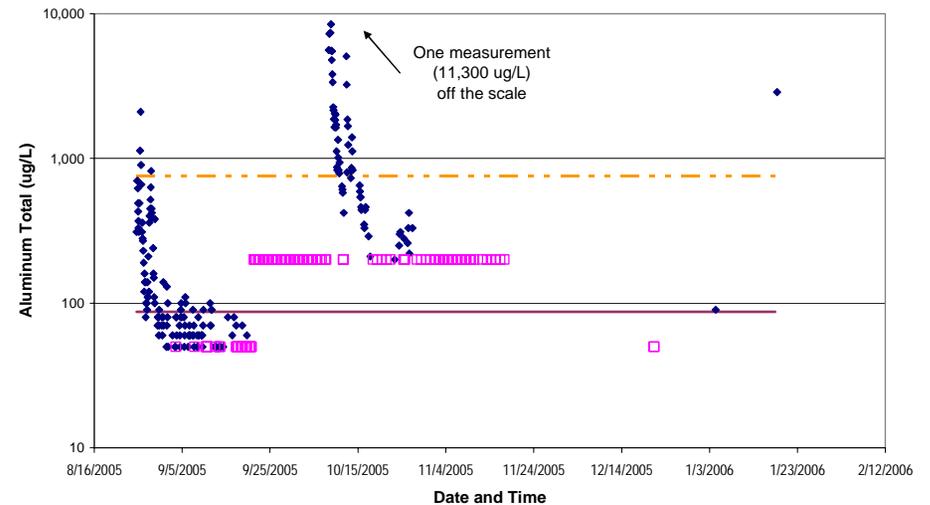
A side-by-side comparison of the upstream and release site plots suggests an initial increase in water column aluminum at the release site, followed by a storm related increase that is consistent with the upstream sites.

Aluminum Concentrations at near downstream locations

Aluminum Water Column Concentrations Measured 0.1 to 0.2 miles downstream from release



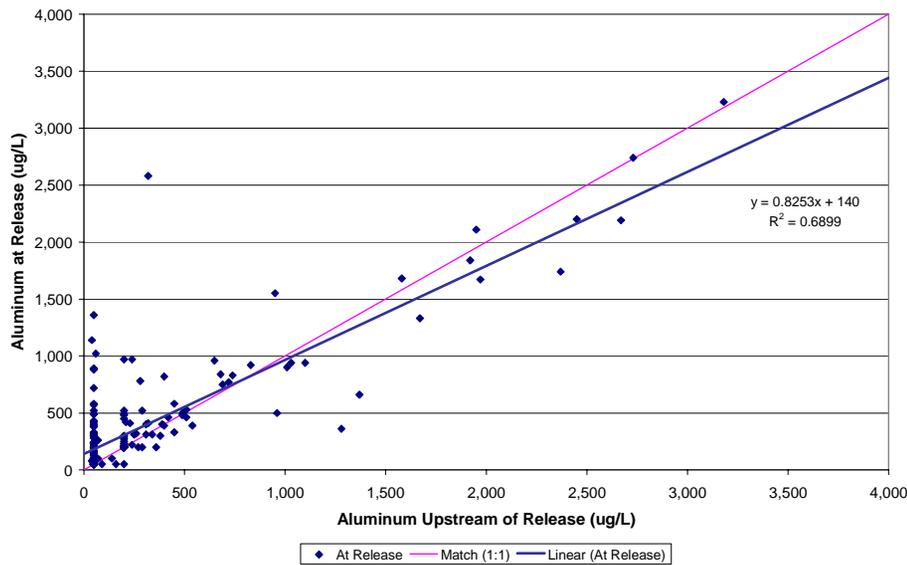
Aluminum Water Column Concentrations Measured 5.13 to 5.18 miles downstream from release



