Quantitative Evaluation of NAPL Seeps Discharging to East Branch

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Photo by Bill Rhodes

NAPL Seeps Overview

- The potential significance of seeps emanating from bulkheads and shoreline areas along Newtown Creek has been questioned by stakeholders
- NYCDEP, in particular, is of the opinion that seeps are important external sources of contaminants and may affect remedial decision-making
- USEPA, NYSDEC, NCG, and NYCDEP have all conducted surveys for different purposes to determine the presence and chemical composition of the seeps and to identify upland sources
- The information collected to-date, however, is insufficient to quantify the mass loadings of contaminants from these seeps to determine their significance and impact on remedial decision-making
- Focusing on East Branch, the NCG developed an approach to quantitatively bound the importance of seeps in the remedial decision-making process

What Are NAPL Seeps?

- Shoreline seeps (water and/or NAPL emerging from the shoreline) and bulkhead seeps (water and/or NAPL flowing out from bulkheads around joints, bolts, cracks, or holes) may occur due to:
  - Lateral groundwater discharge
  - Bank storage (creek water that temporarily inundates fill materials, natural soils, gaps, or voids behind bulkheads during high tide and then drains back to the creek via gravity when the tide recedes)
- Seeps can be **NAPL seeps** (where there is a sign of contamination, such as visual signs of NAPL or sheen) or **aqueous seeps** (where NAPL or sheen is not observed)
- Seeps may introduce contaminants to the surface water, and some of those contaminants may ultimately settle to the sediment bed

Seep Surveys

- Surveys were conducted as part of the RI/FS by the NCG and USEPA
  - These were opportunistic surveys where observed seeps were sampled—NAPL was not observed in the vast majority of these sampled seeps (**aqueous seeps**)
- Surveys were conducted outside of the RI/FS process by NYCDEP and NYSDEC
  - NYCDEP sampled seeps where NAPL was observed (**NAPL seeps**)
  - NYSDEC sampled seeps both with and without NAPL (**NAPL and aqueous seeps**)
- These surveys have generated qualitative information regarding the presence and location of these seeps
- These surveys used a wide variety of sampling methods to measure contaminant concentrations in the seeps, making comparisons difficult
- Because there were no seep volumetric flow data collected concurrent with the chemical analyses, information from these surveys is insufficient to calculate mass loadings of contaminants from these seeps and cannot be used to evaluate the importance of seeps

