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October 10, 2017

Mr. Michael Liberati
DuPont Corporate Remediation Group
Chestnut Run Plaza 715-236
Wilmington, DE 19805

VIA ELECTRONIC MAIL

Re: Revised 2015 Short Term Monitoring Report
Former DuPont Waynesboro Site, Area of Concern 4
Waynesboro, Virginia
EPA ID# VAD003114832

Dear Mr. Liberati:

This letter acknowledges the receipt and review of the Revised 2015 Short Term Monitoring Report (Report) dated October 2016, submitted to the Virginia Department of Environmental Quality, Office of Remediation Programs (VDEQ) by AECOM on behalf of the E.I du Pont Nemours and Company (DuPont).

The Department accepts the report as complete.

If you have any additional technical questions, you may contact me at 703-583-3825 or by email at Kurt.Kochan@deq.virginia.gov.

Sincerely,

Kurt W. Kochan
Corrective Action Project Manager
Office of Remediation Programs

cc: DuPont Waynesboro Correspondence File
Brett Fisher, Calvin Jordan, VDEQ-CO
Ceil Mancini, Josh Collins, AECOM

Environment

Submitted on behalf of
E.I. du Pont de Nemours and Company

Submitted by
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Area of Concern (AOC) 4 2015 Short-term Monitoring Report

Former DuPont Waynesboro Site, Virginia

Project #: 60394083
Date: October 2016

EXECUTIVE SUMMARY

Interim measures are being implemented by E.I. du Pont de Nemours and Company (DuPont) in accordance with the United States Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. VAD003114832, to address mercury contamination historically released to the South River from the former DuPont facility in Waynesboro, Virginia (Site). Riverbank soils impacted by these historical releases are currently the primary source of mercury loading to the South River and as such, are the focus of the planned interim measures (URS, 2012; Anchor QEA et al., 2015).

Short-term monitoring (STM) is being conducted to evaluate the performance of the interim measures and proposed remedial approach. STM is intended to evaluate the approach over a short period of time ranging from two to 10 years, and limited in spatial extent immediately adjacent to a particular bank management area (BMA). Biotic and abiotic measurement endpoints included in the STM program are categorized into the following performance metrics: Bank Stability, Mercury Loading/Exposure, and Riparian/Aquatic Habitat.

Although bank erosion is the primary mercury transport pathway from riverbanks, other transport and exposure pathways are also possible. The ability to differentiate between local sources of mercury (e.g., bank soils) and mercury loading from upstream is essential in the assessment of remedy effectiveness. The measurement of total and methylmercury in near-bank sediments, pore water and periphyton alone may not be sufficient to differentiate between local (i.e., bank) sources, and sources further upstream. Following remedy implementation, these data in context with the Long-term Monitoring (LTM) program surface water data, mid-channel periphyton and *Corbicula* data, and bank stability assessments will provide input to source identification (i.e., bank vs. upstream).

Results of the 2015 STM efforts indicate that riverbanks at each STM station are generally stable with isolated areas of erosion, which is consistent with previous estimates (Anchor QEA et al., 2015). Invasive plant species are present at each STM station and in some instances they are the dominant species within the BMA. Riparian and aquatic habitat value at STM stations evaluated was generally good, with the exception of impacts associated with invasive species and increased embeddedness.

Mercury concentrations in biotic and abiotic media generally followed spatial and temporal trends documented in previous investigations (URS, 2012; URS, 2014). Mercury concentrations in most media generally increased with distance downstream; media from near-bank environments are generally higher than those measured in mid-channel environments. While inorganic mercury (IHg) and methylmercury (MeHg) concentrations in bulk sediment, pore water, periphyton and transplanted *Corbicula* were somewhat variable, they appeared to be locally influenced by areas of elevated total mercury (THg) in bank soils; this finding is consistent with previous data collected at the Pilot Bank Stabilization project.

Monitoring activities will continue in 2016. The specific scope of the 2016 STM, and specific stations to be included, will reflect locations of selected BMAs. The effort will document conditions prior to the implementation of the remedial approach on a broader scale.

These interim measures and monitoring activities also result directly from conclusions drawn from the multi-year study (Ecological Study) conducted in collaboration with the Natural Resources Defense Council (NRDC) and Virginia Chapter of the Sierra Club, and the Remedial Proposal which was part of the final settlement agreement between DuPont and NRDC in 2013 (URS, 2012; Anchor QEA and URS, 2013). As was noted in the Ecological Study and the Remedial Proposal, some aspects of the long and short-term monitoring may change depending on whether the results obtained have a material impact on current or future remedial decisions. How monitoring information is collected and used in determining remedy effectiveness and whether certain aspects of the remedy may need changing is also consistent with DuPont's plan to use adaptive management for this project. In addition, DuPont will continue to undertake the remedial and monitoring work through technical collaboration with the Virginia Department of Environmental Quality (VDEQ) and the South River Science Team (SRST).

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Acronym List

Acronym	Explanation
ADQM	Analytical Data Quality Management
AOC	Area of Concern
BMA	Bank Management Area
C	Degrees Celsius
COC	Chain-of-Custody
CRG	Corporate Remediation Group (DuPont)
CRM	Certified Reference Materials
Cm	Centimeter
DDR	DuPont Data Review
DuPont	E.I. du Pont de Nemours Company
DVM	Data Verification Module
DW	Dry weight
EDD	Electronic Data Deliverable
EIM	Environmental Information Management (Locus)
EPA	U.S. Environmental Protection Agency
EPW	Evaluation of Planned Wetlands
Hg	Mercury
IHg	Inorganic mercury
LiDAR	Light detection and ranging
LCS	Laboratory control sample
LTM	Long-term Monitoring
LWD	Large woody debris
MeHg	Methylmercury
mg/kg	Milligrams per kilogram
ng/L	Nanograms per liter
NRDC	Natural Resources Defense Council
ORP	Oxidation-Reduction Potential
QA/QC	Quality Assurance/ Quality Control
RBP	Rapid Bioassessment Protocols
RCRA	Resource Conservation and Recovery Act
RRM	Relative river mile
SC	Specific conductivity
SOP	Standard operating procedure
SRST	South River Science Team
STM	Short-term Monitoring
STMP	Short-term Monitoring Plan
THg	Total mercury
µg/kg	Micrograms per kilogram
USM	Unified stream methodology
VDEQ	Virginia Department of Environmental Quality
WW	Wet weight

1.0 Introduction

1.1 Background

Interim measures are being implemented by E.I. du Pont de Nemours and Company (DuPont) in accordance with the United States Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. VAD003114832, to address mercury contamination historically released to the South River from the former DuPont facility in Waynesboro, Virginia (Site).

From 1929 to 1950, the Site used mercury compounds (e.g., mercuric sulfate) to produce acetate flake and yarn. The Site recovered the majority of the mercury from the process wastes at an on-site retort facility. Inadvertent mercury releases during that period were remediated in accordance with applicable waste management practices of the time. Riverbank soils impacted by these historical releases are currently the primary source of mercury loading to the South River and as such, are the focus of the planned interim measures (URS, 2012; Anchor QEA, 2015).

Phase 1 interim measures are focused on bank stabilization, which will be implemented at Bank Management Areas (BMAs) beginning with the first two relative river miles (RRM), RRM 0 to RRM 2.0. A combination of source area removal (Primary BMAs), and structural and vegetative stabilization (Secondary BMAs) will be used to reduce mercury transport from eroding banks.Primary BMAs (where the remedy involves removal) consist of banks that contribute disproportionately higher THg loading between RRM 0 and RRM 2 (approximately 40%), while THg loading from Secondary BMAs (where the remedy involves stabilization only), are substantial, but less than the removal BMAs. Phase 1 Primary and Secondary BMAs are further divided into Phase 1A and Phase 1B based on land ownership. Phase 1A BMAs include the City of Waynesboro (City-owned) BMAs at Constitution Park and the Wastewater Treatment Plant (WWTP). The remaining City-owned BMAs and non-City-owned BMAs from RRM 0 to RRM 2 are classified as Phase 1B BMAs. Short- and Long-term Monitoring (STM and LTM, respectively) is being conducted to evaluate the performance of the interim measures and proposed remedial approach. STM, presented in this annual report, is intended to evaluate the approach over a short period of time ranging from two to 10 years, and limited to a specific spatial extent immediately adjacent to a particular BMA. STM specifically evaluates the following:

- Bank stability
- Total mercury (THg) and methylmercury (MeHg) concentrations in:
  - Sediment
  - Pore water
  - Periphyton
  - Transplanted Asiatic clam (*Corbicula fluminea*)
- Riparian and aquatic habitat

Unlike STM reporting which will occur annually, LTM reporting will occur every three to four years. LTM is intended to evaluate the approach over a longer time frame (10+ years) and to provide more of a system-wide characterization.

These interim measures and monitoring activities also result directly from conclusions drawn from the multi-year study (Ecological Study) conducted in collaboration with the NRDC and Virginia Chapter of the Sierra Club, and the Remedial Proposal which was part of the final settlement agreement between DuPont and NRDC in 2013 (URS, 2012; Anchor QEA and URS, 2013). As was noted in the Ecological Study and the Remedial Proposal, some aspects of the long and short-term monitoring may change depending on whether the results obtained have a material impact on current or future remedial decisions. How monitoring information is collected and used in determining remedy effectiveness and whether certain aspects of the remedy may need changing is also consistent with DuPont's plan to use adaptive management for this project. In addition, DuPont will continue to undertake the remedial and monitoring work through technical collaboration with the VDEQ and the SRST.

1.2 Purpose

As outlined above, several measurable metrics and success criteria have been included in the Short-term Monitoring effort to document bank stability and subsequent mercury loading to the South River in response to remedial actions. Although bank erosion is the primary mercury transport pathway from riverbanks, other pathways are also possible. The measurement of total and methylmercury in near-bank sediments, pore water and periphyton alone may not be sufficient to differentiate between local (i.e., bank) sources and sources further upstream. Thus, the STM dataset will be evaluated in context with the Long-term Monitoring (LTM) program, which encompasses a broader distribution of sampling locations, upstream and downstream of the BMAs. LTM data to be considered as part of the STM data evaluation include, but are not limited to, surface water data, mid-channel periphyton and *Corbicula* data, and bank stability assessments.

This report summarizes the sampling methodology and results from the June and October 2015 STM sampling events, which were conducted to assess pre-remediation baseline conditions. These data will be used to assess the effectiveness of bank remedial actions to be implemented at the BMAs. The 2015 STM sampling events included only those Short-term Monitoring Plan (STMP) stations STMP-01, STMP-05 and STMP-07 (Figure 1) that are located relevant to the BMAs anticipated to be included in the first phase of construction.

1.3 Report Organization

Components of this STM Report are provided in the following sections:

- Section 2 describes the methods implemented during STM;
- Section 3 summarizes results of the 2015 baseline STM activities;
- Section 4 reviews the data quality assessment; and
- Section 5 provides an evaluation of the 2015 baseline STM data.

2.0 Methods

The following sections briefly summarize the methods used in the 2015 STM events. Specific details and standard operating procedures (SOP) for these methods are provided in the Final AOC 4 Short-term Monitoring Plan (URS, 2015). Table 1 provides an overview of the STM monitoring plan design, including performance objectives, metrics, success criteria and potential adaptive management outcomes.

Each of the datasets targeted were focused on a specific performance goal directed at bank stability, mercury loading, and mercury exposure. Additional ancillary datasets primarily focused on riparian and aquatic habitat were also collected. Biotic and abiotic media samples collected during the 2015 STM sampling events were analyzed for THg and MeHg; inorganic mercury (IHg) was calculated as the difference between THg and MeHg. The following paragraphs describe the methods used to measure environmental attributes that affect the transport and exposure to mercury in the system.

2.1 Bank Stability

Bank erosion is an important mechanism of THg loading to the South River. Bank areas with elevated mercury concentrations that are also erosive will result in higher system loading. Bank stabilization, to reduce erosion in areas of high loading, is the focus of the Phase 1 interim measure. Baseline BMA bank stability data will be used as a reference for post-remediation stabilized banks.