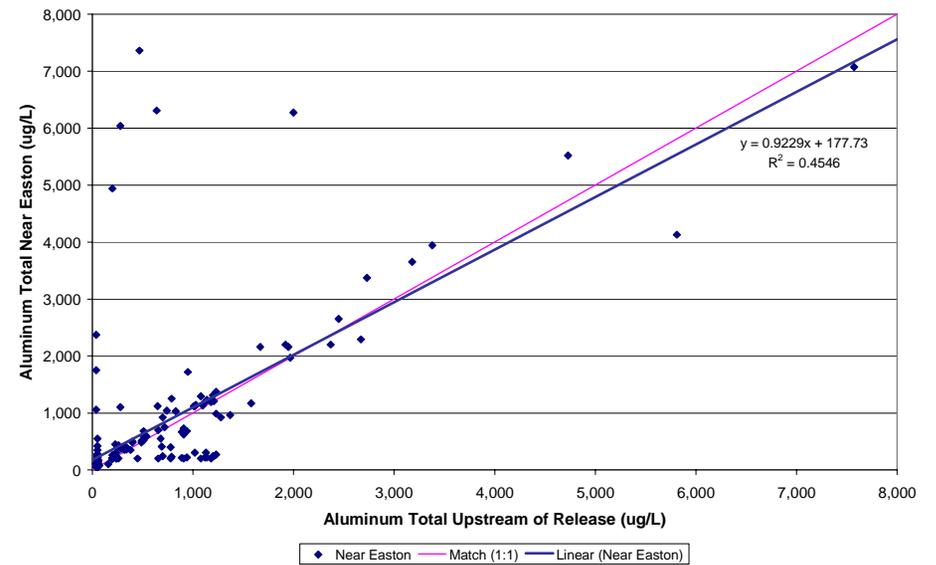
A side-by-side comparison of plots for the 2 near downstream ranges shows an initial increase in water column aluminum concentration after the release, followed by storm related increases in mid October. The structure of the initial concentration increase is more apparent at the second downstream range, even though that range is further from the initial release site. We observed this difference in structure for other analytical parameters as well. One possible explanation is that the second downstream range is shallower and has a higher velocity, keeping more material in suspension. By contrast, the first downstream range is more of a pool and may tend to dampen the signal of the release. As with lead, a change to a higher aluminum reporting limit interferes with direct comparison to the EPA recommended criteria for non-detect data.

Regression of Paired Aluminum Concentrations

Regression of Paired Aluminum Observations Upstream and At Release



Regression of Paired Aluminum Observations Upstream and Near Easton



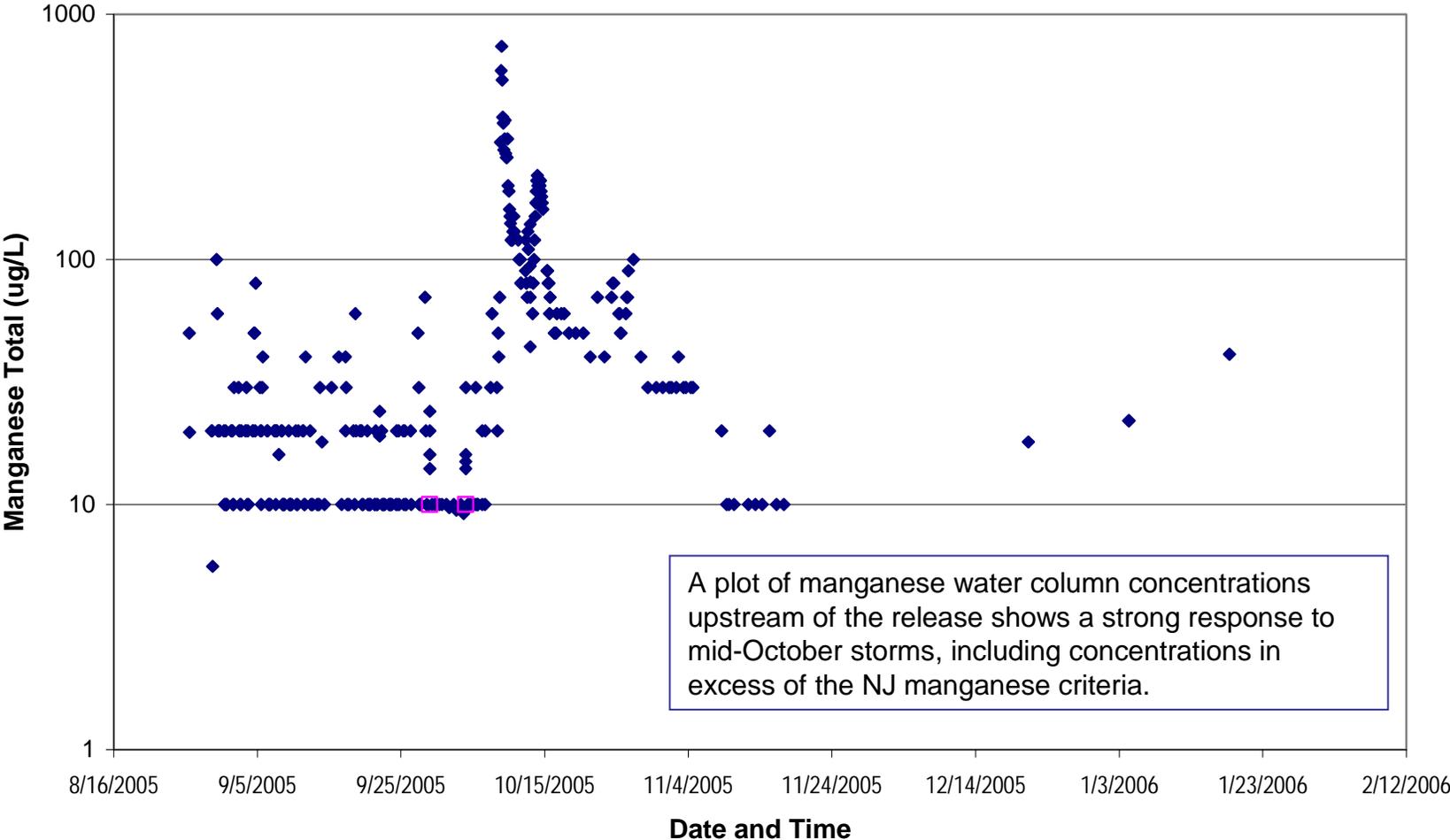
Bivariate plots of aluminum concentrations at the release site and at Easton versus the upstream concentrations, suggests that portion of the variability in the downstream concentrations is explained by the upstream concentration. At each location, however, a subset of values not following this relationship is apparent.

