BATTELLE 2023 SEDIMENTS CONFERENCE

Estimating Long-Term Equilibrium in a Complex Urban Tidal Estuary Using a Simple Spreadsheet Model

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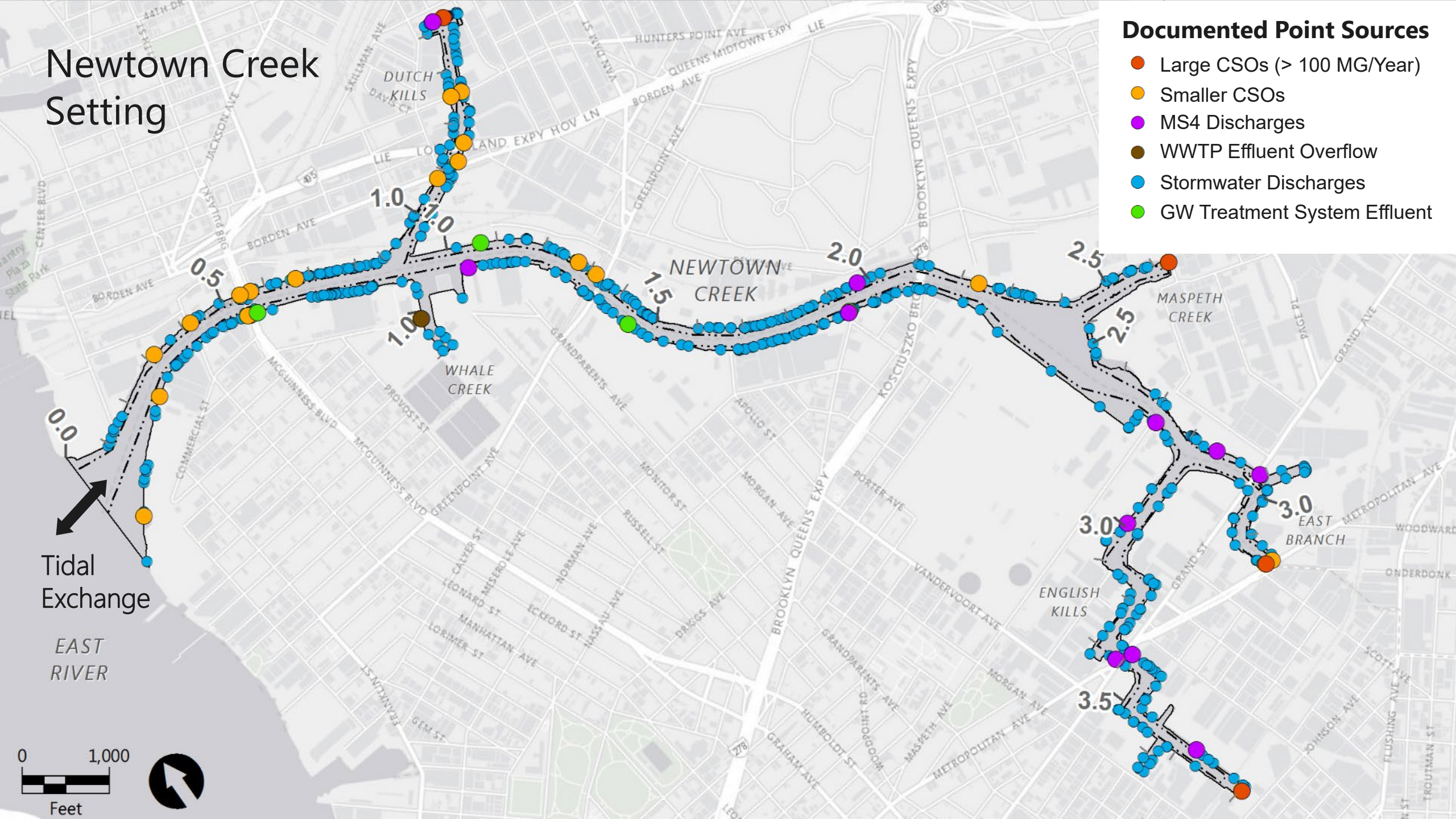
ANCHOR QEA