As described in the Final Interim Measures Design, Implementation and Monitoring Work Plan (Anchor QEA et al., 2015), baseline bank topography for the first two river miles was documented in March 2014 by conducting a shore-based light detection and ranging (LiDAR) survey. To further document pre-remediation bank stability, conditions were visually evaluated during the June and October 2015 STM events. Subsequent post-remediation LiDAR surveys will be conducted annually for three years and following major storm events (e.g., 10-year storm), if warranted based on post-storm visual inspections. A photographic log of key bank features documented at STMP-01, STMP-05 and STMP-07 is provided in Appendix A.

2.2 Mercury Loading and Exposure

Monitoring metrics that represent good indicators of mercury loading include abiotic media such as sediment, that can serve as a transport or exposure medium. Biotic media, at the lowest trophic levels such as periphyton and *Corbicula*, are also sensitive indicators of loading and exposure. Methods to measure these metrics are provided in this section.

2.2.1 Sediment

Near-bank sediment THg and MeHg concentrations can be influenced by localized bank erosion and depositional processes and provide a direct measurement of system loading. Deposition can occur in areas of relatively slower flow, including quiescent areas near the banks, and downstream of large woody debris (LWD) and near-bank obstructions (URS, 2012). Sediment data collected as part of the 2015 efforts will be used to characterize pre-remedial, near-bank sediment mercury concentrations, as a basis for comparison with post remedy conditions.

Sediment samples were collected in June and October 2015 following standard operating procedure SRSE-2 (URS, 2015). Bulk sediment samples were collected at transects spaced approximately 100 to 200 feet apart, from near-bank environments at STMP-01, STMP-05, and STMP-07. The samples were collected by direct pushing dedicated 2" acetate cores to a depth of 15 cm at each individual transect. The sediment samples collected at each individual transect were characterized, and then thoroughly homogenized in a stainless steel bowl prior to being transferred to laboratory-supplied bottleware, and preserved on dry ice. Samples were submitted to Cebam Analytical (Bothell, Washington) under proper chain-of-custody (COC) procedures.

2.2.2 Pore Water

Pore water refers to the aqueous phase occupying sediment interstitial spaces. It is an important medium for mercury transfer between the solid (sediment) and aqueous phases. Conditions in the interstitial spaces can also be conducive to mercury methylation.

Pore water samples were collected in June and October 2015 following procedures outlined in SOP SRPW-1 (URS, 2015). Pore water samples were co-located with bulk sediment samples (i.e., collected at transects along STMP-01, STMP-05, and STMP-07, spaced approximately 100 to 200 feet apart). The samples were collected from near-bank, undisturbed, shallow sediments, 5-10 cm below the sediment surface, with a decontaminated push-point sampler (i.e., Henry Probe). They were field-filtered using 0.45-µm syringe-tip filters.

In situ water quality parameters for the unfiltered pore water and the overlying ambient surface water were monitored and compared to validate the collection of true pore water. A Myron 6P meter was used to document water quality parameters, including temperature, specific conductivity (SC), oxidation-reduction potential (ORP) and pH. Samples were preserved at 4° C (Celsius), and submitted to Cebam Analytical (Bothell, Washington) for analysis.

2.2.3 Periphyton

Epilithic periphyton (i.e., algae and suspended solids associated with streambed substrates) plays an important role in the trophic transfer of MeHg in the South River (URS, 2012). Mercury concentrations in periphyton are expected to respond to the effects of the bank stabilization by declining along with a decrease in sediment concentrations.

Periphyton sampling was conducted in accordance with SOP SRTI-1 (URS, 2015). Three composite samples were collected from near-bank environments at the downstream extent of each STMP during the June and October 2015 sampling events. Three composite samples were also collected from mid-channel environments for comparison with LTM data. Samples were collected from similar surface water depths and flow regimes at each STMP, within each environment (i.e., near-bank and mid-channel).

Samples were collected using a decontaminated plastic spatula to scrape periphyton off streambed cobbles until a suitable sample mass was obtained; descriptions (i.e., texture, color, general abundance, etc.) of all periphyton samples were documented upon collection. Each sample was gently rinsed with site water to remove coarse substrates (i.e., fine-medium sands and gravel). Upon inspection, any invertebrates found in the sample were removed prior to placing the sample in laboratory-supplied bottleware and preserving on dry ice. Samples were submitted to Cebam Analytical (Bothell, Washington) for analysis.

2.2.4 Asiatic Clam

Corbicula were included as a monitoring element in the STM program because of its important role in the South River aquatic and terrestrial food webs, and its sedentary nature. *Corbicula* were collected from a reference location in Middle River and deployed at the 2015 STMP stations for two five-week exposure periods, one in June and one in October 2015, to measure mercury uptake. Clams were deployed at the downstream extent of each STM station in order to capture the cumulative influence of the associated BMAs. Two deployment types were used to evaluate potential differences in mercury exposure to *Corbicula*, including:

- Epifauna (caged): *Corbicula* were contained in porous sleeves and suspended in the water column, off of the substrate, via frame-cages; and
- Infauna (seeded): *Corbicula* were tagged and seeded directly into the sediment.

Similar to the periphyton sampling strategy, two environments were sampled at each 2015 STM station in June (i.e., near-bank and mid-channel); only near-channel clams were deployed in October 2015, in accordance with the STM Plan (URS, 2015). Three composite transplanted *Corbicula* samples were collected per deployment type (i.e., seeded and caged) from near-bank environments at the downstream extent of each STMP (June and October 2015). Additionally, three composite transplanted *Corbicula* samples (caged only) were collected from mid-channel environments at the downstream extent of each STMP (June 2015 only). *Corbicula* were depurated for 24 hours, processed, frozen and submitted to a Cebam Analytical (Bothell, Washington) for analysis.

2.3 Riparian and Aquatic Habitat

Bank stabilization can provide a positive effect on the function of the existing riparian and associated aquatic habitats. This section describes the methods used to evaluate the ecological attributes of these habitats.

2.3.1 Riparian Vegetation

Riparian vegetation plays an important role in bank stability and habitat quality for ecological receptors. It is also an important value to stakeholders in terms of the way the banks are viewed. Riparian vegetative communities for the following strata were assessed at two plots per station during each of the 2015 STM field events:

- Herbaceous: 1 m diameter around the center of the plot;
- Shrub / sapling: 3 m diameter around the center of the plot;
- Tree: 10 m diameter around the center of the plot; and
- Vine: 10 m diameter around the center of the plot.

The dominant vascular plant species were identified to the lowest practical taxon, and the percent areal cover was quantified for each stratum.

2.3.2 Rapid Bioassessment Protocol (RBP)

In October 2015, the pre-remedy quality of the substrate, channel morphology, bank structure and riparian vegetation at each 2015 STM station was evaluated using modified Rapid Bioassessment Protocols (RBPs) (Barbour et al., 1999). Specific metrics assessed included:

- Epifaunal substrate/available cover;
- Embeddedness;
- Pool substrate characterization;
- Sediment deposition;
- Bank stability (subject bank only);
- Vegetative protection; and
- Riparian vegetative zone width.

The RBP scoring system assigns a numerical score that fits into one of four condition categories (i.e., “optimal”, “suboptimal”, “marginal” or “poor”).

2.4 Additional Ancillary STM Habitat Metrics

Additional ancillary STM habitat metrics were included as part of the 2015 pre-remedy monitoring effort to address stakeholder concerns regarding preserving high quality ecological habitats within the City of Waynesboro, but are not part of the RCRA required metrics. The methods used to collect these ancillary data included: Evaluation of planned wetlands (EPW), unified stream methodology (USM), and benthic community evaluations. The ancillary STM habitat metrics are summarized in Appendix B.

3.0 Results

The following sections briefly summarize results from the 2015 STM events. Each of the datasets describes existing, pre-remediation conditions for bank stability, mercury loading, and mercury exposure.

3.1 Bank Stability

Results from the March 2014 LiDAR survey describe existing, pre-remediation bank conditions, and are presented in Section 4.3 and Appendix A of the Final Interim Measures Design, Implementation and Monitoring Work Plan (Anchor QEA et al., 2015). Average bank height at the STMP-01 is 9.5 feet, with bank angles ranging from 15 to 20 degrees; the average sediment load is 6.1 (10^3 kg/year). STMP -05 is comprised of two BMA areas (North Park A and North Park B); average bank heights range from 8.9 to 12.4 feet, with bank angles ranging from 25 to 70 degrees. Average sediment loading rates at STMP-05 range from 6.7 to 8.9 (10^3 kg/year). Monitoring location STMP-07 includes three BMA areas (North Park C, WWTP-A and WWTP-B); average bank heights range from 8 to 11.7 feet, with bank angles ranging from 16 to 60 degrees. Average sediment loading rates at STMP-07 range from 4 to 8.3 (10^3 kg/year). Visual reconnaissance performed in June 2015, confirmed the results of the LiDAR survey at STMP-01, STMP-05, and STMP-07; specifically, isolated areas of bare soil, undercutting and exposed roots were documented at these areas. Access paths to the river, generally present near areas of active public use such as Constitution Park and North Park, were present at a number of locations throughout the monitoring stations (Figure 1). A photographic log of key bank features documented at STMP-01, STMP-05, and STMP-07 in 2015 is provided in Appendix A.

3.2 Mercury Loading and Exposure

Although bank erosion is the primary mercury transport pathway from riverbanks, other transport and exposure pathways are also possible. The ability to differentiate between local sources of mercury (e.g., bank soils) and mercury loading from upstream is paramount in being able to evaluate remedy effectiveness. The measurement of total and methylmercury in near-bank sediments, pore water, and periphyton alone may not be sufficient to differentiate between local (i.e., bank) sources and sources further upstream. Following remedy implementation, these data in context with the LTM monitoring program surface water data, mid-channel periphyton, and *Corbicula* data, which span a larger area, will be used to help evaluate the efficacy of the IRM and aid in the interpretation of results (i.e. bank loading vs. upstream or systemic changes.

3.2.1 Sediment

Transect sample-specific bulk sediment mercury (Hg) concentrations were generally comparable in June and October 2015. Although co-located historical sediment data are not available for direct comparison, baseline STM data collected in 2015 were also generally consistent with historical sediment data trends within the RRM 0-2 reach of the South River (URS, 2012). Average IHg concentrations in bulk sediments at STMP-01, STMP-05 and STMP-07 were 4.24, 65.9 and 8.39 milligrams per kilogram (mg/kg), respectively (Table 2 and Figure 2). Bulk sediment MeHg concentrations generally constituted a relatively negligible portion of THg. Concentrations of IHg in bulk sediment were generally comparable among STM stations; however, samples collected from several transects at STMP-05 had relatively elevated IHg concentrations in both June and October 2015.

3.2.2 Pore Water

Pore water concentrations were generally comparable in June and October 2015; however, substantial variation in concentrations among individual sampling transects was observed. Average IHg concentrations in pore water at STMP-01, STMP-05, and STMP-07 were 13.3, 37.9, and 11.8 nanograms per liter (ng/L), respectively; average MeHg concentrations were 1.70, 4.01, and 1.22 ng/L, respectively (Table 3 and Figure 3). Although co-located historical pore water data are not available for direct comparison, baseline STM data collected in 2015 were generally consistent with historical trends in pore water data within the RRM 0-2 reach of the South River.

3.2.3 Periphyton

Concentrations of IHg and MeHg in epilithic periphyton monitored in June and October 2015 are shown in Table 4 and Figure 4. IHg and MeHg concentrations in near-bank and mid-channel periphyton generally increased with distance downstream. Additionally, IHg and MeHg concentrations in periphyton monitored in June were generally higher in near-bank environments than in mid-channel environments. Near-bank IHg periphyton concentrations were comparable in June and October; however, higher concentrations of MeHg were documented in the June periphyton samples (Table 4 and Figure 4). Previous investigations have documented that MeHg concentrations in various in-stream media increase when surface water temperatures reach 12° to16°C (URS, 2012). Higher MeHg concentrations in periphyton measured in June are likely attributable the seasonal methylation

3.2.4 Asiatic Clam

IHg and MeHg concentrations measured in transplanted caged and seeded *Corbicula* in June and October 2015 are provided in Table 5 and Figure 5. A summary of results is provided below:

- Similar to periphyton, Hg concentrations in clam tissue were generally higher in both transplanted and seeded *Corbicula* in June compared with clams in October, likely attributable to the warming surface water temperatures in the weeks preceding the June sampling event;
- IHg tissue concentrations generally increased with distance downstream in June. Whereas, IHg tissue concentrations were generally comparable among all STM stations in October;
- IHg and MeHg tissue concentrations were generally higher in near-bank environments than in mid-channel environments; and
- IHg and MeHg tissue concentrations were generally higher in seeded than in caged *Corbicula* in June. Whereas, concentrations of IHg and MeHg in near-bank *Corbicula* were generally comparable between seeded and caged deployment treatments in October.