Our interpretation is that the initial peaks are associated with the release, but subsequent peaks strongly follow the upstream storm related pattern.

Manganese

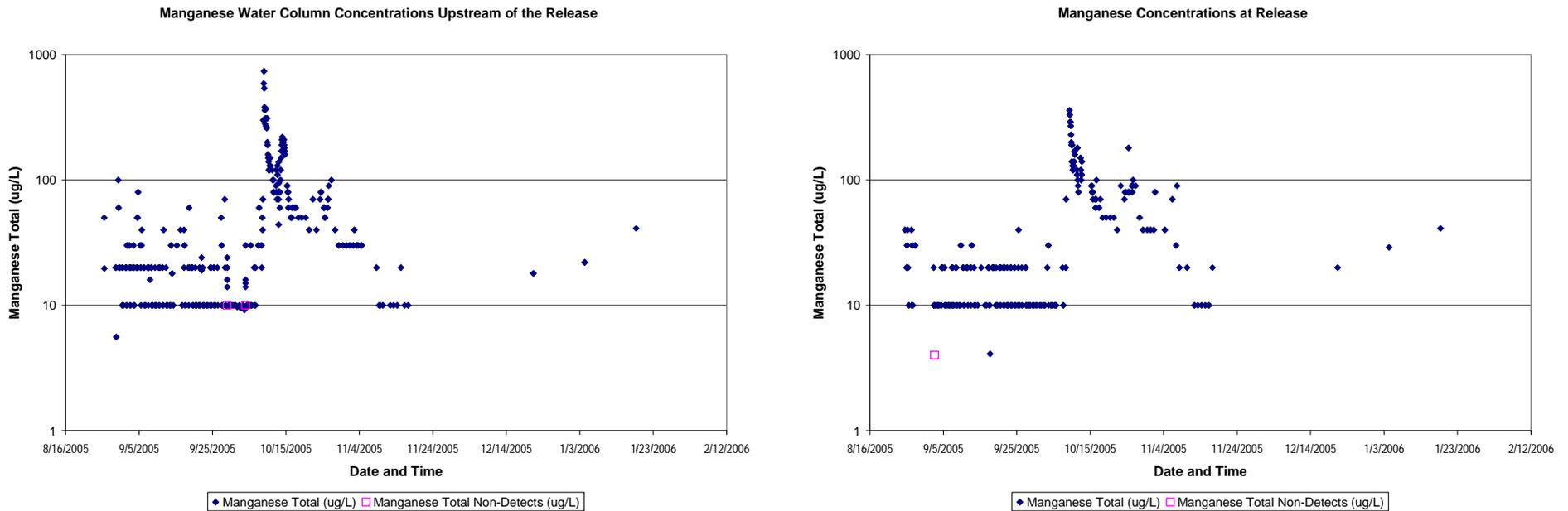
Manganese Concentrations Upstream of Release

Manganese Water Column Concentrations Upstream of the Release



◆ Manganese Total (ug/L) □ Manganese Total Non-Detects (ug/L)