Queens
Manhattan
Hudson River
East River
Newtown Creek
Study Area
Brooklyn

Newtown Creek Setting



CHALLENGE

Quantifying the extent of ongoing external inputs of contaminants to Newtown Creek to inform long-term cleanup goals

CHALLENGE

Ongoing Contaminant Sources

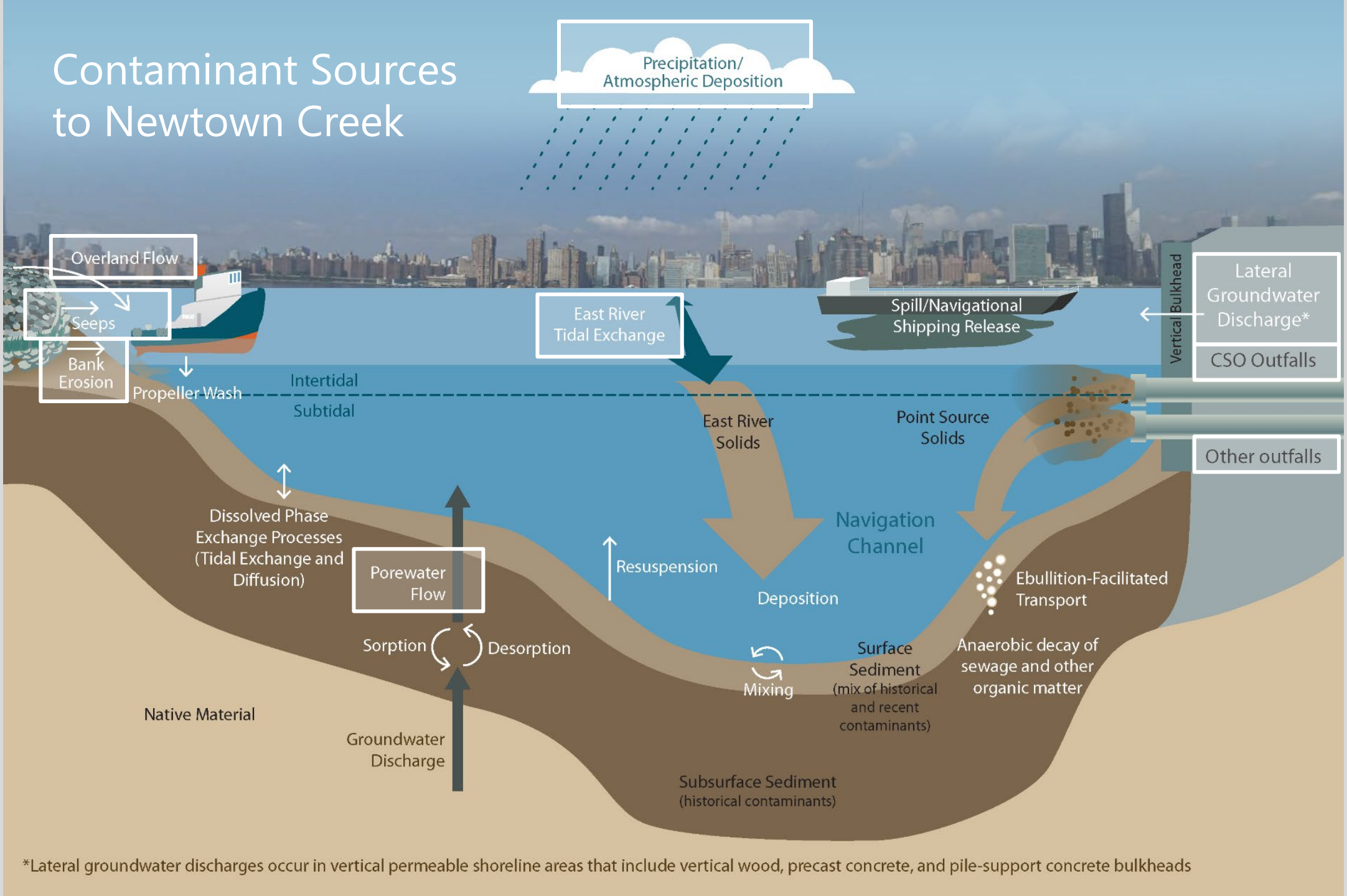
- Site contaminants will continue to enter Newtown Creek due to ongoing sources even after an in-creek sediment remedy is complete
- Need to develop a way to assess the relative contribution of external ongoing sources to long-term equilibrium (LTE) surface sediment concentrations to support the evaluation of remedial alternatives for the Feasibility Study and the sustainability of an in-creek sediment remedy