3.3 Riparian and Aquatic Habitat

3.3.1 Riparian Vegetation

Baseline riparian vegetation conditions have been established at the three STM stations adjacent to Phase 1 BMAs. Riparian vegetation conditions were generally similar between the spring and the fall, per STM station. Additionally, non-native, invasive plant species were present at each STM station in the spring and in the fall, and in some instances, were the majority of the plant community (i.e., STMP-01, Japanese Knotweed). A summary of the results is provided below:

- Tree stratum- The tree species with the highest percent cover among the three STM stations were black locust (*Robinia pseudoacacia*), black walnut (*Juglans nigra*), and silver maple (*Acer saccharinum*). Non-native, invasive species were not observed in the tree stratum at any of the 2015 STM stations;
- Sapling/shrub stratum- The sapling/shrub species with the highest percent cover for all three STM stations was Japanese honeysuckle (*Lonicera japonica*). The Persian silk tree (*Albizia julibrissin*), a non-native, invasive woody plant, was observed at STMP-05 (5% cover); however, non-native sapling/shrubs were not observed at STMP-01 or STMP-07; and
- Herbaceous plant stratum- Japanese knotweed (*Fallopia japonica*), a non-native, invasive plant, represented a substantial portion of the herbaceous plant community at STMP-01 (60%- 80% cover) and was also observed at STMP-07 (10% cover); however, Japanese knotweed was not observed in the herbaceous plant stratum at STMP-05. Other herbaceous plant species observed at STMP-01 and STMP-07, including garlic mustard (*Alliaria petiolata*) and hooded blue violet (*Viola sororia*), had relatively minor percent covers (≤20%).

3.3.2 Rapid Bioassessment Protocol

Rapid Bioassessment Protocol scores varied throughout the area of investigation. Most RBP habitat parameters for STMP-01 were within the “suboptimal” range; however, scores were largely “marginal” for vegetation protection and riparian vegetation zone due to extensive cover of invasive species (e.g., Japanese knotweed) and anthropogenic influences associated with Constitution Park.

STMP-05 RBP scores were generally “optimal” or “suboptimal”. However, embeddedness and epifaunal substrate/ available cover were both scored as “marginal” due to numerous stretches of bedrock and a large fine-grained sediment deposit.

RBP scores for STMP-07 were mostly within the “optimal” range except for bank stability and riparian vegetation (left bank), which were scored as “suboptimal” and “marginal”, respectively. Riparian vegetation scores for the left bank at STMP-07 have been impacted by anthropogenic activities associated with the wastewater treatment plant and North Park.

3.4 Ancillary Habitat Metrics

Ancillary STM habitat metrics described in Section 2.2.2 are summarized in Appendix B.

4.0 Data Quality Assessment

The 2015 STM analytical data were reviewed in accordance with the DuPont Data Review (DDR) process to determine data usability. The DDR is an internal review process used by the DuPont Corporate Remediation Group (CRG) Analytical Data Quality Management Group (ADQM) to assist with the determination of data quality. The electronic data deliverables received from the laboratory were loaded into the Locus Environmental Information Management (EIM™) database and processed through a series of data quality checks, which are a combination of software (Locus EIM™ database Data Verification Module [DVM]) and manual reviewer evaluations. The review process included comparing available laboratory data deliverables [hardcopy and electronic data deliverable (EDD)] versus the original project specifications, examining the completed chain of custody, and using the automated DVM during the data evaluation.

4.1 Findings

Based on the quality assurance/ quality control (QA/QC) data review conducted, the following data evaluation qualifiers were applied to the analytical data, where appropriate:

- J - Estimated result. The sample concentration was between the laboratory method detection limit and reporting limit.
- B - The detection was not substantially higher than the level reported in the associated equipment blank and may not be representative of actual field conditions. Results were not adjusted for equipment or field blank detections.

Based on the scope of the data quality assessment, all 2015 STM data are considered usable.

5.0 Conclusions

The 2015 STM events documented pre-remediation, baseline conditions at three monitoring stations adjacent to Phase 1BMAs, in accordance with the Final AOC 4 Short-term Monitoring Plan (URS, 2015). The data collected during the 2015 STM event provide an initial characterization of bank stability and subsequent mercury loading and exposure to ecological receptors adjacent to these BMAs. These data, and future data collected at these and other STM stations, will be used to evaluate the effectiveness of the planned interim remedial measures. Although this dataset is a limited 'snapshot' of conditions at this time, several similarities were observed when compared with historical data collected as part of the Ecological Study (URS, 2012). Regional climatic conditions in 2015 were typical; South River stream discharge was similar to the 62-year median daily discharge for the majority of the year (Figure 6).

Bank Stability

- Riverbanks within Phase 1 BMAs are generally stable overall without large areas of extensive erosion;
- Isolated areas of erosion including undercut banks, and steep bank slopes with limited vegetation are present at each monitoring station.

Mercury Loading and Exposure

- Mercury concentrations generally follow spatial and temporal trends documented in previous investigations (URS, 2012; URS, 2014).
- Mercury concentrations in most media increase with distance downstream, and are higher in near-bank environments compared to mid-channel.
- THg in near-bank sediments were generally higher adjacent to, and downstream of riverbanks with the highest THg concentrations in bank soils [i.e., Primary BMAs (removal areas)].

Riparian and Aquatic Habitat

- Invasive plant species were present at each monitoring station and in some instances (e.g., STM-01) dominated the plant communities.
- EPA RBP scores were generally "sub-optimal" to "optimal"; however a few "marginal" scores were documented.

The STM program will continue at STMP-01, STMP-05, and STMP-07, and may also be modified depending on the final interim remedial measures design, to document pre-remedy conditions prior to the implementation of the remedial approach on a broader scale. Consistent with adaptive management principles, the STM approach may be revised based on documented progress towards the achievement of success criteria, contingency actions and emerging decision analysis options (URS, 2015).

6.0 References

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Tables

Table 1
AOC 4 Short-Term Monitoring Plan Summary
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Short-Term Remedial Action Objectives				Monitoring Plan Designs			Adaptive Management Outcomes	
General Objective	**Performance Objective**	**Measurable Metric**	**Preliminary Success Criteria**	**General Station Locations**	**Monitoring Frequency (post construction)**	**Analytical Parameters**	**Contingency Actions**	**Decision Analysis**
Reduce Mercury Transport and Exposure	Increase in Bank Stability	Topography	Maintenance of Post-Construction Bank Condition	BMA Evaluated Holistically	Twice Annually for First 3 Years; Post-storm	Continuous Bank Angle / Grade	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
		Vegetation	>80% Cover; <10% Invasives	Vegetation Plots at Each BMA	Twice Annually for First 3 Years; Post-storm	Cover and Species Composition	Additional Vegetation Enhancement	Refine Effectiveness Estimates
		Design and Implementation	Landowner Approvals and Permits	BMA Properties	NA	NA	NA	Refine Implementation Estimates
	Reduce Mercury Loading from Bank	Surface Sediment	>75% Mercury Concentration Reduction	Transects Spaced ~100-200' at each BMA	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Pore Water	>75% Mercury Concentration Reduction	Transects Spaced ~100-200' at each BMA	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Periphyton	>75% Mercury Concentration Reduction	Downstream of Representative BMAs (Near-shore)	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
		Asiatic Clam Sampling	>75% Mercury Concentration Reduction	Downstream of Representative BMAs (Near-shore)	Twice Annually for First 3 Years	IHg and MeHg Concentrations	NA	Refine Effectiveness Estimates
	Reduce In-Channel Mercury Exposure	Periphyton	>50% Mercury Concentration Reduction	Downstream of Representative BMAs (Channel)	Annually for First 10 Years	IHg and MeHg Concentrations	NA	Refine CSM
		Asiatic Clam Sampling	>50% Mercury Concentration Reduction	Downstream of Representative BMAs (Channel)	Annually for First 10 Years	IHg and MeHg Concentrations	NA	Refine CSM
Maintain or Improve Riparian and Aquatic Habitat	Improve Bank Vegetation	Vegetation	>80% Cover; <10% Invasives	Vegetation Plots at Each BMA	Twice Annually for First 3 Years	Cover and Species Composition	Additional Vegetation Enhancement	Refine Effectiveness Estimates
	Improve In-Stream Habitat	Rapid Bioassessment Protocols	Visual Stream Classification	Each BMA Assessed Independently	Quarterly for the First Year and Semi Annually (Q1/Q3) for years 2-10[1]	Rapid Bioassessment Protocol Scores	NA	Refine Effectiveness Estimates
	Maintain Detrital Input/Stream Shading	Canopy Cover	Achievement of Baseline Canopy Coverage	Transects Spaced ~ 100-200' at each BMA	Annually for First 3 Years	Percent Canopy Coverage (Spherical Densiometer)	Additional Vegetation Enhancement	Refine Effectiveness Estimates
	Maintain Stream Substrate Condition	Wolman Pebble Counts	Maintenance / Improvement of Baseline Conditions	Transects Spaced ~100-200' at each BMA	Annually for First 3 Years	Particle Size Analysis	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
	Maintain In-stream Habitat Features	# of In-stream Habitat Features	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Twice Annually for First 3 Years	# of In-stream Habitat Features	Structural Stabilization	Refine Effectiveness Estimates
	Habitat Function and Ecological Value	EPW & USM	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Annually for first 3 Years	USM Methodology & EPW Non-tidal Stream - Fish FCI	Structural and/or Vegetative Stabilization	Refine Effectiveness Estimates
Maintain or Improve Benthic Community	Maintenance of Benthic Community	Benthic Invertebrate Metrics	Maintenance / Improvement of Baseline Conditions	Four Locations Within the Interim Measures Area (RRM 0.5, RRM 1.0, RRM 1.5, RRM 2.0)	Twice Annually for First 3 Years	300 Organism Sub-count	NA	Refine Effectiveness Estimates
River Access / Aesthetics	Provide Stable River Access Points	Stable Access Points	Maintenance / Improvement of Baseline Conditions	Each BMA Assessed Independently	Twice Annually for First 3 Years	# of Stable and Improvised Access Points	Structural Stabilization	Refine Effectiveness Estimates

Notes:
EPW, Evaluation for Planned Wetlands
FCI, Functional Capacity Index
USM, Unified Stream Methodology
RRM, Relative River Mile
NA, Not applicable
IHg, Inorganic Mercury
MeHg, Methylmercury
CSM, Conceptual Site Model
BMA, Bank Management Area
Ancillary habitat/ public access metrics

Table 2
Sediment IHg and MeHg Monitoring Summary
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Transect ID	**Sediment Type**	**IHg (mg/kg dw)**			**MeHg (µg/kg dw)**		
		June 2015 Sampling Date	October 2015 Sampling Date	Mean ± SD	June 2015 Sampling Date	October 2015 Sampling Date	Mean ± SD
STMP-01							
A	Bulk	0.11	0.09	4.24 ± 4.85	0.47	0.85	4.97 ± 6.80
B		1.13	0.48		2.51	4.12	
C		1.98	3.27		1.64	5.85	
D		10.4	13.9		2.98	23.6	
E		8.08	2.97		1.92	5.80	
STMP-05							
A	Bulk	5.26	2.56	65.9 ± 175	10.5	13.0	24.4 ± 20.9
B		13.19	2.88		4.64	6.34	
C		6.63	5.03		17.0	4.15	
D		3.24	3.89		9.35	9.70	
E		7.11	19.2		24.4	48.2	
F		44.1	93.2		52.3	31.6	
G		149	792		77.5	47.6	
H		13.2	19.5		51.6	22.4	
I		9.34	43.6		7.25	5.84	
J		22.7	61.2		13.2	31.8	
STMP-07							
A	Bulk	2.75	3.03	8.39 ± 8.58	0.96	1.02	10.4 ± 9.93
B		4.60	12.8		16.2	4.86	
C		12.0	10.6		18.1	1.77	
D		30.0	13.4		8.63	6.16	
E		4.38	2.96		20.9	3.01	
F		3.09	2.44		16.0	2.05	
G		26.6	25.9		41.4	9.75	
H		3.01	4.31		9.90	9.36	
I		4.91	3.33		26.1	10.3	
J		3.50	1.70		13.2	5.21	
K		1.75	7.56		0.47	2.32	

Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
mg/Kg, Milligrams per Kilogram
µg/kg, Micrograms per kilogram
dw, Dry weight
Mean ± SD, Arithmetic mean ± standard deviation

Table 3
Filtered Pore Water IHg and MeHg Monitoring Summary
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Transect ID	FIHg (ng/L)			FMeHg (ng/L)		
	June 2015 Sampling Date	October 2015 Sampling Date	Mean ± SD	June 2015 Sampling Date	October 2015 Sampling Date	Mean ± SD
STMP-01						
A	2.58	3.68	13.3 ± 17.3	0.96	1.69	1.70 ± 1.05
B	10.7	8.36		1.17	2.52	
C	5.69	4.77		0.58	0.49	
D	61.4	11.0		3.37	0.79	
E	14.2	10.7		2.61	2.85	
STMP-05						
A	42.3	31.3	37.9 ± 102	1.67	22.6	4.01 ± 7.27
B	4.14	4.33		0.74	0.30	
C	11.4	6.87		1.31	0.45	
D	2.54	2.70		6.14	0.09	
E	23.6	4.41		26.7	2.04	
F	15.2	467		3.44	3.74	
G	18.5	5.62		0.68	0.40	
H	8.60	10.4		1.23	0.49	
I	15.8	33.1		2.16	0.82	
J	24.4	26.3		4.39	0.74	
STMP-07						
A	13.7	4.69	11.8 ± 16.9	0.94	0.04	1.22 ± 1.61
B	3.71	4.70		0.24	0.19	
C	7.47	22.3		0.02	0.19	
D	2.49	14.2		0.18	0.20	
E	1.29	5.06		0.96	0.18	
F	5.25	2.76		4.63	0.31	
G	12.3	19.0		0.40	4.46	
H	14.3	4.96		4.84	0.10	
I	1.68	4.91		2.36	1.36	
J	1.59	4.30		2.91	0.04	
K	28.8	79.6		0.29	1.99	

Notes:
FIHg, Filtered Inorganic Mercury
FMeHg, Filtered Methylmercury
ng/L, Nanograms per Liter
Mean ± SD, Arithmetic mean ± standard deviation

Table 4
Periphyton IHg and MeHg Monitoring Summary
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Sampling Date	**Environment**	**IHg (µg/kg ww)**		**MeHg (µg/kg ww)**	
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD
STMP-01					
June & Oct. 2015	Near Bank	112 - 861	435 ± 294	0.3 - 2.7	1.49 ± 1.24
June 2015	Mid-Channel	134 - 189	156 ± 29.1	0.9 - 1.0	0.95 ± 0.05
STMP-05					
June & Oct. 2015	Near Bank	1590 - 2661	2208 ± 393	0.9 - 7.0	3.24 ± 2.58
June 2015	Mid-Channel	37.1 - 49.8	44.0 ± 6.41	0.8 - 0.9	0.85 ± 0.06
STMP-07					
June & Oct. 2015	Near Bank	1963 - 3509	2562 ± 604	1.5 - 7.0	4.01 ± 2.39
June 2015	Mid-Channel	482 - 580	539 ± 50.8	1.3 - 2.1	1.69 ± 0.40

Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
µg/kg ww, Micrograms per kilogram, wet weight
Mean ± SD, Arithmetic mean ± standard deviation

Table 5
Corbicula IHg and MeHg Monitoring Summary
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Sampling Date	Environment	IHg (µg/kg ww)		MeHg (µg/kg ww)	
		Concentration Range	Mean ± SD	Concentration Range	Mean ± SD
STMP-01					
June 2015	Near-Bank Seeded	34.8 - 47.0	39.4 ± 6.6	41.0 - 52.7	46.6 ± 5.9
	Near-Bank Caged	22.0 - 26.2	24.5 ± 2.3	15.3 - 17.8	16.7 ± 1.3
	Mid-Channel Caged	16.9 - 38.1	25.0 ± 11.5	6.1 - 12.8	9.2 ± 3.4
October 2015	Near-Bank Seeded	14.3 - 17.4	15.6 ± 1.6	10.4 - 12.0	11.1 ± 0.8
	Near-Bank Caged	9.9 - 13.7	12.0 ± 2.0	7.3 - 9.2	8.4 ± 1.0
STMP-05					
June 2015	Near-Bank Seeded	44.3 - 68.0	52.7 ± 13.2	41.8 - 42.8	42.2 ± 0.5
	Near-Bank Caged	30.3 - 38.3	34.5 ± 4.0	29.8 - 35.1	31.8 ± 2.9
	Mid-Channel Caged	19.7 - 34.7	26.0 ± 7.8	6.5 - 11.8	8.8 ± 2.7
October 2015	Near-Bank Seeded	15.2 - 17.6	16.4 ± 1.2	13.5 - 14.6	14.1 ± 0.6
	Near-Bank Caged	13.7 - 18.9	16.5 ± 2.7	9.2 - 11.2	10.4 ± 1.1
STMP-07					
June 2015	Near-Bank Seeded	53.5 - 65.7	59.5 ± 6.1	28.0 - 32.3	30.1 ± 2.1
	Near-Bank Caged	38.4 - 49.7	43.3 ± 5.8	13.9 - 18.4	16.1 ± 2.2
	Mid-Channel Caged	23.2 - 28.5	25.4 ± 2.8	10.4 - 11.5	10.9 ± 0.6
October 2015	Near-Bank Seeded	13.2 - 16.6	15.2 ± 1.8	14.1 - 14.9	14.5 ± 0.4
	Near-Bank Caged	9.4 - 18.9	13.5 ± 4.9	8.0 - 12.2	9.6 ± 2.3

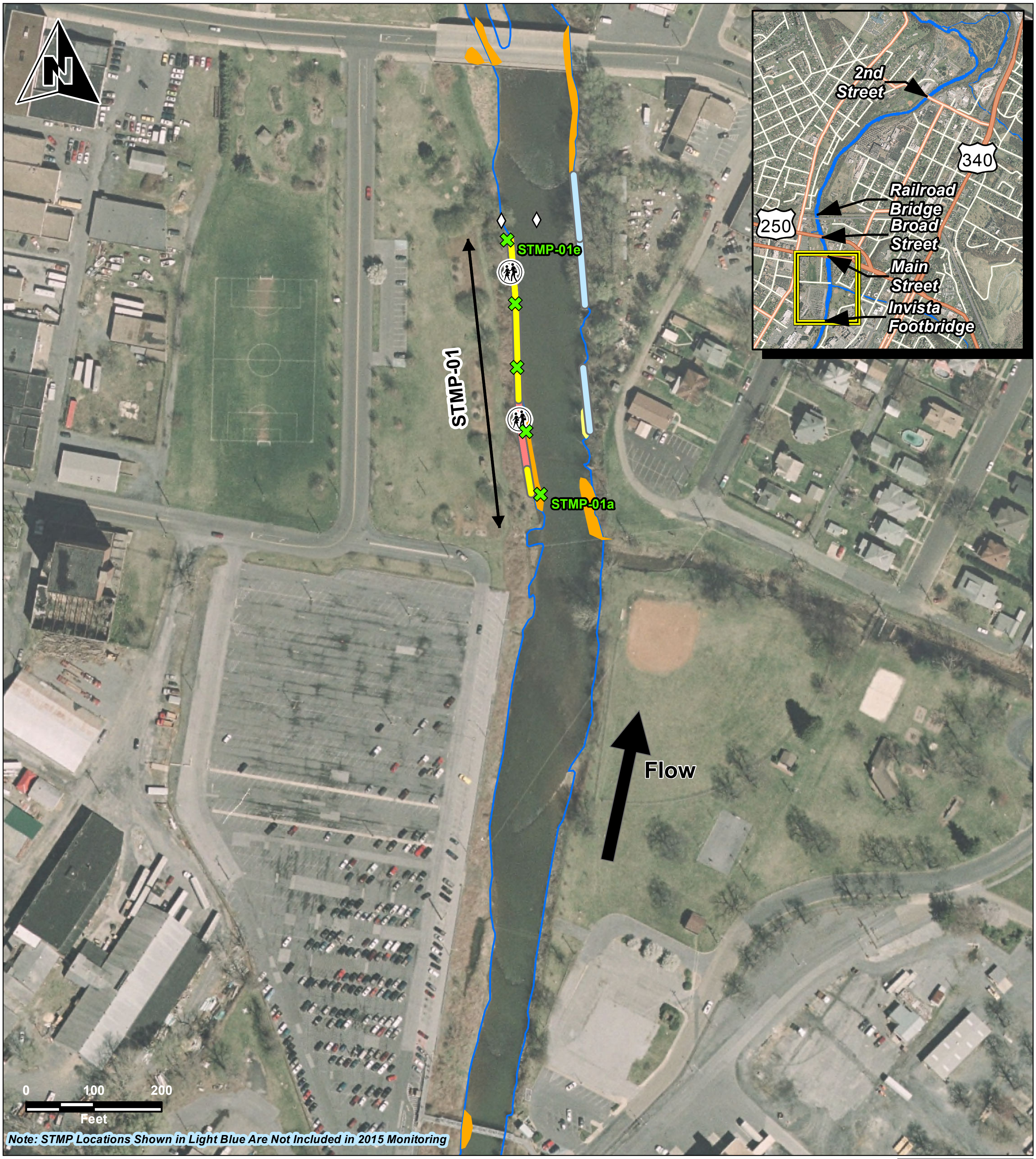
Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
µg/kg ww, Micrograms per kilogram, wet weight
Mean ± SD, Arithmetic mean ± standard deviation

Table 6
Riparian Vegetative Survey Summary
Short-term Monitoring 2015 Annual Monitoring Report
DuPont South River- AOC 4

Vegetative Species		Absolute % Cover[1]	
Scientific Name	**Common Name**	**Spring 2015**	**Fall 2015**
STMP-01			
Tree/Vine Stratum			
Robinia pseudoacacia	Black Locust	0-40	0-40
Platanus occidentalis	American Sycamore	0-10	0-10
Sapling/Shrub Stratum			
Robinia pseudoacacia	Black Locust	0-10	0-10
Lonicera japonica	Japanese Honeysuckle	0-70	0-70
Herbaceous Stratum			
Fallopia japonica	Japanese-Knotweed	60-80	60-80
Alliaria petiolata	Garlic Mustard	0-20	0
Viola sororia	Hooded Blue Violet	0-20	0
STMP-05			
Tree/Vine Stratum			
Juglans nigra	Black Walnut	60-70	60-70
Robinia pseudoacacia	Black Locust	0-30	0-30
Platanus occidentalis	American Sycamore	0-20	0-20
Sapling/Shrub Stratum			
Lonicera japonica	Japanese Honeysuckle	60	60
Juglans nigra	Black Walnut	0-20	0-20
Cornus amomum	Silky Dogwood	0-10	0-10
Rhus typhina	Staghorn Sumac	0-5	0-5
Acer platanoides	Norway Maple	0-10	0-10
Carya cordiformis	Bitter-Nut Hickory	0-5	0-5
Quercus montana	Chestnut Oak	0-5	0-5
Albizia julibrissin	Persian Silk Tree	0-5	0-5
Herbaceous Stratum			
None Observed	NA	NA	NA
STMP-07			
Tree/Vine Stratum			
Acer saccharinum	Silver Maple	0-50	0-50
Juglans nigra	Black Walnut	40-50	40-50
Robinia pseudoacacia	Black Locust	0-20	0-20
Acer negundo	Ash-Leaf Maple	0-10	0-10
Platanus occidentalis	American Sycamore	0-10	0-10
Sapling/Shrub Stratum			
Lonicera japonica	Japanese Honeysuckle	40-75	40-75
Lonicera maackii	Amur Honeysuckle	0-10	0-10
Herbaceous Stratum			
Fallopia japonica	Japanese-Knotweed	0-10	0-10
Viola sororia	Hooded Blue Violet	0-5	0
Alliaria petiolata	Garlic Mustard	0-5	0
Polygonatum biflorum	King Solomon's-Seal	0-5	0

Notes:
1, Represents the range observed between two riparian vegetative survey plots per Short-term Monotoring station.
NA, Not applicable