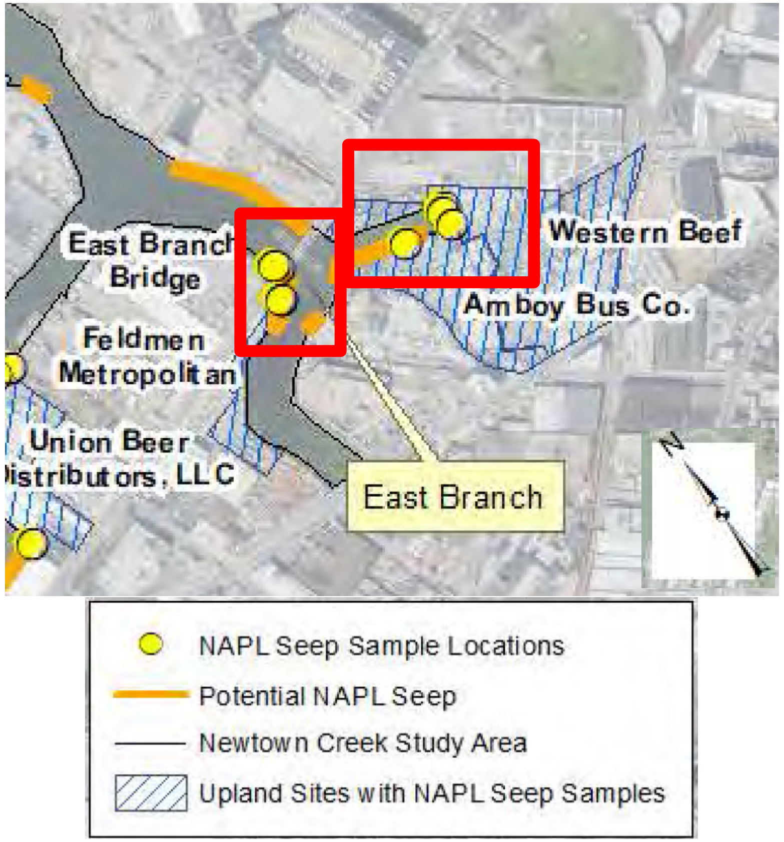
Existing Seep Survey Data

- The media sampled and sampling methods vary among the surveys
  - Direct sampling of seep fluid
    - NAPL seep samples collected by NYCDEP
    - Aqueous seep samples collected by the NCG, NYSDEC, and USEPA
  - Surface water sampling by NYSDEC
    - Sampled near the observed discharge point of a seep for a subset of the locations and sampling events; this represents a localized condition of seep fluid mixed with nearshore surface water
    - Background surface water samples were collected away from the shoreline and seeps to characterize existing surface water conditions
  - Sheen net sampling (of both NAPL from seeps and surface water in areas where NAPL was not visually present) by both NYCDEP and NYSDEC

