EXTERNAL MEMORANDUM

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cc: Project Central File 4069 — Category A

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Subject: Pawcatuck Sampling and Analysis Plan Review Comments

This memorandum has been prepared for the Connecticut Department of Energy and Environmental Protection (CT DEEP) to satisfy the requirements of Component/Task 2-1A of contract #19PSX0167 between CT DEEP and RESPEC. The objective of Component/ Task 2-1A is to review and comment on the water quality sampling and analysis plan developed by the US Geological Survey (USGS) titled "Water-Quality Sampling and Monitoring of the Pawcatuck Watershed" dated April 26, 2019. This memorandum documents the comments compiled by the RESPEC project team.

BACKGROUND

The Pawcatuck River, the Pawcatuck River Estuary (PRE), and Little Narragansett Bay (LNB) form part of the state boundary between the states of Connecticut and Rhode Island. Water quality impairments were identified by the states of Connecticut and Rhode Island that related to insufficient dissolved oxygen levels and excessive bacteria in these waterbodies. Connecticut also identified impairments associated with excess nutrients and eutrophication. The CT DEEP and Rhode Island Department of Environmental Management (RIDEM) are seeking to develop a new watershed-focused approach for identifying and managing nutrient inputs into these coastal estuaries. The approach will employ dynamic watershed models to facilitate the analysis of the water quality impacts associated with the current and future conditions within the watersheds across the state.

The USGS New England Water Science Center, in cooperation with the CT DEEP and RIDEM, began a sampling and monitoring project to enhance on-going efforts within the Pawcatuck River Watershed. Water quality and instantaneous-streamflow data are being collected for the development of a scientifically defensible watershed model that calculates pollutant loads and supports detailed watershed management planning in the Pawcatuck River Watershed.

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PURPOSE

The USGS is a well-established and widely recognized agency that provides highly competent sampling, monitoring, and data collections. The USGS's data have been used successfully in numerous watershed modeling efforts over the past few decades. These procedures are well-accepted and well-documented, as well as their established quality assurance/quality control (QA/QC) practices. This review is therefore focused on site selection, sample timing, and the parameters that are sampled and analyzed to support the watershed modeling to calculate flow and pollutant loads generated by the PRE, LNB, and Long Island Sound (LIS) tributary watersheds. The primary goal is to identify potential data gaps in the collection of water quality data and recommend approaches for addressing the data gaps. Since the sampling project being reviewed is ongoing, RESPEC understands that the comments and recommendations may not be practical to address at this point in the project but may be considered for future sampling efforts.

SITE SELECTION

The Pawcatuck Watershed Sampling Project operates 14 monitoring stations along the mainstem of Pawcatuck River and major tributaries, as shown in Figure 1. Five monitoring stations are on the mainstem of Pawcatuck River with a station upstream and a station downstream from Kenyon Industries (i.e., an industrial National Pollutant Discharge Elimination System (NPDES) discharger in the watershed). The remaining nine stations are strategically placed on the significant tributaries.

COMMENTS AND RECOMMENDATIONS

- The monitoring stations are well distributed across the watershed and appear to cover the major tributaries.
- The contributing upstream areas of the stations have a good mixture of the different land-cover distributions that are within the watershed. A hydrologic-soil groups and surficial geology are consistent across the major tributaries. Looking at the land-cover distributions above each tributary monitoring station for the site location selection analysis would be valuable.
- There are monitoring stations upstream and downstream from Kenyon Industries industrial NPDES discharger. There is also a monitoring station that is sampling the effluent from Kenyon Industries to help differentiate loading from the effluent during baseflow.
- A natural benchmark can be set by selecting one or more reference stations that monitor the drainage from areas with minimal to no anthropogenic influence.
  - A good reference watershed has become increasingly difficult to find because of pervasive developments throughout the states and equally pervasive effects of climate and land-use legacies.
  - Adding a reference station may currently be impractical; however, a recommended location would be on the Wood River, downstream from the Arcadia Management Area, before there are significant impacts from agriculture and the Hope Valley, Rhode Island, community. A USGS Massachusetts Water Science Center monitoring station does exist with adequate recent data to represent the recommended reference location area.
- The RIDEM rotating basin-monitoring data will help provide a good understanding of water quality conditions on the upstream tributary spatial data gaps that are not covered by this monitoring plan.