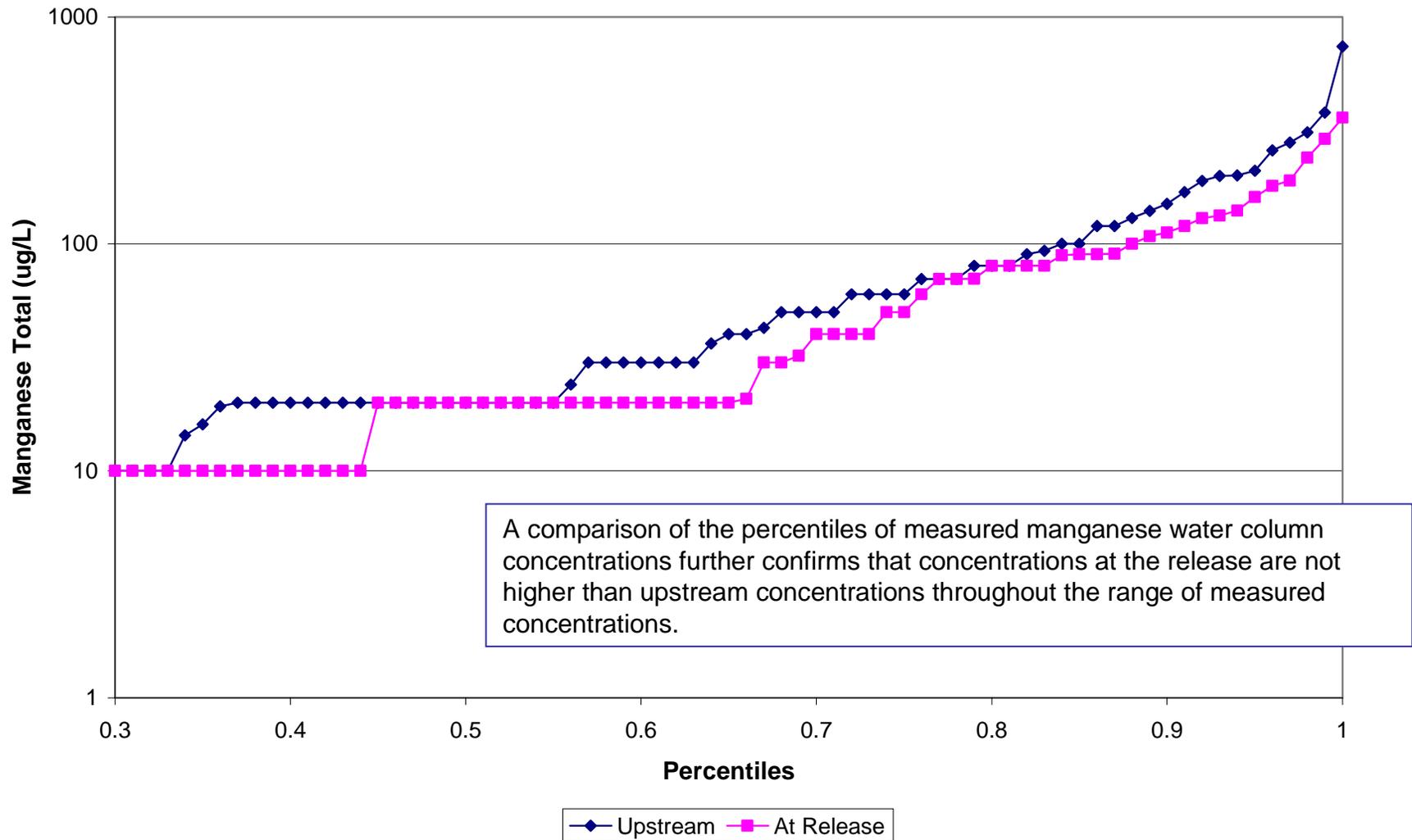
Manganese Concentrations Upstream of and at Release



A side-by-side comparison of plots of manganese water column concentrations upstream and at the release indicates that both sites show a strong response to mid-October storm events, including concentrations in excess of the NJ manganese criteria. There are no apparent