APPROACH + METHODS

Spreadsheet-based Mass Balance Model

- A spreadsheet-based mass balance model was developed to approximate the fundamental underlying processes affecting surface sediments at the site based on the conceptual site model
- The calculation is based on a mass accounting approach that includes net sedimentation rates and quantifies the primary contaminant inputs
- The spreadsheet model is an interim tool to be used prior to finalization of the full chemical fate and transport model

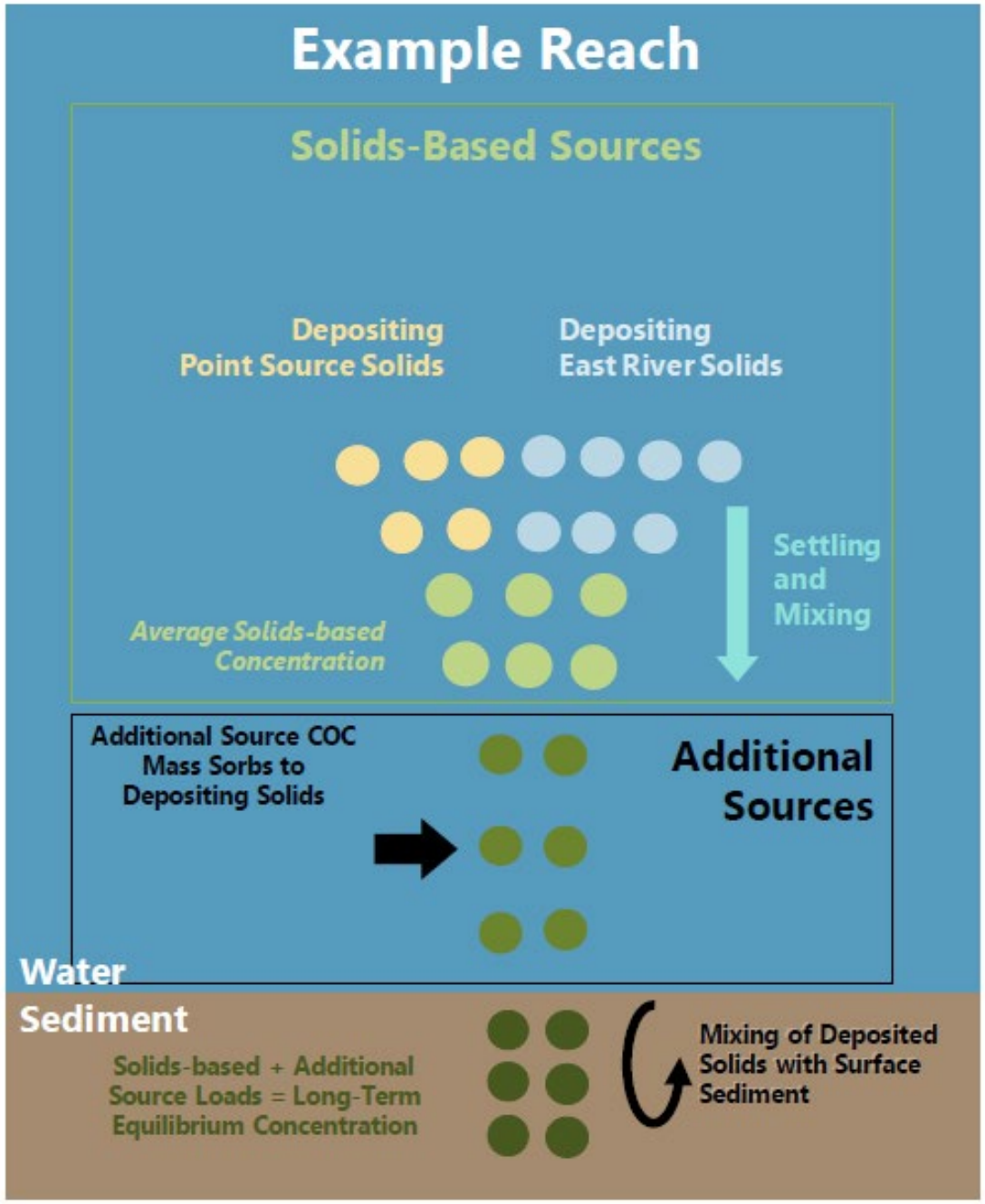
Contaminant Sources to Newtown Creek



*Lateral groundwater discharges occur in vertical permeable shoreline areas that include vertical wood, precast concrete, and pile-support concrete bulkheads