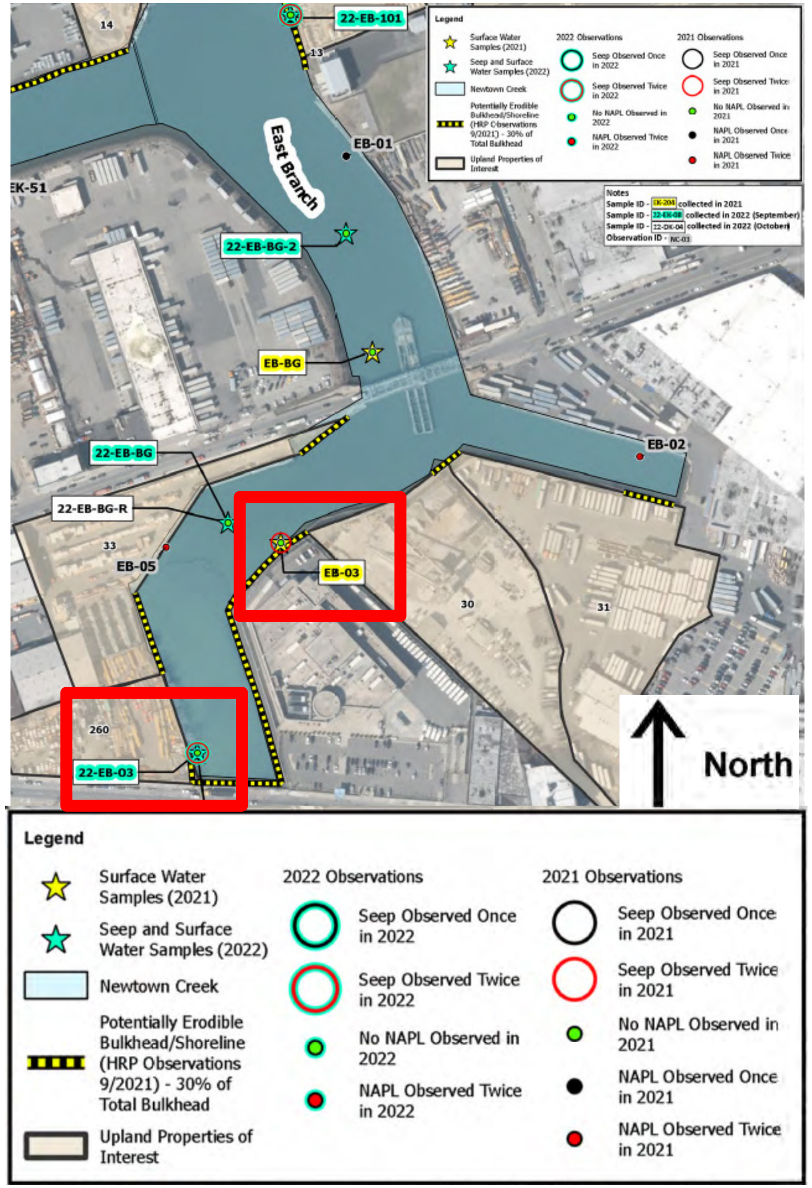
NCG

Aqueous seeps observed by NCG in other reaches but not in East Branch

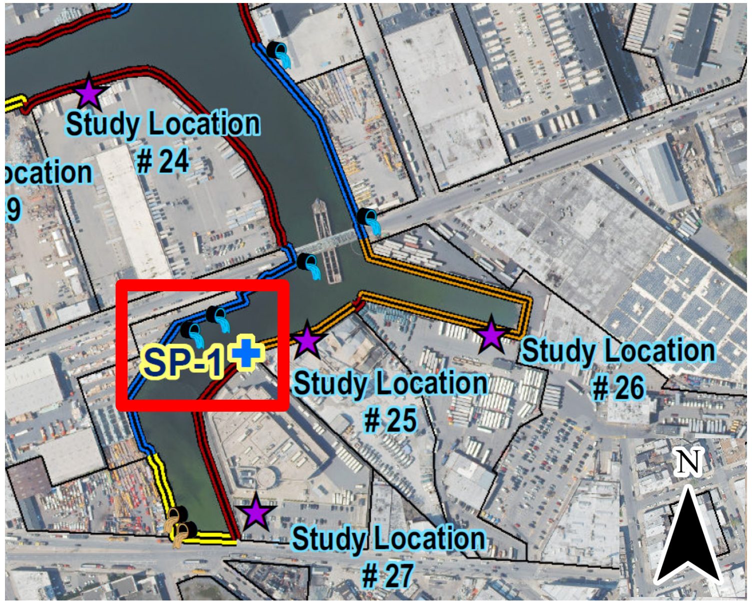
NYCDEP

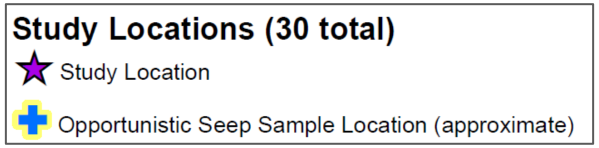


NYSDEC



USEPA





*Note, "Study Location" refers to lateral groundwater sample station

Seep Sample Location

Sources:
Figure 2-1 from NYCDEP's *2017 Upland NAPL Seep Sampling Data Summary Report* (NYCDEP 2020)
Figure 4E from NYSDEC's *Upland Site Characterization Report* (HRP 2023)
Figure 1-1c provided in an email from Mark Schmidt of USEPA to Jim Quadrini of Anchor QEA on June 22, 2023

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NCG Approach to Evaluating Relative Importance of Seeps

- Evaluated survey data and performed analysis to determine:
  - Potential for seeps to re-contaminate surface sediments after sediment remediation
  - Importance of seeps relative to other external inputs (e.g., point sources, East River)
- Current focus is on East Branch because the proposed Early Action will likely represent the first remedial action in the creek
- Focused on TPAH (34) because this COC has been well studied during the RI/FS, it has a preliminary remediation goal, and PAHs make up a known fraction of the hydrocarbons that compose NAPL at the site
- Performed bounding analysis, to conservatively estimate the potential importance of seeps in remedial design planning for the East Branch Early Action, using the project's long-term equilibrium (LTE) model