elevated concentrations of manganese at the release site relative to the upstream sites. In fact the range of concentrations for the upstream sites is slightly higher than for the release site.

Percentiles of Manganese Concentrations Upstream of and At Release

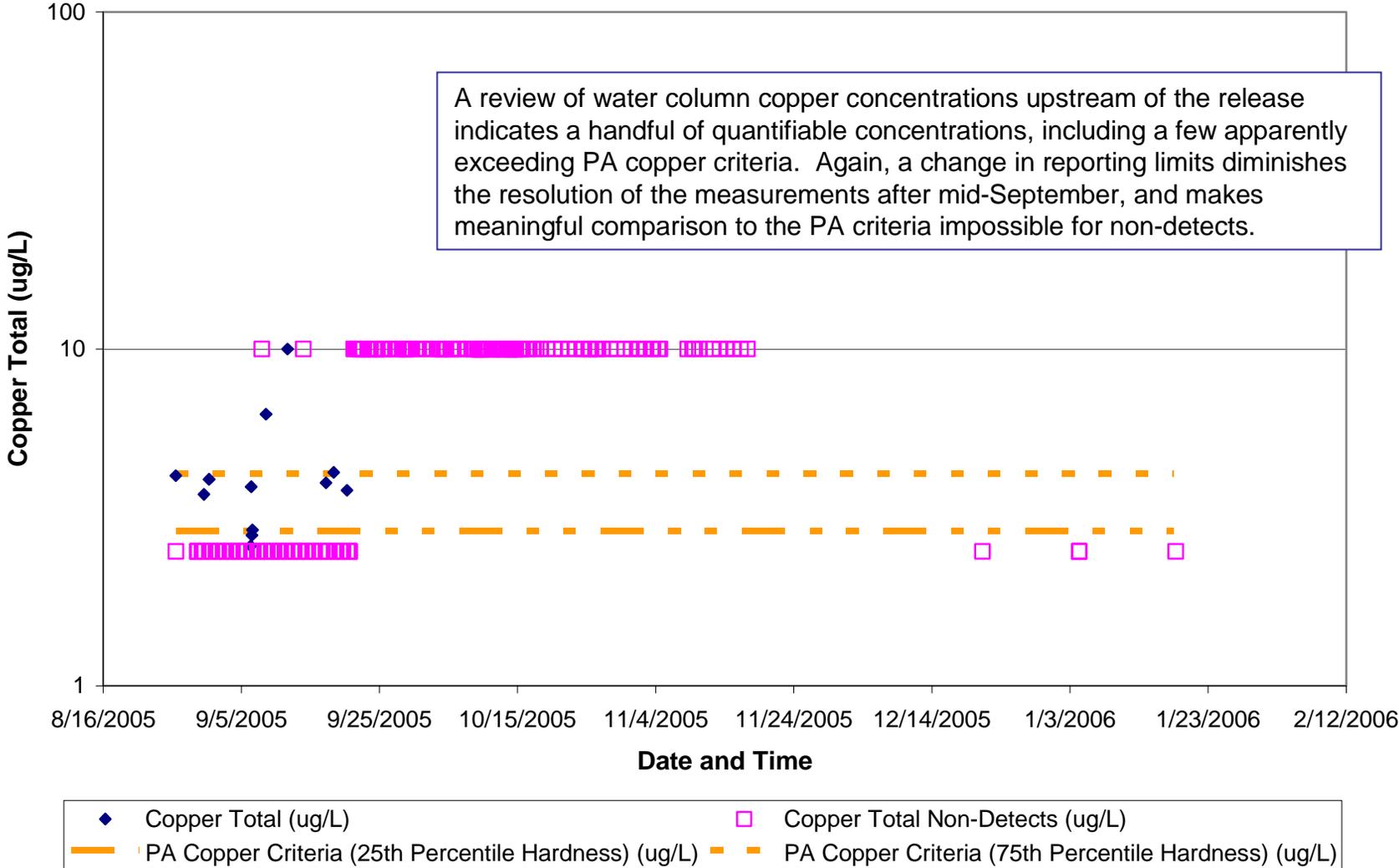
Percentiles of Manganese Concentrations Upstream of at At Release