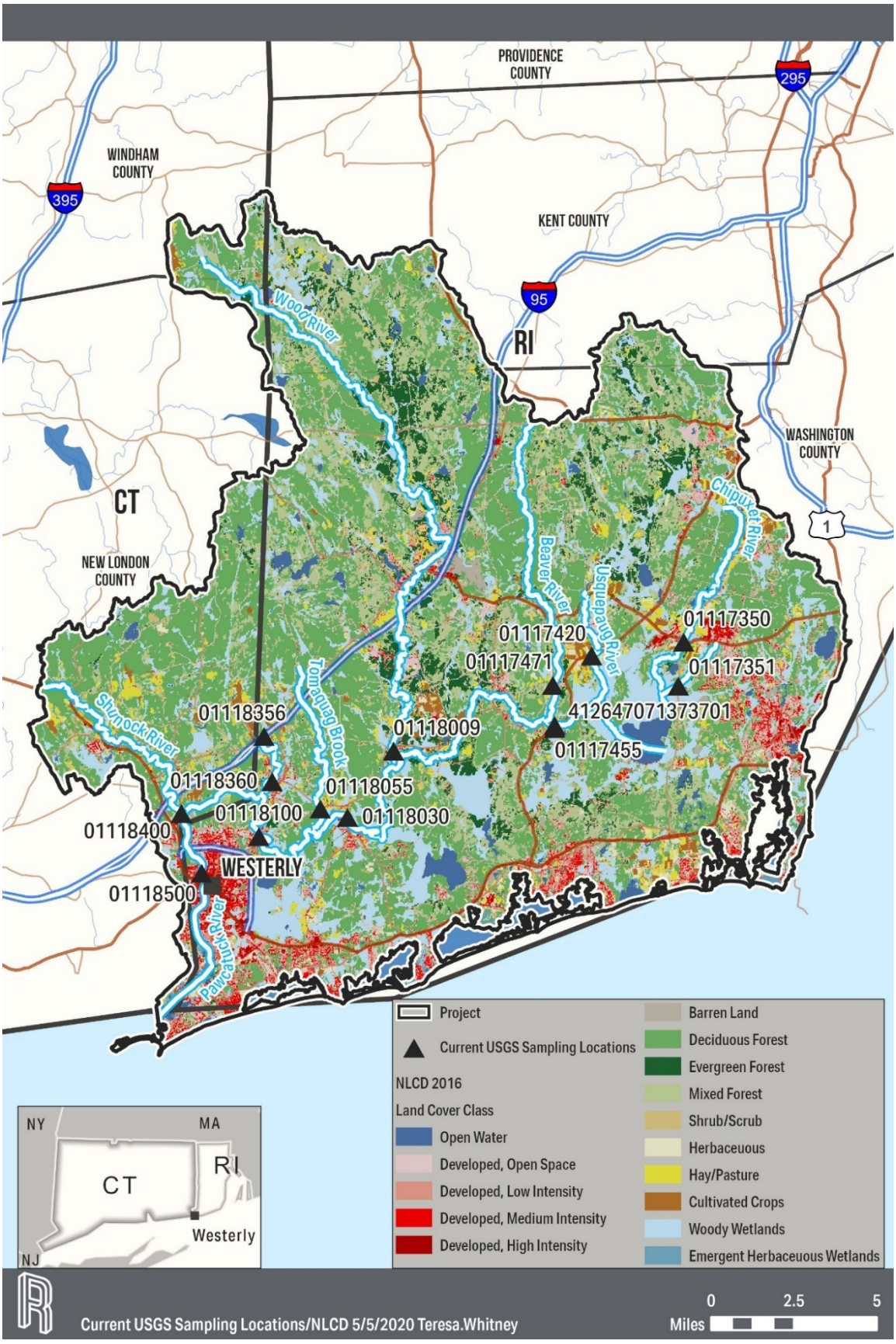

Figure 1. Map of the Water Quality Sampling and Monitoring Stations of the Pawcatuck Watershed Sampling Project.

SAMPLE TIMING

A discrete sample is being collected monthly at each of the 14 stations with an addition sample collected in the months of April through September. The only continuous monitoring station is at/near the watershed outlet at USGS Station 01118500 of Pawcatuck River at Westerly, Rhode Island. This continuous monitoring station is collecting samples in 15-minute intervals using a YSI EXO multi parameter sonde.

COMMENTS AND RECOMMENDATIONS

- The monthly and bi-monthly sampling at the 14 stations should provide a sound basis for comparison with the model simulations during baseflow conditions between storm events.
- A significant portion of the nutrient load will occur during storm events. This can significantly limit the validating the model's representation of different nutrient loading characteristics throughout the watershed.
  - Storm sampling at the continuous monitoring station will allow for the development of robust water quality load relationships between the discrete sampling and continuous monitoring constituents to further enhance the load estimates and representation within the watershed model.
  - Well-timed monthly monitoring to capture an occasional storm event at many of the discrete stations would also provide value to the model calibration and load estimation.
- The only continuous monitoring station is located within a dense urban area. The water quality data collected will be heavily influenced by the urban runoff.
  - Establishing an additional continuous monitoring station in the upper reaches of the Pawcatuck Watershed (e.g., Station 01118009, Wood River near Alton, Rhode Island; Station 01117455, Pawcatuck River near Sherman Avenue in Kenyon, Rhode Island; Station 01117350, Chipuxet River in West Kingston, Rhode Island) would be beneficial. If resources are limited, a continuous station at one of these sites would be a preferred choice as a replacement for one or two of the other 14 sites.
  - If an addition continuous monitoring station is established, storm sampling would also be recommended for the reasons previously described.