LTE Calculation Overview

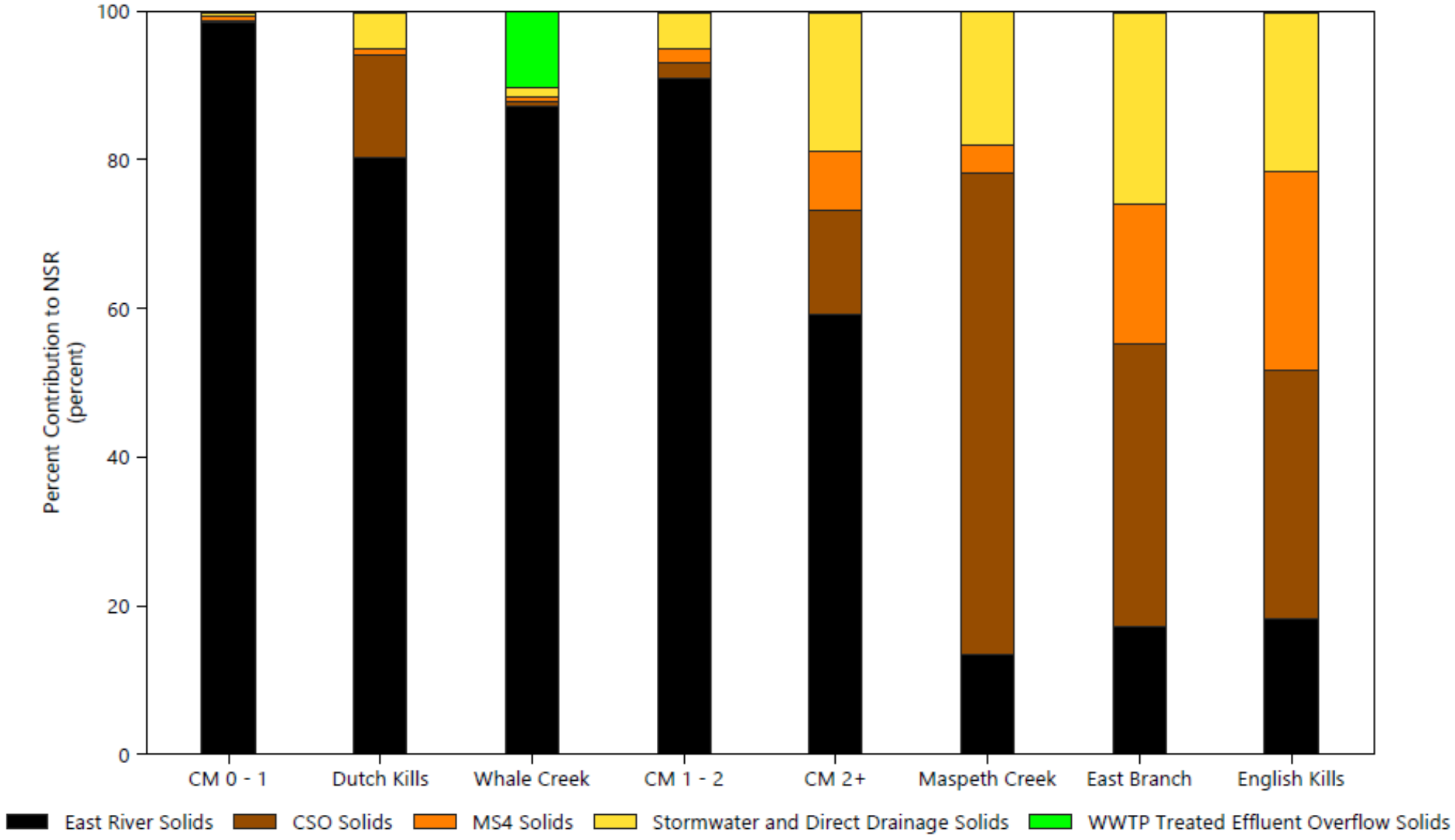
- **Solids-based sources**: Quantified by relative contribution to net sedimentation rate (NSR) and measured particulate phase contaminants
  - East River surface water
  - Point sources (combined sewer outfalls [CSOs], stormwater/direct drainage [SW/DD], and wastewater treatment plant [WWTP] effluent overflow)
- **Additional sources**: Quantified by annual contaminant load estimates (mostly dissolved phase processes)
  - Atmospheric deposition
  - Treated groundwater effluent
  - Lateral groundwater/seeps
  - Porewater advection (driven by groundwater flow)
  - Bank erosion