Copper Results

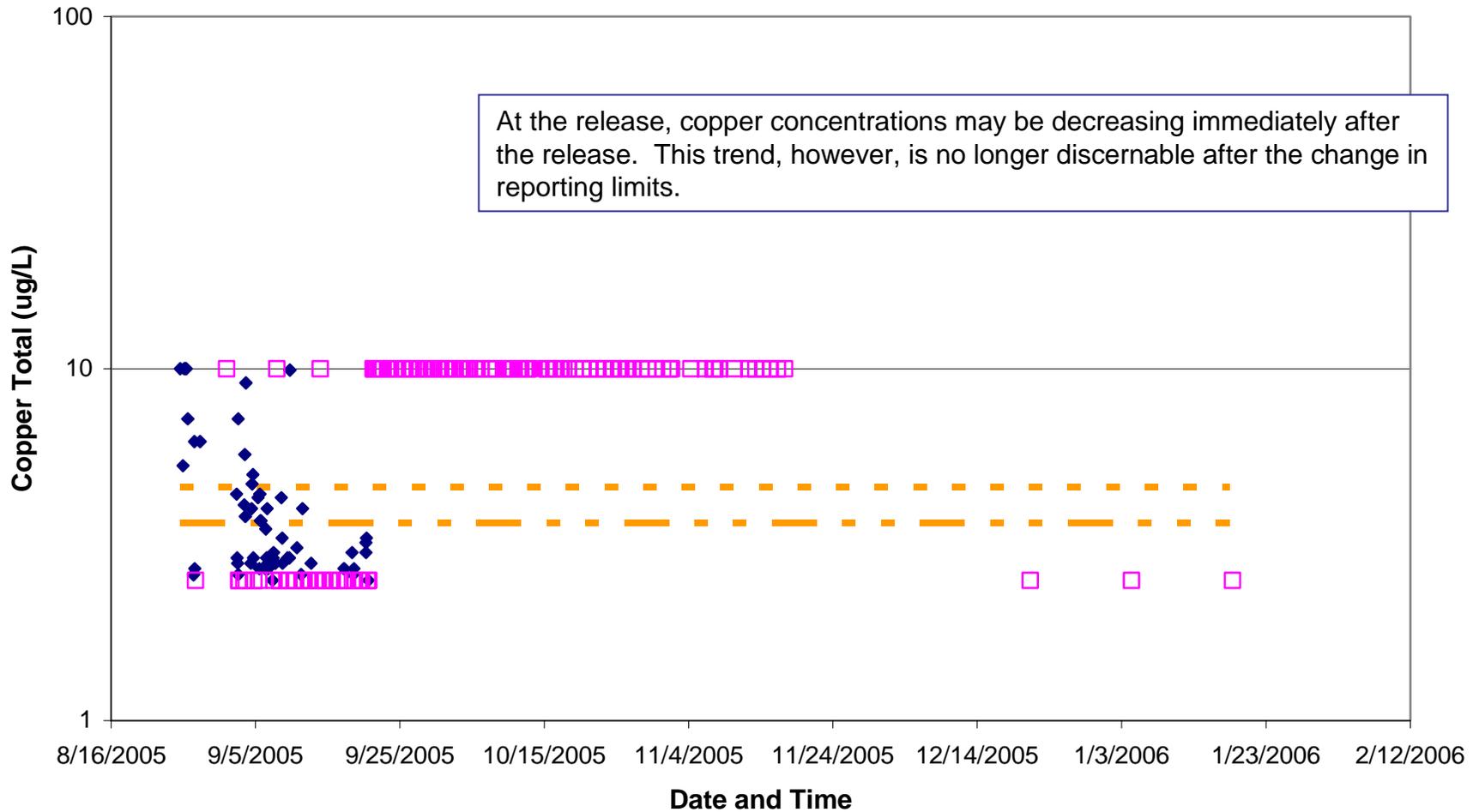
Copper Concentrations Upstream

Copper Water Column Concentrations Measured Upstream of Release



Copper at Release

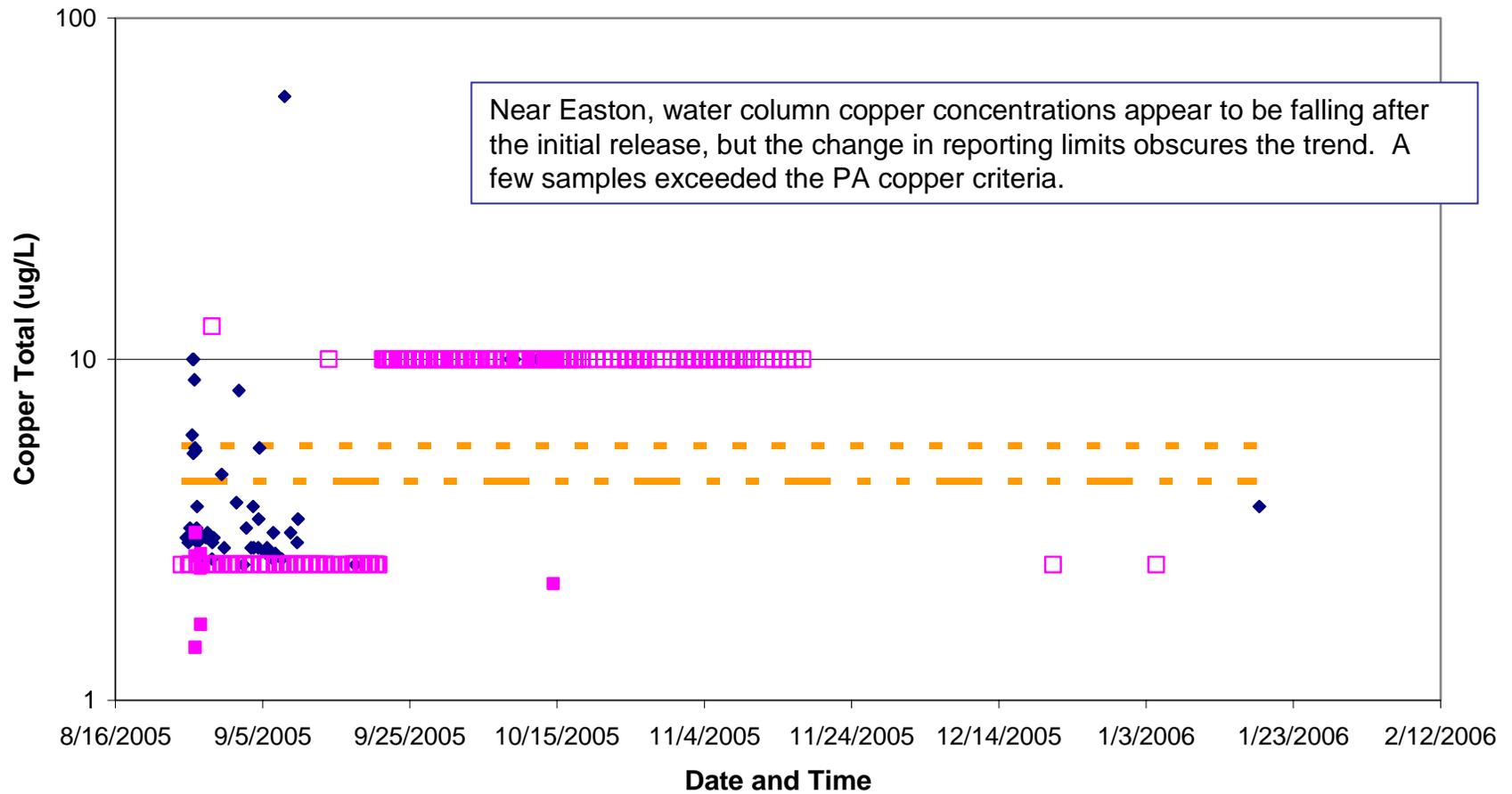
Copper Water Column Concentrations Measured at the Release



