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TO: David Epps – DuPont CRG
Maryann Nicholson – DuPont CRG
Edward Seger – DuPont CRG

DATE: January 28, 2014

FROM: Sagar Thakali
Gary Long

PROJECT: PLW Ramapo/Pompton River Investigation

URS JOB NO.: 18986472 FININFO NO.: 507990 cc :

SUBJECT: **Ramapo River and Pompton River Substrate Characterization**
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Introduction

Environmental investigations are being conducted to confirm or further refine the conceptual site model (CSM) identifying the source(s), fate, and transport of mercury in Pompton Lake sediments associated with historical discharge from the DuPont Pompton Lakes Works (PLW) in Pompton Lakes, New Jersey (ARCADIS et al., 2013). As part of the Corrective Action program under the Resource Conservation and Recovery Act (RCRA), numerous environmental investigations have been conducted to characterize the nature and extent of site-related constituents attributed to the PLW facility. As part of the RCRA Corrective Action program, the U.S. Environmental Protection Agency (EPA) requested additional sediment sampling in the Ramapo River and Pompton River downstream of Pompton Lake to evaluate the potential downstream transport of mercury (EPA, 2012). To support the development of a sediment sampling plan for the downstream area, a riverbed substrate mapping survey was conducted in the Ramapo River and Pompton River from the Pompton Lake Dam approximately three miles downstream to Riverside Park (Figure 1). The purpose of this survey was to identify and map depositional areas that have accumulated fine-grained sediments (silts/clays and fine sands) within the Ramapo and Pompton Rivers to inform and guide the selection of potential sediment sampling locations for analytical characterization. Fine-grained deposits will be the focus of the analytical sampling program to evaluate the potential for mercury to be associated with fine-grained sediments.

The survey results indicate that fine-grained sediment deposits represent only a minor component (< 9 % spatial coverage) of available habitat within the mapped areas. A greater distribution of fine-grained sediment deposits was found upstream of three feeder dams: Pompton Dam, Pequannock Dam, and Passaic Valley Water Commission (PVWC) Dam. These fine-grained deposits will be the focus of the analytical sampling program given the greater capacity of fine-grained sediments to retain mercury. A total of 30 sampling locations are proposed within the surveyed area (Figures 2 through 12). Further details are provided below on the riverbed substrate mapping survey, historical analytical sampling data, and the locations of sediment sampling stations proposed based on substrate mapping.

Objectives and Spatial Scope

The primary objective of the riverbed substrate field mapping survey was to create a contiguous geospatial database of substrate composition within approximately three miles of the Ramapo and Pompton Rivers downstream of the Pompton Lake Dam to Riverside Park (Figure 1). Within the study area, the Ramapo River flows from the Pompton Lake Dam to its confluence with the Pequannock River between the Pompton and PVWC Dams to form the Pompton River. Northeast of the Aquatic Park, the Ramapo River braids, with a branch flowing to the southwest-south to the Pequannock Dam and the main channel continuing to flow south. During high flow conditions, the Ramapo River branch that flows southwest-south to the Pequannock Dam may represents a transport pathway for sediments from the Ramapo River below the Pompton Lake Dam.

As stated in the *Substrate Mapping Protocol* (Attachment A), detailed substrate mapping was not conducted between the Hamburg Turnpike Bridge and the Pompton Lake Dam due to restricted access and safety concerns associated with high water velocity discharging from the Pompton Lake Dam. Additionally, substrates were not mapped within 150 feet of the Pompton, Pequannock, and PVWC Dams due to safety concerns associated with low-head dams. Substrate mapping was not conducted in the areas between the Pompton Dam and PVWC Dam, due to inaccessibility of these areas from adjacent property owners; however, visual observations of general stream conditions were made from the shoreline at accessible locations. Based on the observed spatial distribution of the substrate types, sediment sampling stations were proposed to characterize the potential downstream transport and deposition of mercury in sediments from Pompton Lake.

Technical Scope and Approach for Substrate Mapping

Substrate mapping and bank surveys were conducted in two phases: an initial reconnaissance to identify river access, followed by detailed field mapping. Reconnaissance efforts were conducted on the Ramapo River and Pompton River below the Pompton Lake Dam on July 16, 2013 to identify: access/egress points, river conditions (depth/width, general substrate type), and locations of several low-head dams (Pompton Dam, Pequannock Dam, and PVWC Dam). Two primary access/egress locations were identified that permitted safe access to the river. The upstream access point was located at a township park on River Edge Drive in Pompton Lakes. The second access point was located behind the shopping center located at the corner of Jackson Ave (Pompton Plains Crossroads) and Route 23 in Wayne Township. During the reconnaissance, outfalls were also identified and recorded on the field map to assist in bank survey.