Figures



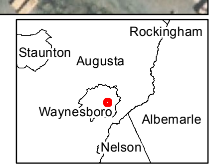
Legend

- Near bank and Mid-channel Periphyton/Clam Collections
- Sampling Transect
- Extent of Short-term Monitoring Location
- Shoreline
- Non-Use BMAs
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs
- LWD
- River Access

Substrate Class

- 1.) Clay and Silt Deposits
- 2.) Fine Sand Deposits

Reference:
Aerial Orthophotography (2007)



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Date: 7/13/2016

Figure 1: Sheet 1 of 3
Short-term Monitoring Locations Overview Map
Short-Term Monitoring 2015 Annual Monitoring Report
Area of Concern (AOC) 4
Former DuPont Waynesboro Site, Virginia

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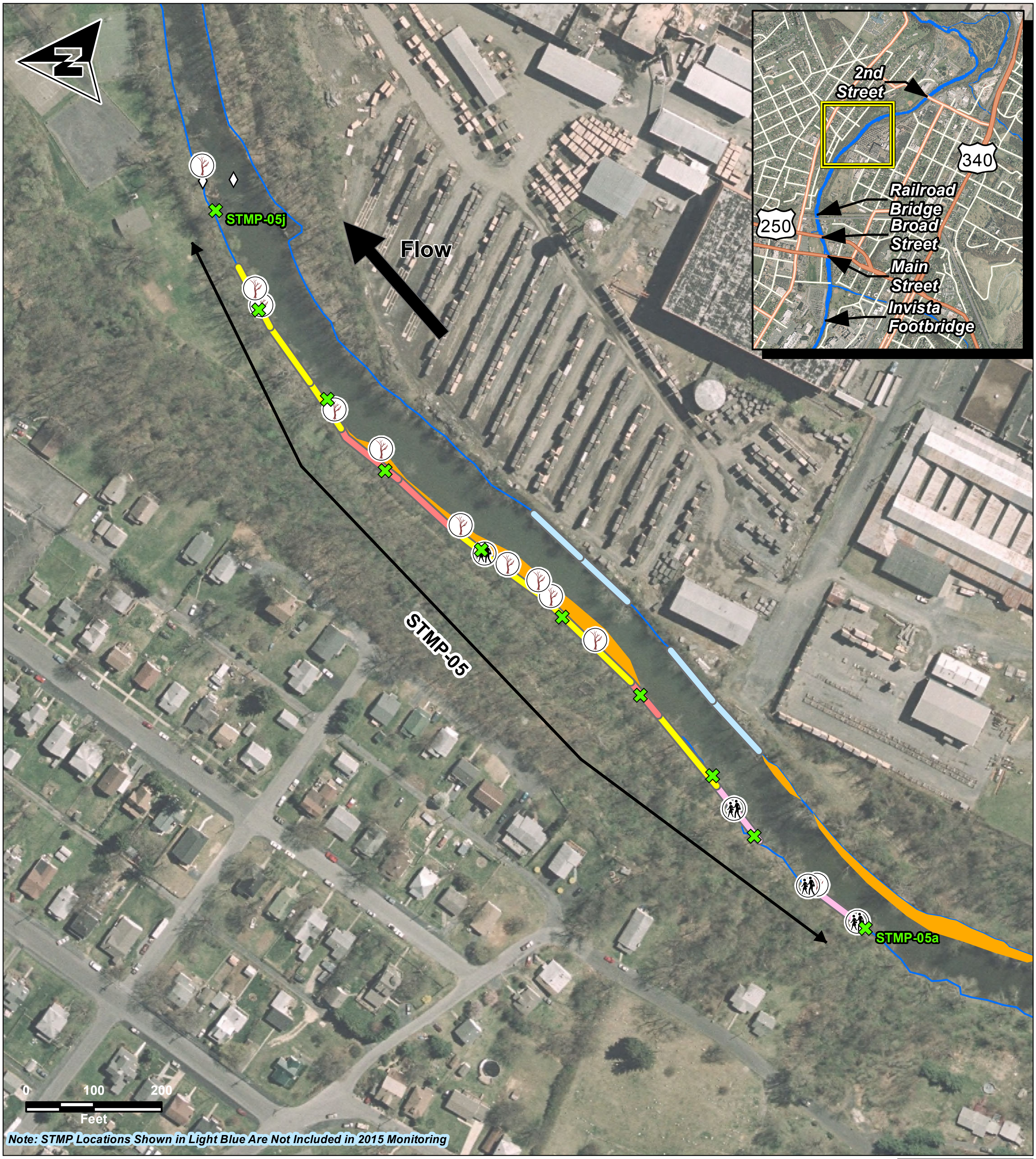

Legend

- Near bank and Mid-channel Periphyton/Clam Collections
- Sampling Transect
- Extent of Short-term Monitoring Location
- Shoreline
- Non-Use BMAs
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs
- LWD
- River Access

Substrate Class

- 1.) Clay and Silt Deposits
- 2.) Fine Sand Deposits

Reference:
Aerial Orthophotography (2007)

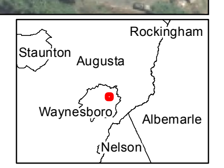

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Figure 1: Sheet 2 of 3
Short-term Monitoring Locations Overview Map
Short-Term Monitoring 2015 Annual Monitoring Report

Area of Concern (AOC) 4
Former DuPont Waynesboro Site, Virginia

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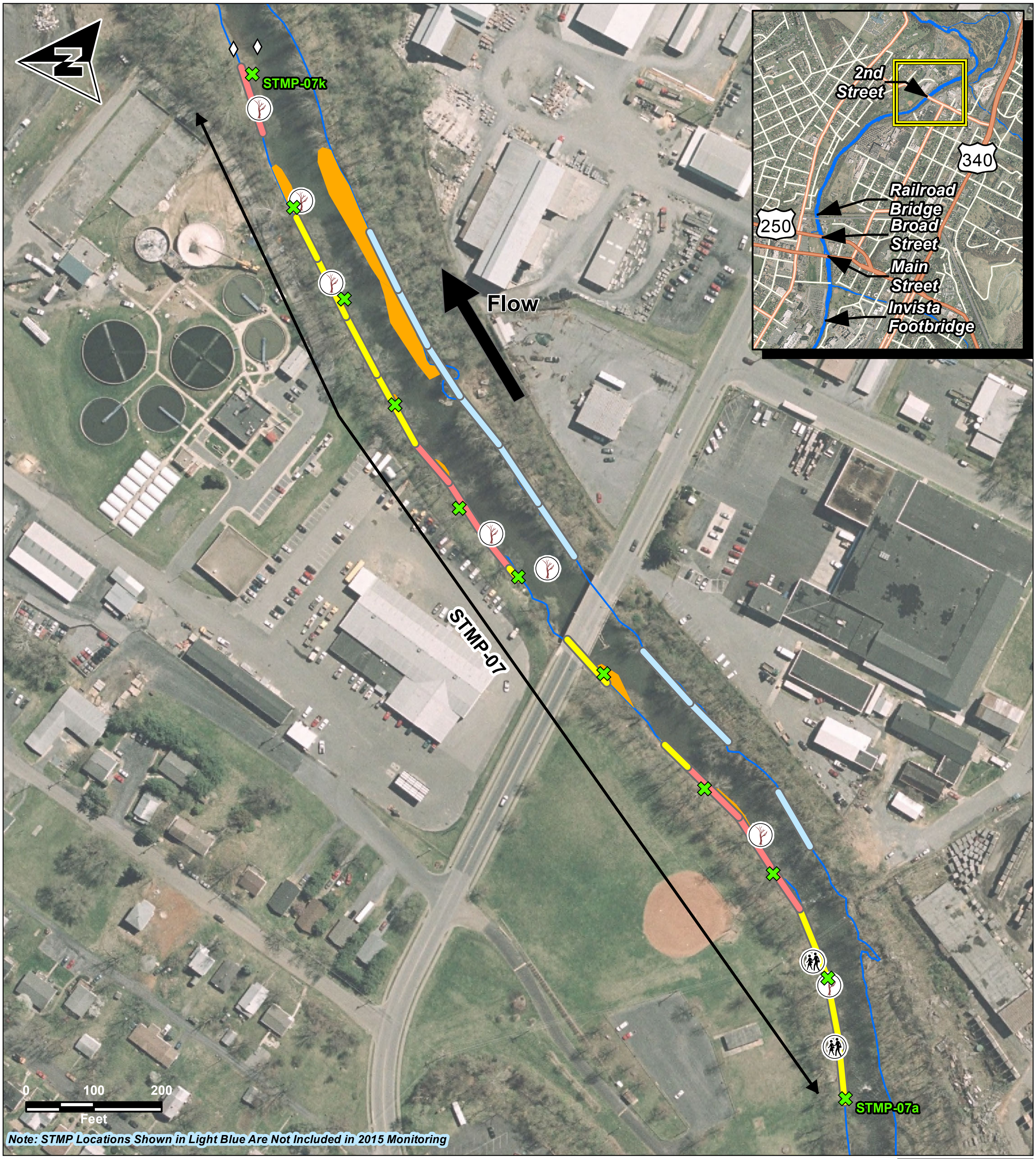

Legend

- Near bank and Mid-channel Periphyton/Clam Collections
- Sampling Transect
- Extent of Short-term Monitoring Location
- Shoreline
- Non-Use BMAs
- Phase 1A Primary BMAs
- Phase 1A Secondary BMAs
- Phase 1B Primary BMAs
- Phase 1B Secondary BMAs
- LWD
- River Access

Substrate Class

- 1.) Clay and Silt Deposits
- 2.) Fine Sand Deposits

Reference:
Aerial Orthophotography (2007)

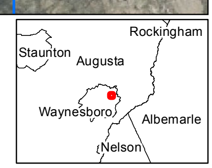

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Figure 1: Sheet 3 of 3
Short-term Monitoring Locations Overview Map
Short-Term Monitoring 2015 Annual Monitoring Report