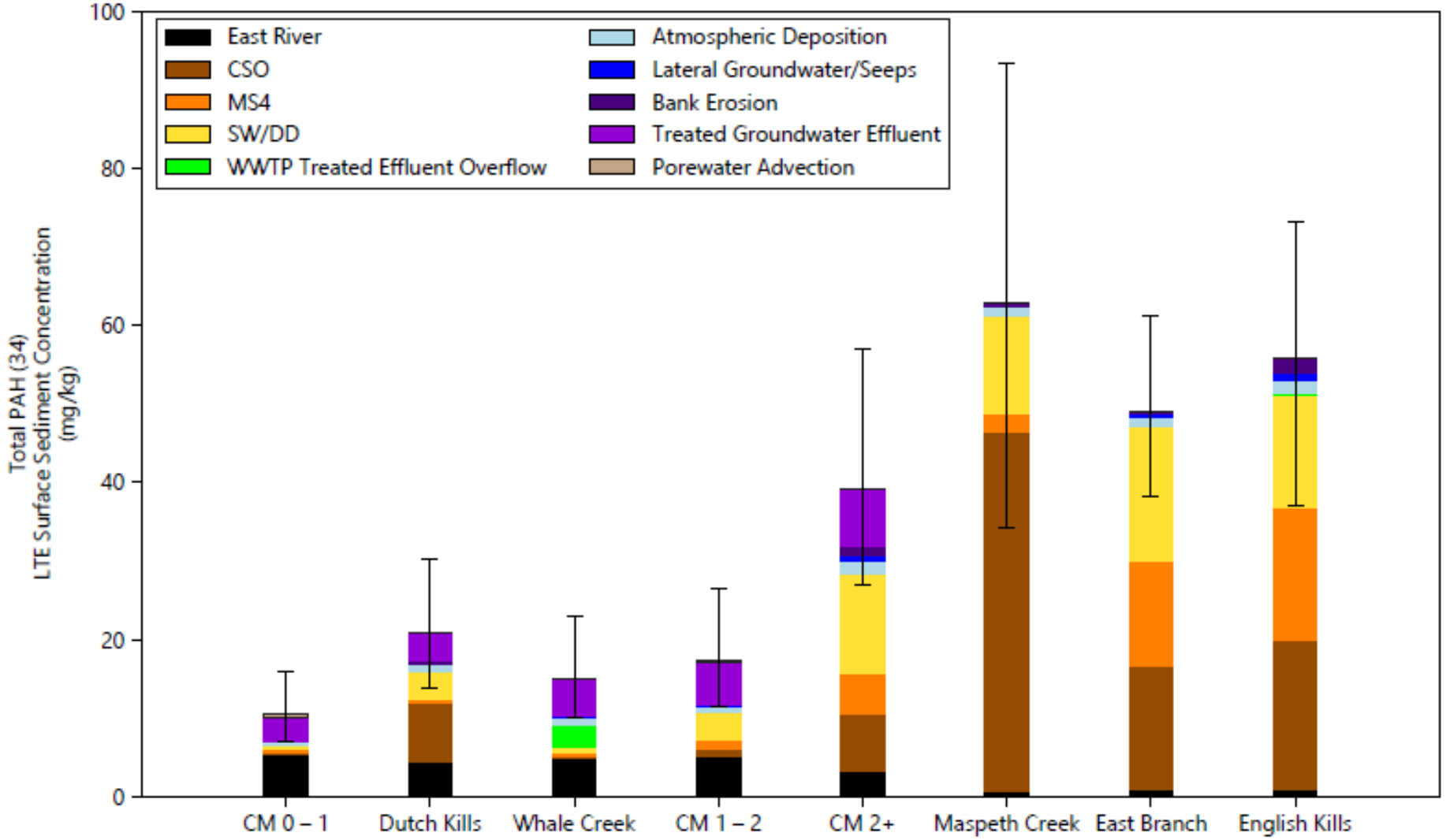
Spreadsheet-based Model Inputs

- Source inputs were developed using robust empirical data
  - East River surface water was sampled over a transect at the mouth of Newtown Creek and at an East River location for 10 monthly events
  - Multiple samples were taken from each type of point source discharge
- To quantify variability in the data, upper and lower bounds for the source terms were calculated as +/- 2 times the standard error of the mean (SEM) of the chemical concentrations

Contribution of Solids-based Sources to NSR



Estimated LTE Concentrations: Total PAH (34)



Note: The range on each bar indicates the calculated LTE concentrations with upper- and lower-bound ranges based on +/- 2 times the SEM of the chemical concentration data for each source input, while the bar itself shows the base case.