SAMPLED PARAMETERS

The Pawcatuck Watershed Sampling Project is performing discrete sampling for nutrients, total suspended solids (TSS), and related parameters at each of the 14 monitoring stations. Water quality monitoring at the one continuous monitoring station will be for dissolved oxygen, pH, water temperature, turbidity, specific conductance, and chlorophyll. In addition, discrete chlorophyll samples will be collected from April through September at the continuous monitoring station. Instantaneous discharge measurements are being taken at stations where no streamflow gage exists and the streamflow correction factor is greater than 10 percent.

COMMENTS AND RECOMMENDATIONS

- The attention to a wide range of particulate and dissolved forms of nutrients and TSS sampling methods will be valuable.
- TSS data acquired from this sampling program would be enhanced with an established relationship between TSS and either specific conductance (SC) and/or turbidity (T). The information on TSS for use in the modeling is greatly enhanced by T and SC being analyzed with continuous monitoring.

- Relationships between particulate forms of nutrients with T and SC may also be beneficial if the accuracy and precision of the methodology are sufficient to satisfy the objectives.
- A specific need for the watershed sediment modeling is data on the particle size distributions (PSD); which would identify sand, silt, and clay fractions using TSS samples; and bed material samples. Since the model simulates these size fractions, data to confirm and help calibrate the model for sediment/TSS are a significant need not addressed by the current sampling program.
- A critical objective of the watershed model is to identify scenario alternatives needed for attainment of dissolved oxygen water quality improvement goals. Valuable data for representing significant components of dissolved oxygen fluxes are carbonaceous biochemical oxygen demand (CBOD), sediment oxygen demand (SOD), and benthic algae. Productivity and biomass have been challenging to effectively monitor but are critical to understanding the effects of nutrients on stream and estuarine health.
  - CBOD or biochemical oxygen demand (BOD) are additional parameters that help with understanding instream production and biomass as they relate to differentiating oxygen-demanding biomass from refractory biomass.
  - SOD is one of the primary oxygen-demanding processes in streams with increased eutrophication present; however, this type of data collection is often limited by time and resources.
  - With the majority of algal biomass in flowing waters being associated with benthic substrates, a biological monitoring program that includes benthic algae monitoring (e.g., benthic chlorophyll-a) would provide valuable data on algal biomass and diversity. Benthic algae can have a significant influence on the instream biomass and dissolved oxygen fluxes and is an important indicator of nutrient enrichment.
- The Pawcatuck Sampling Plan notes that "The goal of QC sampling is to identify, quantify, and document bias and variability in data that result from collection, processing, shipping, and handling of samples …." (Pawcatuck Sampling Plan, page 5). Data assessment and the modeling effort would be greatly benefited if the results of these efforts can provide estimated error bounds about the sample values.

SUMMARY

Overall, the Pawcatuck Sampling Plan is a well-structured sampling plan with a good distribution of stations across the watershed, and appropriate parameters are being monitored. The outcome of the sampling plan will provide an adequate set-of-data to represent recent conditions and identify significant water quality responses within the watershed. The primary data gap identified was the lack of targeted storm sampling that can be critical to effectively estimate nutrient and sediment loadings during runoff events. This recent sampling effort, in addition to previous sampling efforts, should be able to provide a reasonable range of flow conditions and corresponding water quality data to estimate nutrient and sediment loads and effectively support the watershed-focused approach to managing nutrient loads in the Pawcatuck River Watershed. The following is a compiled list of recommendations from the previous sections, grouped by priority. With the timing of this review being at the later stages of the monitoring schedule, most of the recommendations may currently be of a lower priority.

HIGHLY RECOMMENDED ACTIONS

- Sample Timing
  - Include some level of storm sampling at the continuous and discrete monitoring stations.

- Sample Parameters
  - Develop relationships comparing nutrient and TSS data to turbidity and specific conductance.
  - Develop PSD data to; identify sand, silt, and clay fractions with TSS samples and channel bed materials.

SUGGESTED ACTIONS

- Site Selection
  - Consider an improved reference station for representing areas dominated by natural landscape.
- Sample Timing
  - Add continuous monitoring at an additional location at a larger tributary with minimal urban influence.
- Sampled Parameters
  - Consider sampling for a form of CBOD or BOD.

LOW-PRIORITY ACTIONS

- Sampled Parameters
  - Collect samples for benthic algae and SOD.

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