Area of Concern (AOC) 4
Former DuPont Waynesboro Site, Virginia

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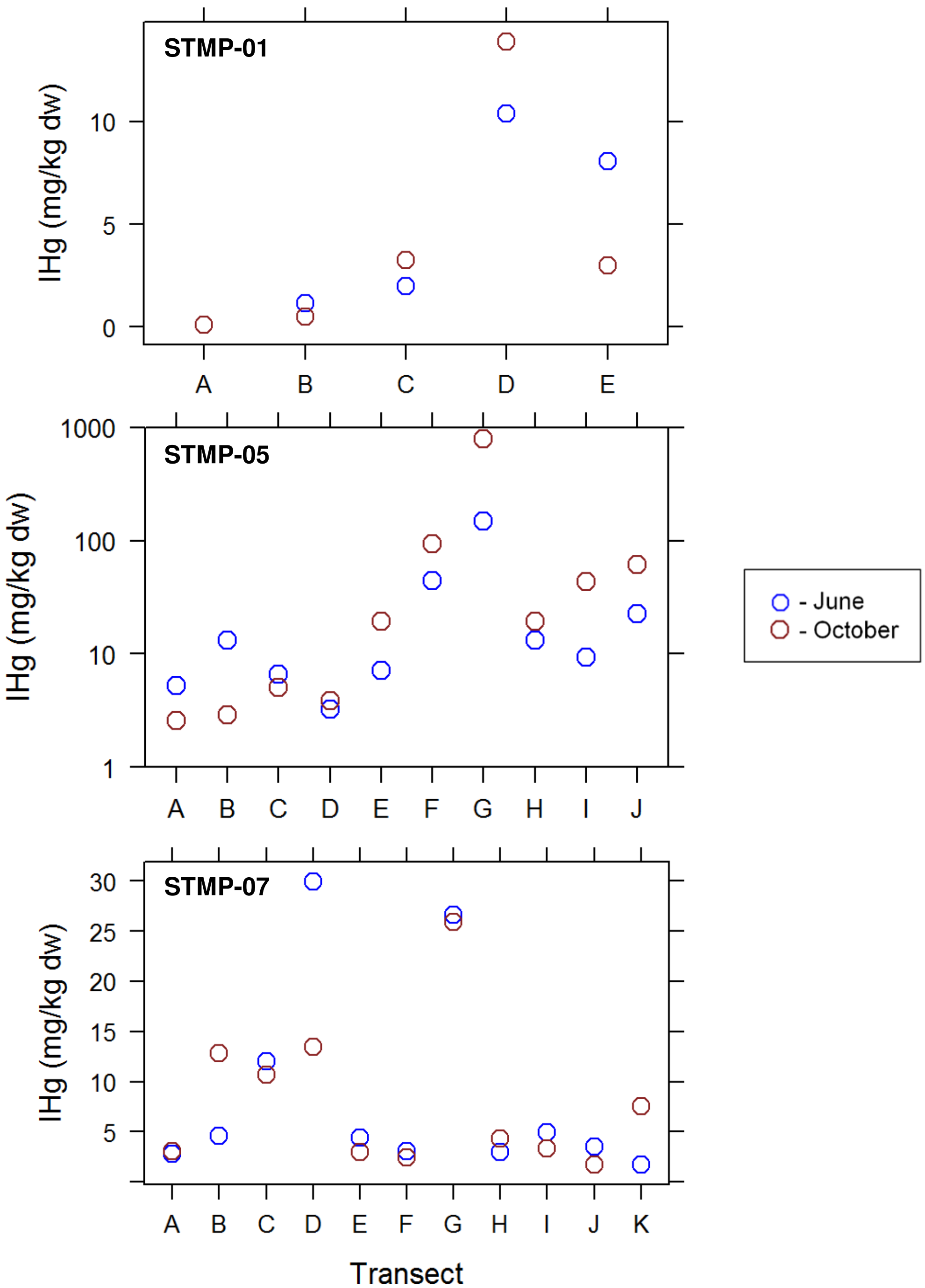
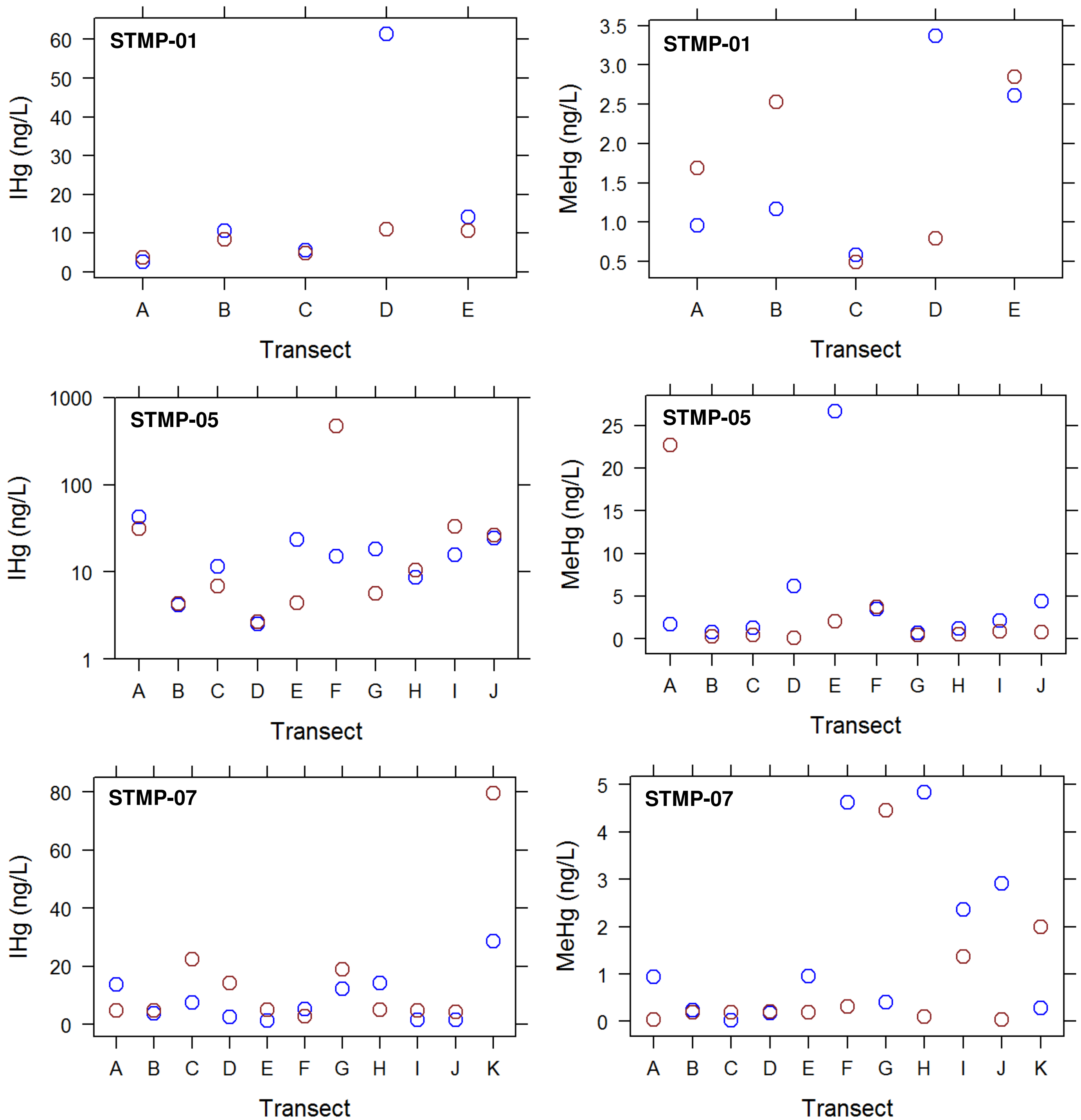
Figure 2
Inorganic Mercury (IHg) in Sediment
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River – AOC 4



Notes:
mg/kg, Milligrams per kilogram
dw, Dry weight

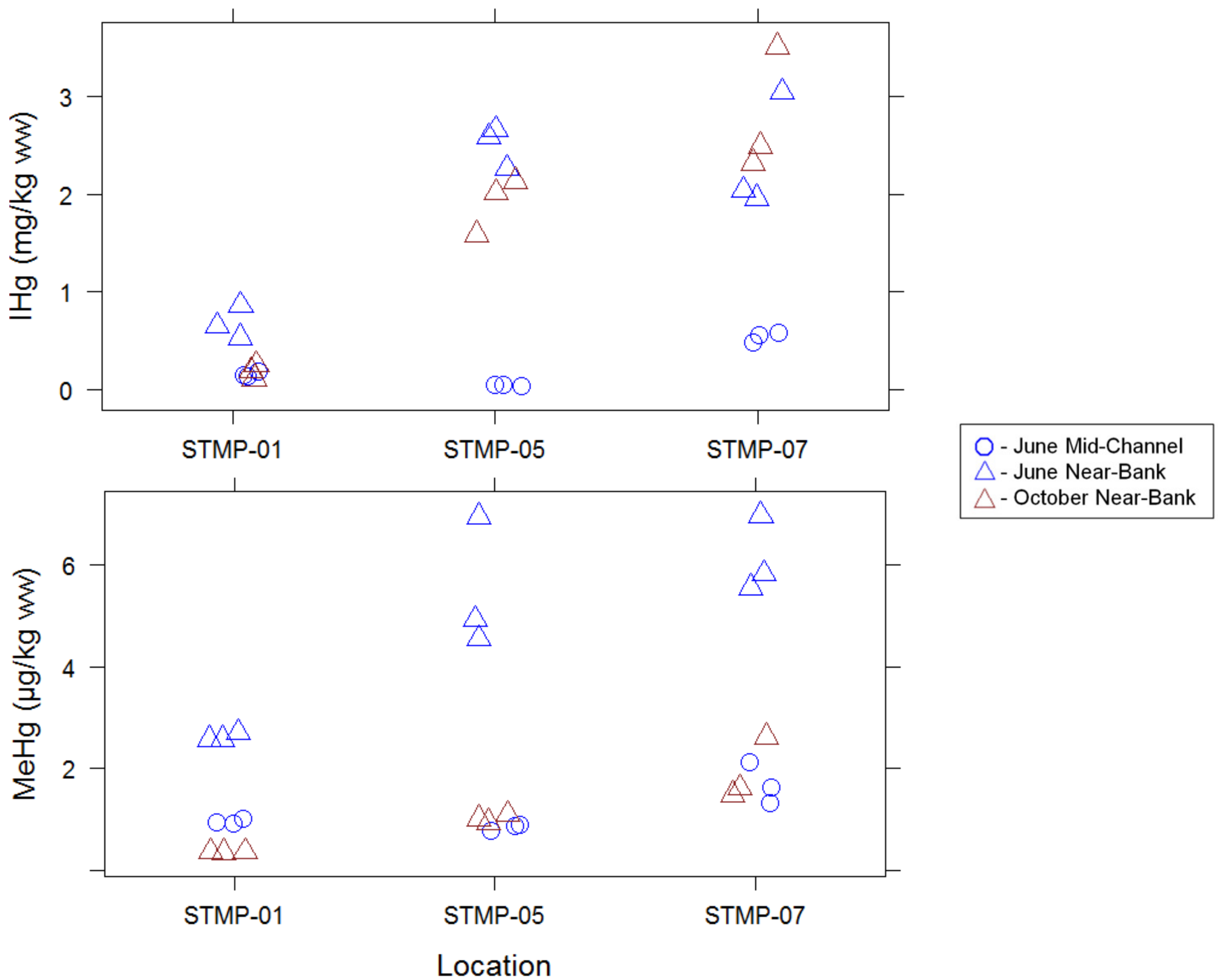
Figure 3
Mercury Concentrations in Filtered Pore Water
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River – AOC 4



Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
ng/L, Nanograms per liter

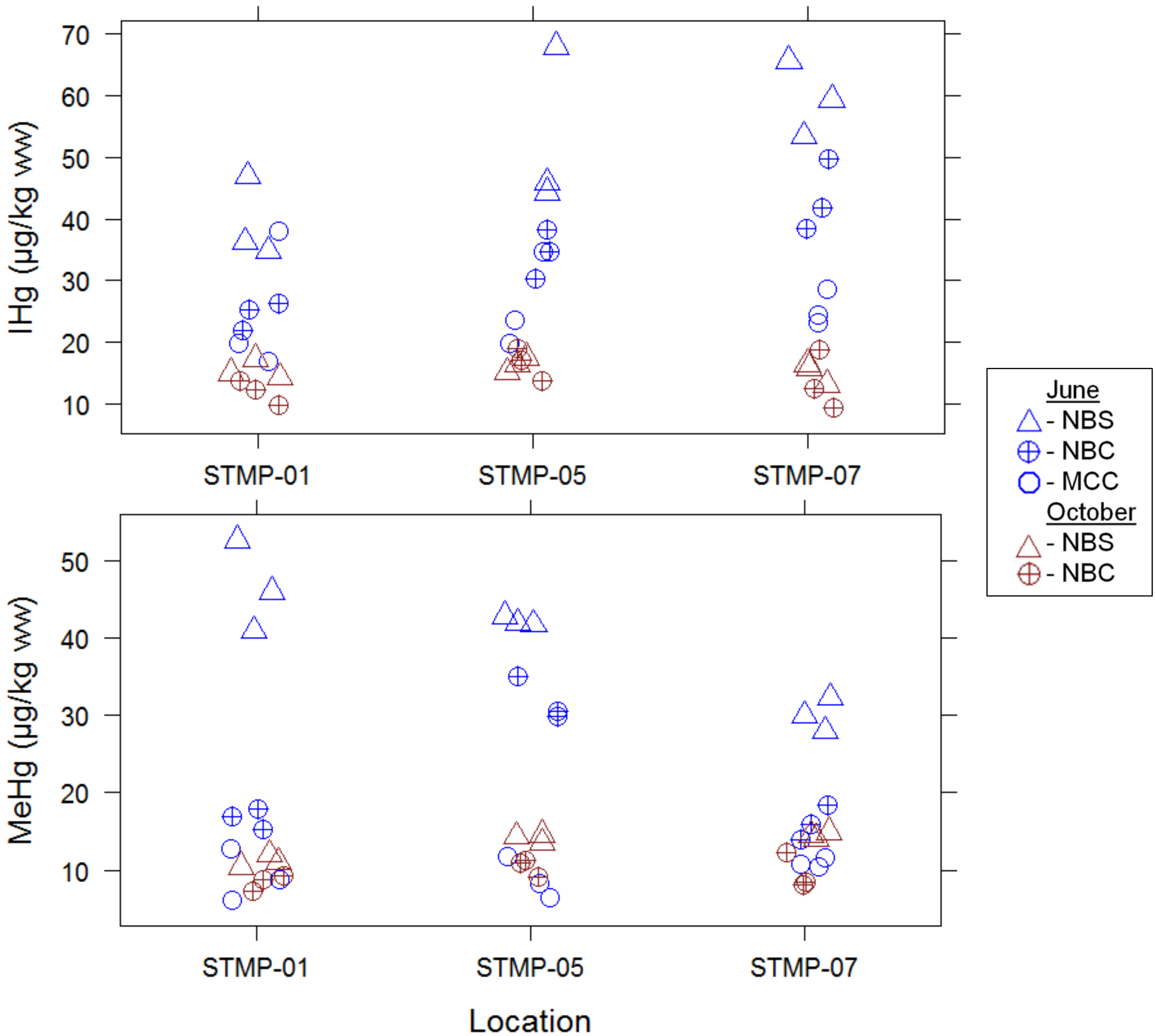
○ - June
○ - October

Figure 4
Mercury Concentrations in Periphyton
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River – AOC 4