- ◆ Copper Total (ug/L)
- Copper Total Non-Detects (ug/L)
- PA Copper Criteria (25th Percentile Hardness) (ug/L)
- - PA Copper Criteria (75th Percentile Hardness) (ug/L)

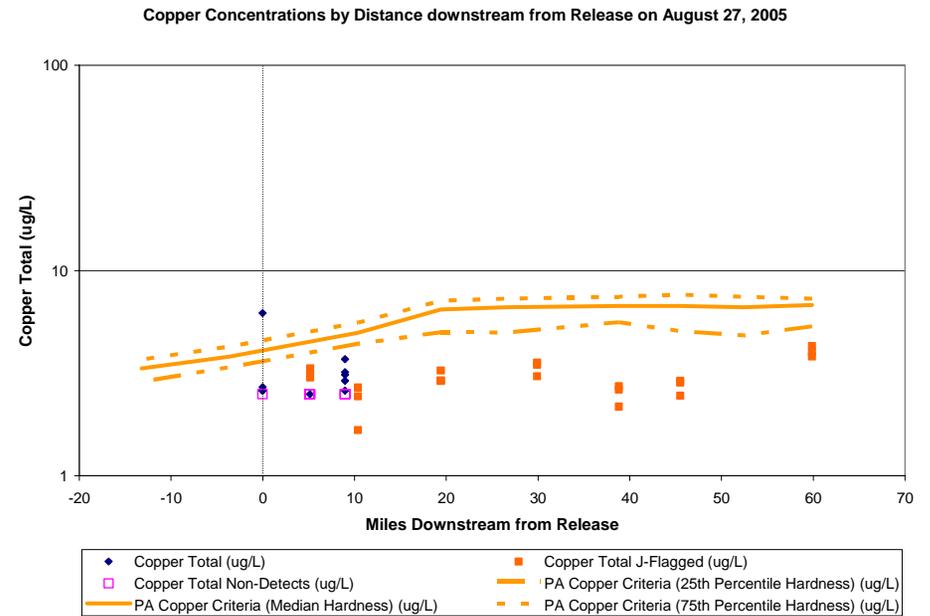
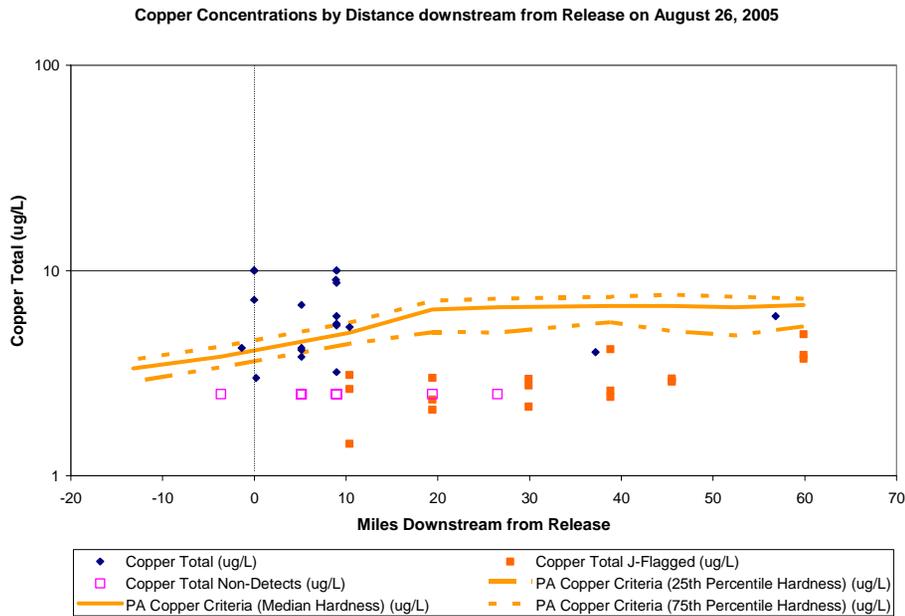
Copper Near Easton

Copper Water Column Concentrations Measured between RM 8 and 11 (Easton)



- ◆ Copper Total (ug/L)
- Copper Total J-Flagged (ug/L)
- Copper Total Non-Detects (ug/L)
- PA Copper Criteria (25th Percentile Hardness) (ug/L)
- - - PA Copper Criteria (75th Percentile Hardness) (ug/L)