Aqueous Seep Data Comparison

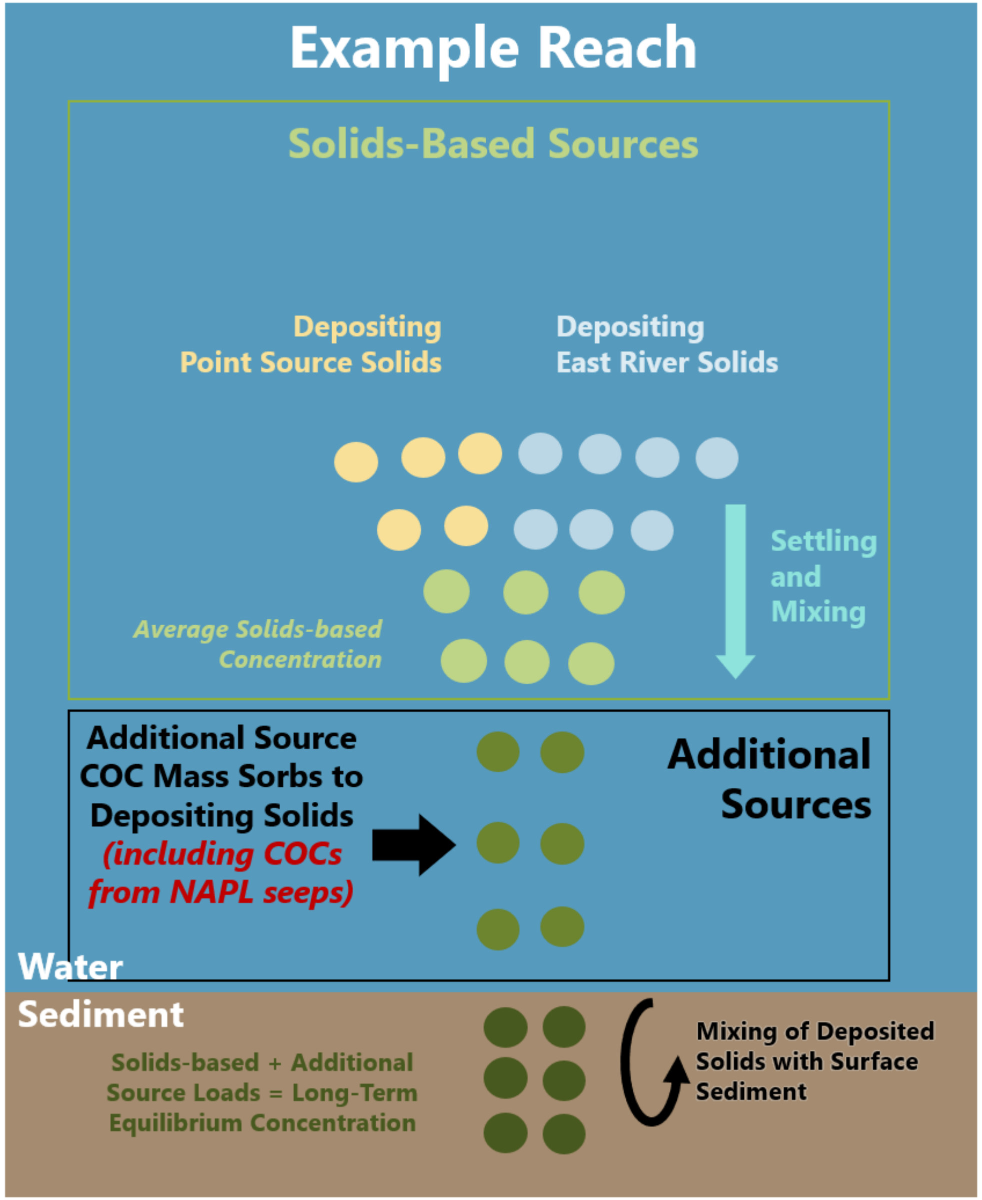
- TPAH (34) concentrations
  - Two-thirds of the aqueous seep samples have a concentration within the range found during dry weather RI surface water sampling, which indicates seeps are not a significant source to the Study Area
  - Remaining one-third of samples are either influenced by sampling artifacts (entrained solids in several NYSDEC samples) or have concentrations that are only slightly higher than the RI dry weather surface water data, which does not indicate a large source
- Chloride and conductivity (which measure amount of saline seawater versus fresh groundwater)
  - Values in many samples were similar to the surface water salinity measured during RI surface water sampling
  - Values in some samples indicated elevated salinity, but levels were lower than those measured in surface water during the RI
  - This suggests that many of the sampled seeps are likely due to bank storage, with the others likely being due to a mixture of groundwater and bank storage

Bounding Evaluation Overview

- LTE model was used to evaluate how high the TPAH (34) load (in kg per year) associated with NAPL seeps would need to be in East Branch to cause the surface sediment LTE concentration to exceed the risk-based PRG of 100 mg/kg
  - At that hypothetical loading, NAPL seeps would be considered a significant source that needs to be considered prior to the East Branch Early Action remedy implementation
- Hypothetical additional NAPL seep load was then compared to existing data to evaluate whether it is realistic with respect to other measured loads