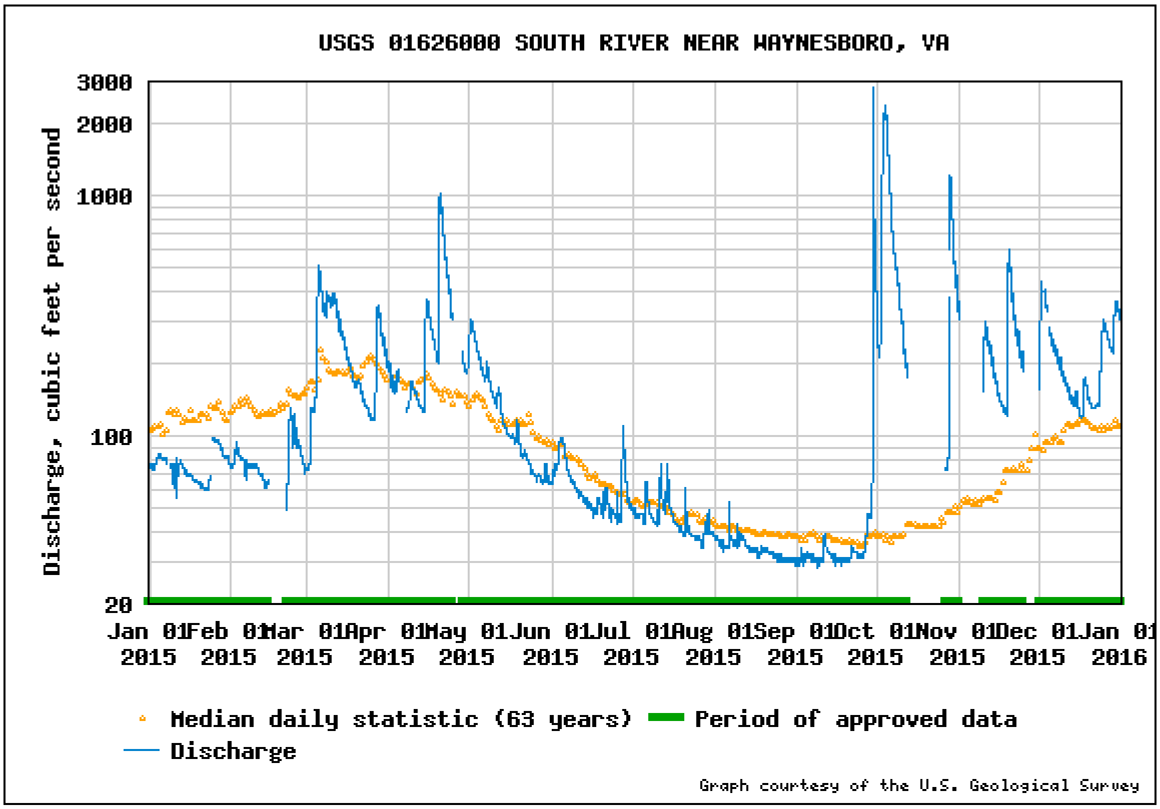
Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
Ww, Wet weight

Figure 5
Mercury Concentrations in Asiatic Clams (*Coribicula*)
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River – AOC 4



Notes:
IHg, Inorganic Mercury
MeHg, Methylmercury
µg/kg, Micrograms per kilogram
ww, Wet weight
NBS, Near- bank seeded
NBC, Near-bank caged
MCC, Mid-channel caged

Figure 6
2015 USGS Discharge at Station # 01626000
Short-Term Monitoring 2015 Annual Monitoring Report
DuPont South River – AOC 4



Appendices

APPENDIX A- PHOTOGRAPHIC LOG OF SHORT-TERM MONITORING STATIONS

Client Name:	Site Location:	Project No.
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	Date:
1	10/13/2015

Direction Photo Taken:

South

Description:

Long view of STMP-01. Large areaof Japanese Knotweed (*Fallopia japonica*) in middle of extent.

Photo No.	Date:
2	04/07/2015

Direction Photo Taken:

North

Description:

Isolated area of bare soil and exposed roots at STMP-01.

Client Name:	Site Location:	Project No.
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	Date:
3	04/07/2015

Direction Photo Taken:

East

Description:

Improvised access path to the river; photo taken looking down from the top of the bank at STMP-01. Note exposed soil and minor localized erosion due to overland flow of rainfall down the bank face.

Photo No.	Date:
4	06/10/2015

Direction Photo Taken:

Northwest

Description:

Erosional bank and attached fine-grained channel margin deposit at STMP-05.

Client Name:	Site Location:	Project No.
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	Date:
5	06/10/2015

Direction Photo Taken:

North

Description:

Natural LWD (exposed) on left bank of STMP-05.

Photo No.	Date:
6	06/10/2015

Direction Photo Taken:

Northeast

Description:

Overhanging vegetation with undercut banks beneath at STMP-05. Large woody debris present along the bank and in the foreground (submerged).

Client Name:	**Site Location:**	**Project No.**
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	**Date:**
7	06/10/2015

Direction Photo Taken:

Northeast

Description:

Extensive exposed roots at the toe of slope at STMP-05 downstream of Transect C. Leaning American sycamore (with orange flagging) due to undercutting.

Photo No.	**Date:**
8	04/07/2015

Direction Photo Taken:

Southeast

Description:

Improvised access path to river at STMP-07 with exposed soil.

Client Name:	Site Location:	Project No.
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	Date:
9	06/10/2015

Direction Photo Taken:

North

Description:

Cobble riffle at the upstream extent of STMP-07.

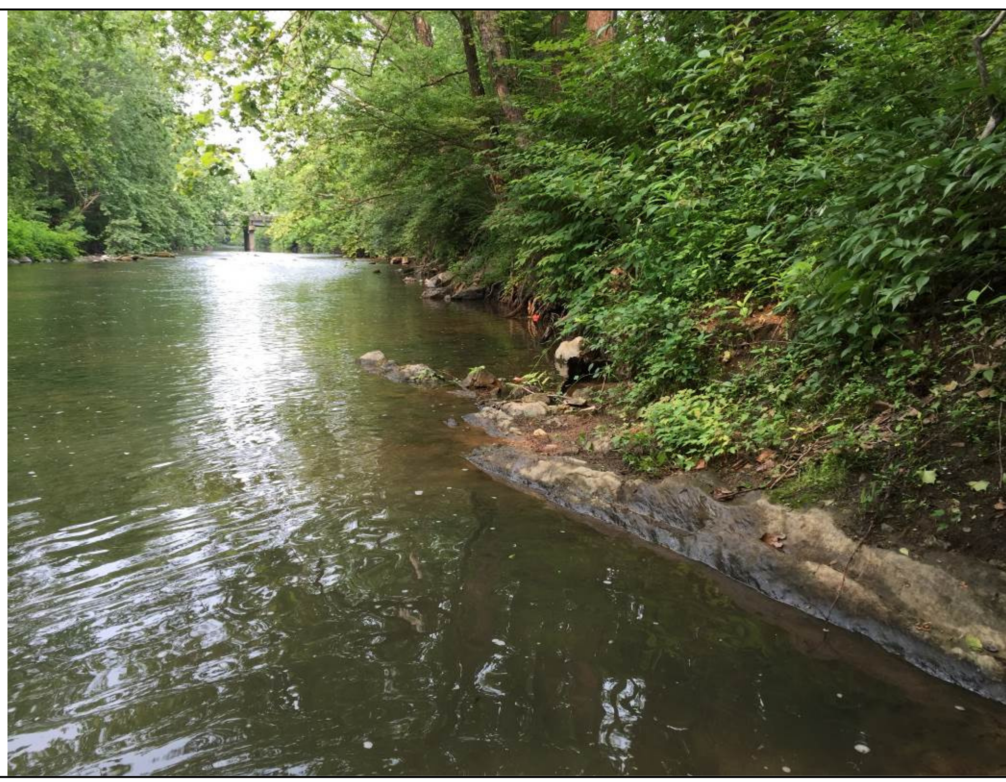
Photo No.	Date:
10	06/10/2015

Direction Photo Taken:

West

Description:

Exposed bedrock on the left bank of STMP-07.



Client Name:	Site Location:	Project No.
DuPont	South River – Short-Term Monitoring	60394083

Photo No.	Date:
11	10/14/2015

Direction Photo Taken:

Northwest

Description:

Erosional area with significant undercutting and exposed roots on the left bank at STMP-07.

Photo No.	Date:
12	06/10/2015

Direction Photo Taken:

Northeast

Description:

Gravel bar at the downstream extent of STMP-07.

Appendix B

Appendix B
Ancillary Short-term Monitoring Measures
Area of Concern (AOC) 4
Former DuPont Waynesboro Site, Virginia

This appendix presents a summary of ancillary habitat-specific metrics conducted during the 2015 pre-interim measures, baseline Short-term Monitoring (STM) events. These ancillary parameters are being evaluated to address stakeholder concerns regarding preservation of existing ecological habitats during the implementation of the Phase I interim measures and are not part of the Virginia Department of Environmental Quality (VDEQ) approved STM Plan under the Resource Conservation and Recovery Act (RCRA).

Canopy Cover

Canopy cover was assessed using a spherical densiometer in order to quantify the percent canopy cover at each STM station. The spherical densiometer is a concave mirror that is divided into 94 cells. The number of cells with open sky (out of 94 available) were recorded. Four densiometer readings (i.e., number of cells with open sky) were collected from the middle of the river (one facing each compass direction), co-located with each sediment and pore water sampling transect. The arithmetic mean was calculated for the four readings collected at each transect, which was then used to determine the overall arithmetic mean percent (%) open sky and % canopy cover for each STM station. Average percent canopy cover at STMP-01, STMP-05, and STMP-07 was 9.1%, 37.4% and 43.1%, respectively (Table B-1).

Aquatic/Riparian Habitat

Additional assessments of aquatic and riparian habitat, similar to the EPA Rapid Bioassessment Protocols (RBPs), were conducted [i.e., Evaluation of Planned Wetlands (EPW), and Unified Stream Methodology (USM)] with the goal of documenting baseline habitat quality and ecological function.

Evaluation for Planned Wetlands

The Evaluation for Planned Wetlands (Bartoldus, 1994) is an assessment methodology that can be utilized to evaluate pre- and post-restoration/creation ecological function and value of an ecosystem, typically a wetland. For this assessment, only the Non-Tidal Fish assessment (EPW Fish) was conducted as other elements of the EPW are redundant with the RBP metrics already conducted as part of the AOC 4 STM Plan. The EPW Fish Functional Capacity Index (FCI) is composed of 20 monitoring elements that are separated into the following four categories: limiting factors; food/cover; reproduction; and water quality. Individual scores for each element were averaged within the four categories to determine the overall FCI which ranges from zero to one, with zero being a limited ecological value and one representing high ecological value. The EPW Fish scores for STMP-01, STMP -05, and STMP -07 were 0.58, 0.62 and 0.55, respectively, indicating a moderate functional capacity for fish populations.