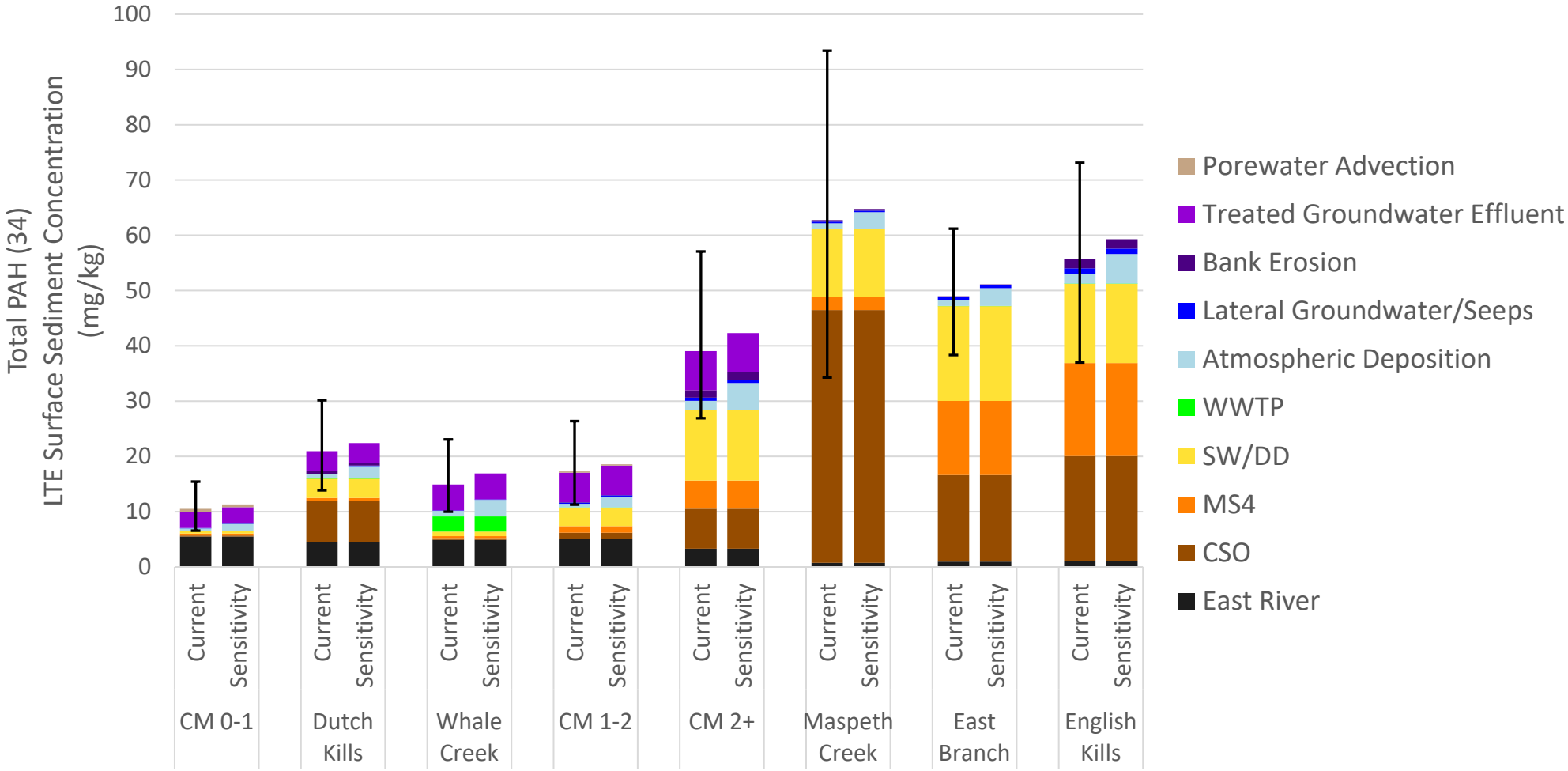
SOLUTION / LESSONS

Sensitivity Evaluations

- The spreadsheet model was developed so that the relative contribution of each ongoing source to LTE concentrations can be evaluated
- The spreadsheet model also includes the ability to evaluate the sensitivity of the LTE to uncertainty in each ongoing external input
  - Some inputs are *de minimis* contributors
  - LTE concentrations are influenced to the greatest degree by East River and select point sources (stormwater and CSOs)