LTE Model Overview

- Data-based, mass budget calculation developed to assess the relative contribution of external ongoing sources to post-remediation sediment concentrations
- Model includes contaminant inputs from **solids-based sources** (East River surface water and point sources) as well as **additional sources** (e.g., atmospheric deposition, lateral groundwater/seeps)



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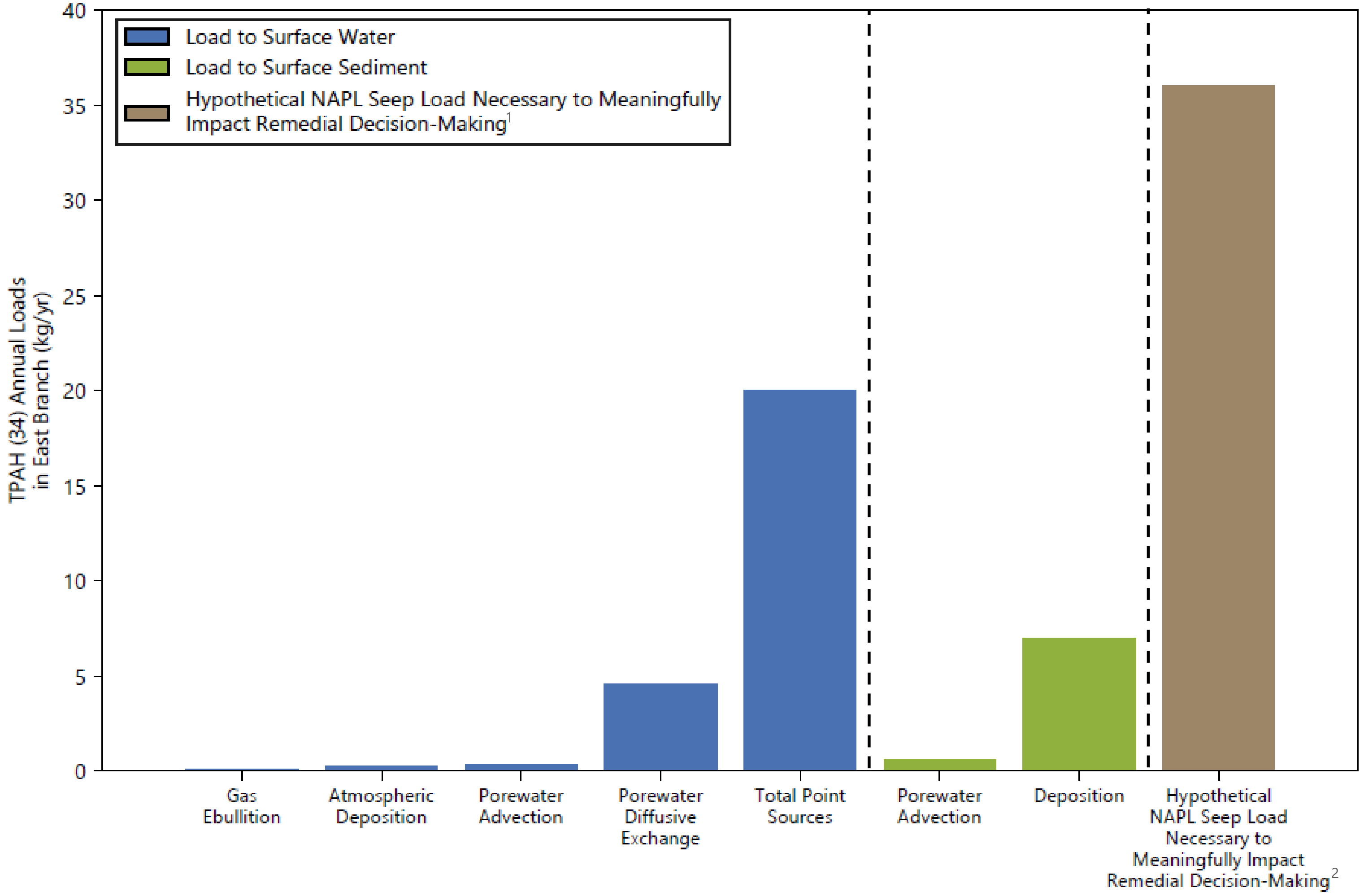
Comparison of Empirical Annual TPAH (34) Loads in East Branch and the Hypothetical Bounding Evaluation NAPL Seep Load



Hypothetical TPAH load is larger than all other loads measured or calculated to be entering East Branch—combined, which is implausible

Notes:
1. NAPL seeps contribute contaminant loads to the surface water and some portion may ultimately settle to the sediment bed.
2. Hypothetical NAPL seep load would result in an exceedance of the PRG.