Unified Stream Methodology

The USM was completed in accordance with *Unified Stream Methodology for use in Virginia* (U.S. Army Corps of Engineers (USACE) and Virginia department of Environmental Quality (VDEQ), 2007). This approach was used to evaluate potential impacts to the South River by assigning a Reach Condition Index (RCI) for each STM station. The RCI is based on the condition of the channel, riparian corridor, and instream habitat, as well as the extent of channel alteration. The RCI ranges from 0.5 to 1.5, with streams in poorer condition scoring lower. RCIs for STMP-01, STMP -05, and STMP -07 were 1.08, 1.14 and 1.05, respectively.

In addition to overall habitat quality, the location, quantity and approximate size of in-stream habitat features [i.e., large woody debris (LWD)], adjacent to each STMP station were characterized and located using a hand-held Global Positioning System (GPS) (Figure 1; AECOM, 2016). No in-stream LWD features were observed along STMP-01; however, twelve and seven LWD features were observed along STMP-05 and STMP-07, respectively.

Civilian access paths to the river were also surveyed and located using GPS. A total of eight civilian access paths to the river, of varying degrees of apparent use, were observed; the civilian access path observations included two paths at STMP-01, four paths at STMP-05 and two paths at STMP-07. Generally, greater apparent use of the access paths was evident at STMP-01 and STMP-07, presumably due to the proximity to Constitution Park and North Park, respectively (Figure 1; AECOM, 2016).

Benthic Community

Benthic communities were sampled in accordance with EPA RBP methodologies (Barbour et al., 1999) at four locations. Of note, these locations do not directly correspond to STMP-01, STMP-05 and STMP -07; rather, they are spaced approximately 0.5 relative river miles (RRMs) between RRM 0 and RRM 2. At each location, three replicate samples were collected along a gradient from toe of pool, transitional and head of riffle habitats at the left, middle, and right points of the wetted stream channel using a standard Surber sampler.

Preserved benthic community samples were submitted to a laboratory for taxonomic analysis. Results from the benthic community assessment will be compared to post-remediation results as an additional evaluation of overall habitat quality. The arithmetic average for each metric/sampling location is listed in the table below:

Metric	Sampling Location			
	RRM 0.5	RRM 1.0	RRM 1.5	RRM 2.0
June 2015				
Corrected Abundance (N)	5742	4361	7809	4538
Taxa Richness	36	25	23	24
% EPT	40.48	19.31	29.69	21.96
Shannon’s H	1.12	0.7	0.76	0.68
Pielou’s J	0.72	0.5	0.56	0.48
Hilsenhoff Biotic Index	4.37	4.71	4.4	4.04
% Diptera/Oligochaeta	24.46	15.31	15.38	13.28
October 2015				
Corrected Abundance (N)	946	394	652	700
Taxa Richness	35	33	32	30
% EPT	44.22	37.06	25.22	19.60
Shannon’s H	1.06	1.02	0.87	0.76
Pielou’s J	0.69	0.67	0.58	0.51
Hilsenhoff Biotic Index	4.48	4.48	4.38	4.34
% Diptera/Oligochaeta	3.27	3.22	3.60	1.84

Notes:
EPT, Ephemeroptera, Plecoptera and Trichoptera

As indicated by the metrics above, benthic invertebrate communities are relatively diverse and generally comparable among the four sampling locations, RRM 0.5, RRM 1.0, RRM1.5 and RRM 2.0. However, in regards to benthic community evenness and diversity indices (i.e., Shannon’s H and Pielou’s J), a slight decreasing trend can be observed with distance downstream. Between the June and October sampling events, the majority of the metrics were generally similar, with the exception of corrected abundance and % Diptera/Oligochaeta. Among all sampling locations, corrected abundance was approximately an order of magnitude lower in October than in June; % Diptera/Oligochaeta also decreased in October compared to June. Although negligible, these minor spatial and temporal differences in the benthic invertebrate communities in the RRM 0-2 reach are likely related to substrate conditions (discussed below) and the natural life cycles of benthic invertebrates, respectively.

Substrate Characterization

Pebble counts are used to assess substrate distribution. Wolman pebble counts (Wolman, 1954) were conducted at each STM sampling transect during the October 2015 monitoring event; twenty (n=20) data points were collected along each transect, equally spaced, spanning from left bank to right bank. Water depth prevented data collection at some transects.

Substrate sizes were generally larger throughout STMP-05 and STMP-07. Additionally, a generally normal distribution was observed at STMP-01 and STMP-05 (Figure B-1). Of note, a large amount of Class 1 substrate (i.e., sand/fines) was documented at all 2015 STM locations; however this is does not necessarily represent the presence of large fine-grained deposits, but rather fine-grained substrates that has settled between larger substrates in the riverbed (i.e. embeddedness). The D_{50} (median) substrate size classes for STMP-01, STMP-05 and STMP-07 were 32 millimeters (mm) (very coarse gravel), 90 mm (medium cobble) and 45 mm (very coarse gravel), respectively.

Summary

Additional habitat/ecological function metrics were evaluated to document existing conditions prior to implementation of the Phase 1 Interim Measures for AOC 4. The data summarized above will serve as the baseline dataset for which post-remediation datasets will be compared. Overall, habitat and ecological function at the areas evaluated can be generally described as moderate to optimal which is consistent with the findings of the EPA Rapid Bioassessment protocol conducted as part of the AOC 4 STM program. Canopy cover was low- to moderate (e.g. < 50%) on average at each STMP. Channel substrates were moderately embedded, however relatively diverse benthic invertebrate communities were documented throughout the RRM 0-2 reach.

References

AECOM. 2016. *Area of Concern (AOC) 4 Short-term Monitoring 2015 Biannual Monitoring*. Area of Concern (AOC) 4. Former DuPont Waynesboro Site, Virginia. Conshohocken. PA.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish. Second Edition. EPA 841-B-99-002. USEPA Office of Water, Washington, D.C.

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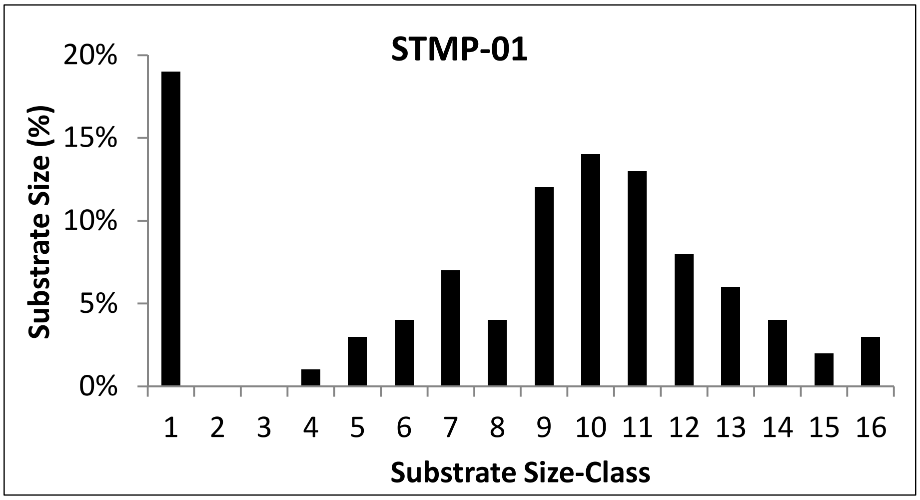
Table B-1
Average Canopy Cover
Appendix B- Ancillary Short-term Monitoring Measures
DuPont South River- AOC 4

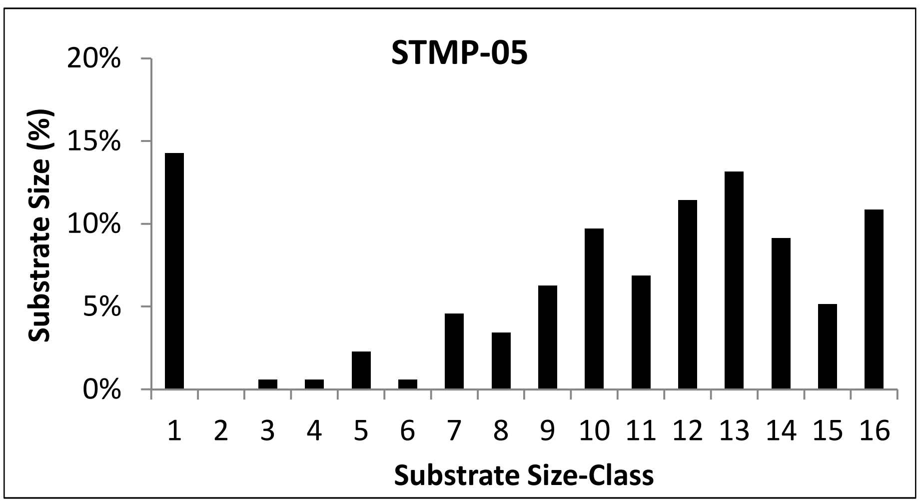
Transect ID	Mean Densiometer Reading[1]	Mean Open Sky (%)[1]	Overall Mean Open Sky (%)	Overall Mean Canopy Cover (%)
STMP-01				
A	93.5	97.4	90.9	9.1
B	89.5	93.2		
C	94.0	97.9		
D	80.5	83.9		
E	78.8	82.0		
STMP-05				
A	47.3	49.2	62.6	37.4
B	48.8	50.8		
C	49.0	51.0		
D	54.5	56.8		
E	62.8	65.4		
F	86.0	89.6		
G	66.8	69.5		
H	55.8	58.1		
I	61.5	64.1		
J	69.0	71.9		
STMP-07				
A	71.5	74.5	56.9	43.1
B	47.3	49.2		
C	51.8	53.9		
D	47.8	49.7		
E	75.5	78.6		
F	53.0	55.2		
G	57.8	60.2		
H	61.5	64.1		
I	37.3	38.8		
J	43.3	45.1		
K	54.5	56.8		

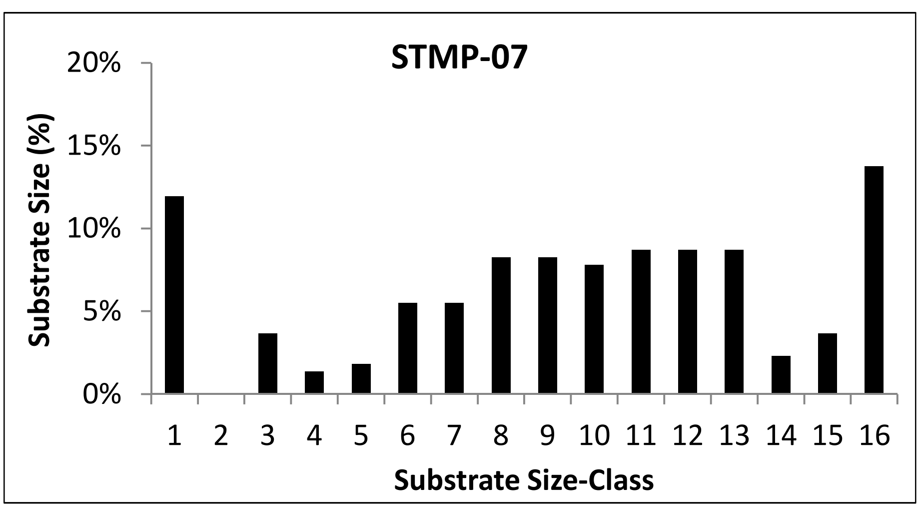
Notes:

1, Canopy cover was assessed using a spherical densiometer, a concave mirror giving the user a view of the sky and canopy cover above. The mirror is divided into 94 cells; the number of cells with open sky (out of 94 available) were recorded and converted to the proper metric desired. Four densiometer readings (i.e., number of cells with open sky) were collected from the middle of the river, co-located with each sediment and pore water sampling transect; the arithmetic mean was calculated for the four readings collected at each transect. The overall arithmetic mean % open sky and % canopy cover were then calculated for STMP-01, STMP-05 and STMP-07.

Figure B-1
Substrate Size Distribution
Appendix B- Ancillary Short-term Monitoring Measures
DuPont South River – AOC 4







Substrate Size Classes	
Substrate Size-Class	Class
1	Sand/Fines
2	Very Fine Gravel
3	Very Fine Gravel
4	Fine Gravel
5	Fine Gravel
6	Medium Gravel
7	Medium Gravel
8	Coarse Gravel
9	Coarse Gravel
10	Very Coarse Gravel
11	Very Coarse Gravel
12	Small Cobble
13	Medium Cobble
14	Large Cobble
15	Very Large Cobble
16	Boulder/Bedrock