Sensitivity Analysis: Atmospheric Deposition

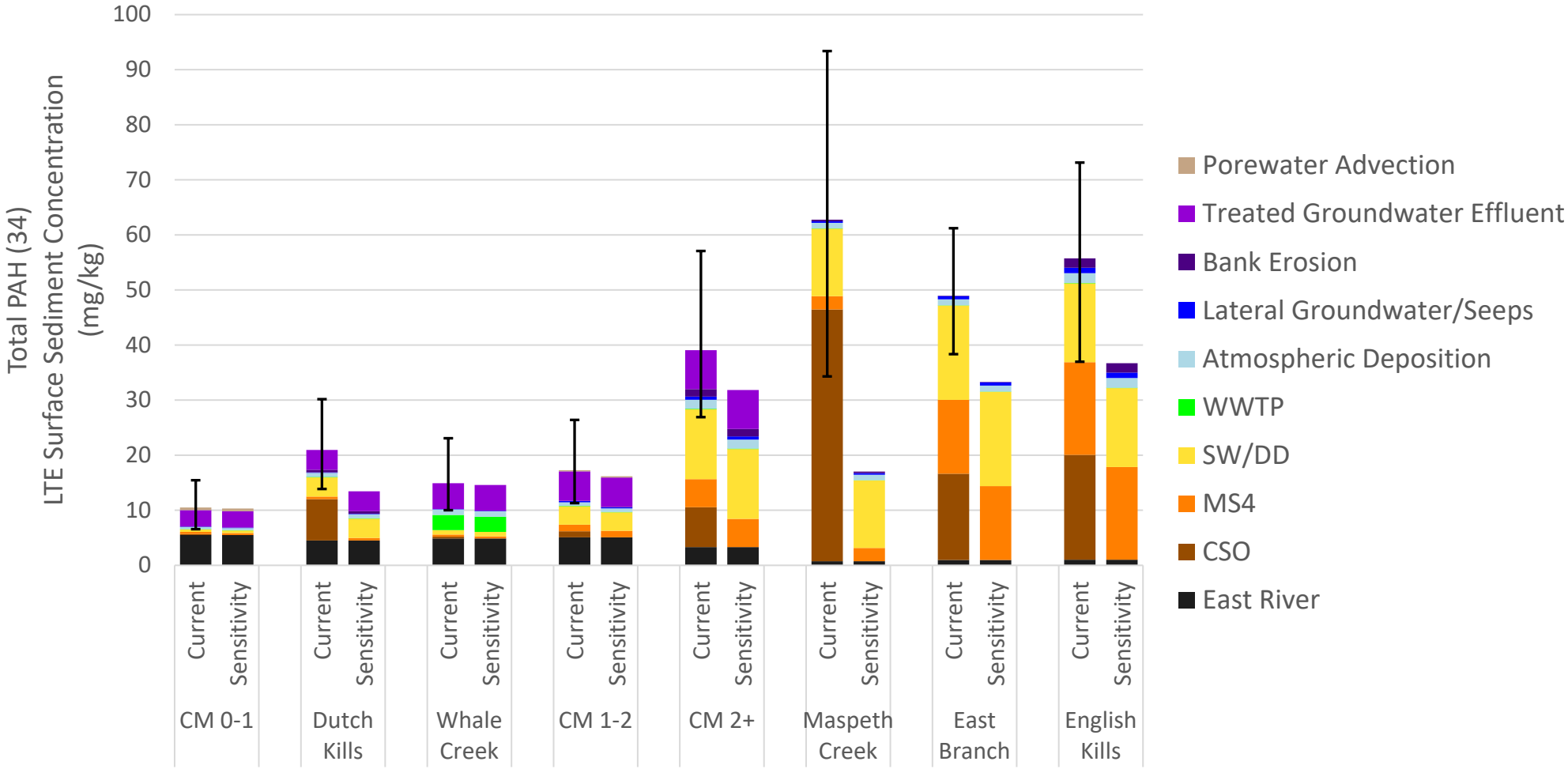
Sensitivity case with 3x higher atmospheric deposition load



Note: The range on each original bar indicates the calculated LTE concentrations with upper- and lower-bound ranges based on +/- 2 times the SEM of the chemical concentration data for each source input, while the bar itself shows the base case.

Sensitivity Analysis: CSO Loads

Hypothetically, what if chemical concentrations on CSO solids were reduced to zero?



Note: The range on each original bar indicates the calculated LTE concentrations with upper- and lower-bound ranges based on +/- 2 times the SEM of the chemical concentration data for each source input, while the bar itself shows the base case.

SOLUTION / LESSONS

Summary

- The spreadsheet model is a tool that can be used by decision makers to understand the main sources that will drive future background conditions in different reaches of Newtown Creek
- The spreadsheet model was provided to USEPA project managers to allow them to perform sensitivity analyses to understand how uncertainty in the various source terms may impact the LTE concentrations
- Insights from this evaluation are being incorporated into the development of preliminary remediation goals, remedial alternatives, and into the more refined chemical fate and transport model

THANK YOU

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