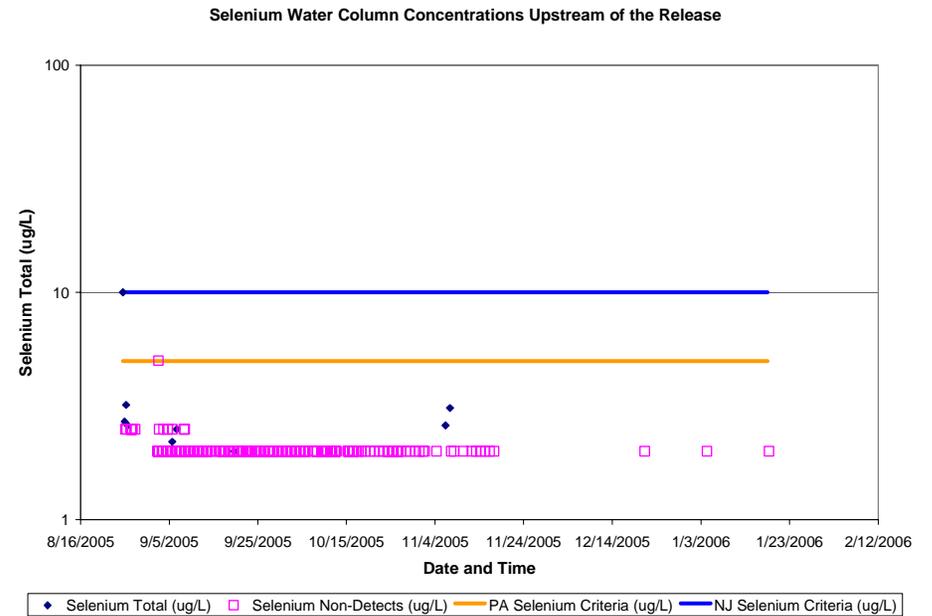
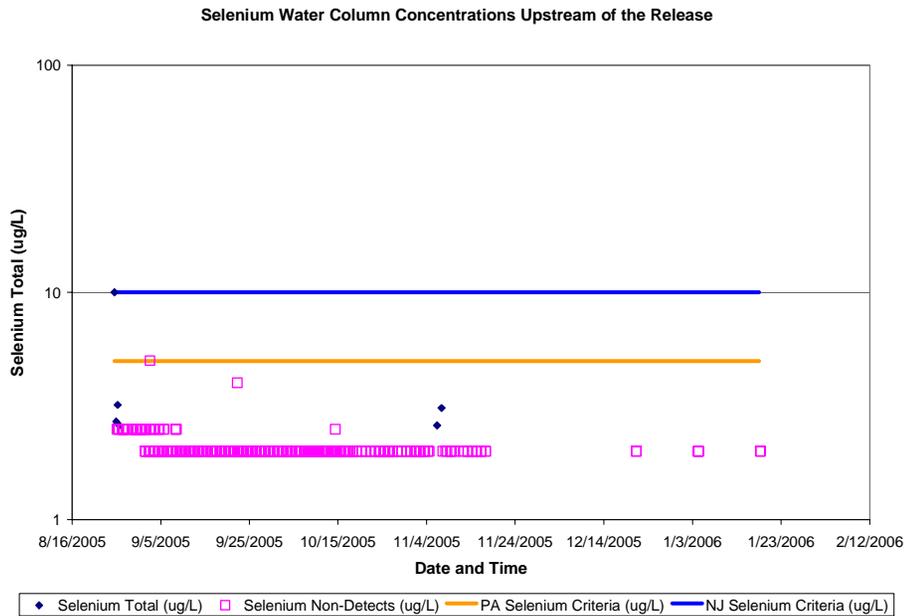
Copper by Miles from Release on August 26th and 27th, 2005



A side-by-side comparison of copper concentration measured on August 26 and 27, 2005 plotted by River Mile suggests that higher concentrations observed near the release on August 26th have decreased by August 27th. Unlike arsenic, there is no apparent downstream movement of a concentration peak.

Selenium Results

Selenium Concentrations Upstream of and at the Release



A side-by-side comparison of water column selenium concentrations measured upstream of and at the release are nearly identical, suggesting that the release did not contribute to water column selenium concentrations.

Mercury

- All mercury measurements (1,805) were non-detect except for one sample collected 0.2 miles downstream of the release on 10/13/05;
- About 65% of the samples had a reporting limit of 0.2 ug/L and about 35% of the samples had a reporting limit of 0.5 ug/L.

Conclusions

Arsenic

- Some apparent exceedance of PA arsenic criteria immediately after the release in the vicinity of the release. These exceedances are not observed upstream.
- Apparent signature of release observable downstream but below PA arsenic criteria.
- Any quantifiable concentration of arsenic exceeds NJ criteria (both upstream and downstream).

Conclusions (continued)

Lead

- Apparent exceedances of PA and NJ lead criteria immediately after release in the vicinity of the release.
- Most quantifiable lead concentrations exceed PA criteria (including upstream).

Aluminum

- Some short term local exceedance of PA aluminum criteria from release, but background and high flows account for most of the observed concentration.

Conclusions (continued)

Manganese

- Manganese concentrations appear to be background concentrations.

Copper

- Short term copper exceedances of PA criteria at release and downstream.

Conclusions (continued)

Selenium

- Selenium concentrations appear to be background concentrations.

Mercury

- Mercury data almost completely below reporting limits.

Assessment of Water Column data collected in response to a fly ash release on the Delaware River



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