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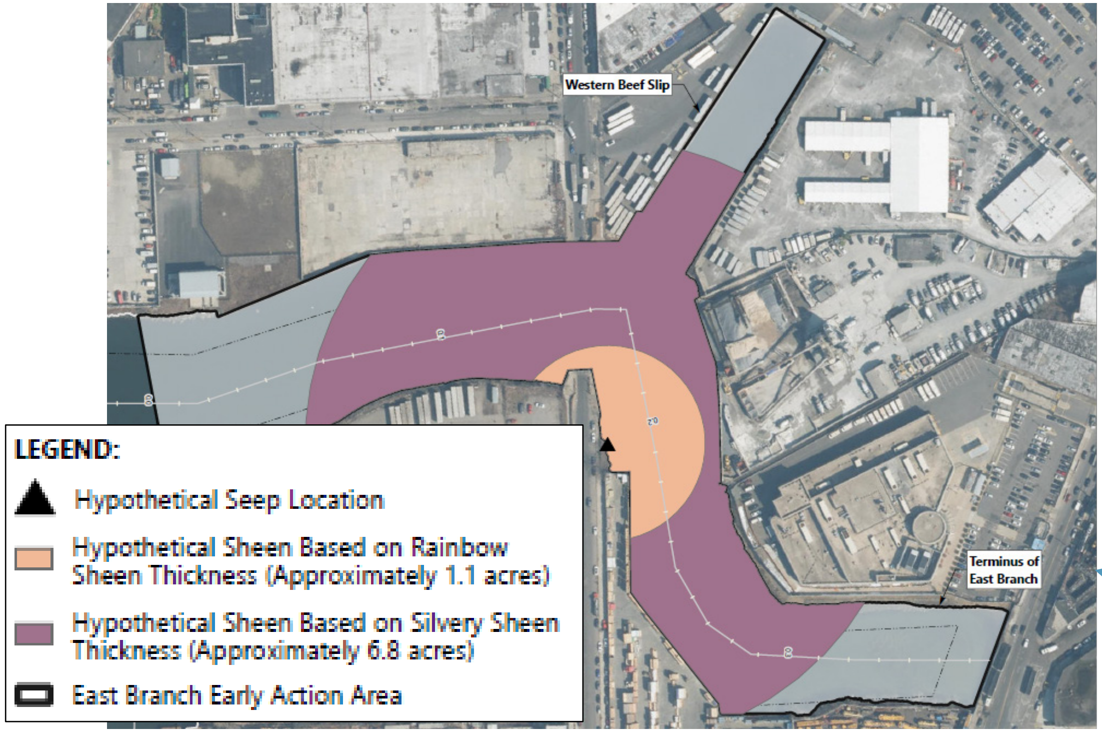
Additional Approach to Bound the Impacts of NAPL Seeps

- Using data and ASTM Standard Guide F2534, hypothetical NAPL seep TPAH (34) load was converted to equivalent NAPL volume and associated sheen surface area that would be present during every low tide:
  - Inputs: TPAH (34) concentration of site NAPL, density of NAPL, thickness of sheen based on appearance (silvery, rainbow, etc.)



Hypothetical sheen extent has never been observed; therefore, the corresponding hypothetical load from NAPL seeps is implausible

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Conclusions

- Based on the qualitative information available, NAPL seeps are not a significant source to East Branch
- Multiple lines of evidence demonstrate that NAPL seeps likely represent a comparatively minor source of contaminants to surface sediment in East Branch and thus do not represent a potential for significant sediment recontamination that could affect remedial decision-making
- This is not to say that seeps should go unaddressed by the relevant agency/parties; merely that seeps are not significant sources of contamination that could impact sediment remedy decision-making

What questions do you have?