The field survey was conducted during August 12-14, 2013. The study area was assessed during the field survey to identify and document existing riverbed and bank conditions, consistent with the field operational procedures provided in the *Substrate Mapping Protocol* (Attachment A). Predetermined locations were established using a 50-feet x 100-feet grid to facilitate systematic

spatial coverage of the study area. Bank disturbances and features, including fallen trees (large woody debris/snags) and additional outfalls, were photographed and detailed notes regarding overall bank condition were recorded.

A Trimble® Geo-XH 6000 GPS unit was used to collect the spatial position of predominant substrate types (> 50% coverage) and bank features. Substrate mapping was performed at the highest resolution possible, given the weather and hydrologic conditions at the time of survey. Generally, substrate patches greater than or equal to approximately 100 square feet were mapped in detail. Where surface water depths precluded the clear identification of substrate type, a rod was used to probe the benthic layer and identify substrate type. Petite Ponar® grab samples and photographs were also collected at 10% of the sediment probing locations to enable qualitative characterization and photo documentation of sediments (Photographic Log is provided in Attachment B).

Riverbed substrates were classified into one of six types based on the predominant particle diameter size, as adopted from the Wentworth scale (Leeder, 1982):

❑ Type 1) Silts and Clays	< 0.063 mm
❑ Type 2) Fine Sands	0.064 mm – 0.25 mm
❑ Type 3) Medium / Coarse Sand and Granules	0.26 mm – 4.00 mm
❑ Type 4) Pebbles	4.01 mm – 64 mm
❑ Type 5) Pebble/Cobbles/Boulders	64.01 mm – 4,096 mm
❑ Type 6) Bedrock	> 4,096 mm

Following the field mapping of riverbed substrates, geospatial data and associated observations were post-processed and integrated into a geographic information system (GIS) platform to produce a contiguous geospatial mapping of the riverbed substrate types, as follows:

- Depositional areas with fine-grained substrates were identified based on detailed mapping;
- Larger surveyed areas with uniform coarse substrate types (Types 4, 5, or 6) were approximated based on survey results at discrete locations; except at survey points, no distinction was made between substrate Types 4 through 6 in mapping the spatial coverage of coarse-grained substrates.

The approximate spatial extent (i.e., areal coverage) of substrate types was then calculated based on the resulting maps.

Mapping Survey Findings

The findings of the substrate mapping survey indicate that fine-grained sediment deposits represent a relatively minor component of overall habitat availability within the surveyed areas. Figures 2 through 12 illustrate the mapped substrate types for the survey areas within the Ramapo River and Pompton River between the Pompton Lake Dam and Riverside Park; Table 1 shows a summary of spatial coverage by predominant substrate type. The results indicate that the substrates are generally coarse (Types 3 to 6), with over 90% of the mapped area characterized by predominantly coarse substrates with particle sizes greater than four millimeters (mm). Fine-grained sediments, comprise only 5.4% of the mapped area, with substrates predominated by fine sands representing an additional 2.8% of the available benthic habitat. Fine-grained or Type 1 substrates were primarily located in the following depositional areas:

- Areas within the branch of the Ramapo River that flows southwest-south to the Pequannock Dam from where the channel braids near Aquatic Park (Figures 5 and 6);
- Several areas within the braided channel of the Ramapo River downstream of the Pequannock Dam and upstream of the Pompton Dam (Figures 6 through 8); and
- Backwater areas along the downstream banks within the Pompton River approximately between 1,200 and 1,600 feet downstream of the PVWC Dam (Figure 10).

Typically, hand probing in fine-grained sediment deposits encountered refusal at less than one foot below the sediment-surface water interface. One exception was the deposit downstream of the PVWC Dam on the left bank (Figure 10), where the substrate depth was one to two feet. Water depths in the thalweg within the study area generally averaged five feet in the areas upstream of Pompton Dam and four feet in the areas downstream of the PVWC Dam. No significant bank erosion was observed during the survey period; bank conditions were generally stable and represented vegetated adjacent floodplains.

The survey team was unable to access the study area between the Pompton Dam and the PVWC Dam (Figure 9). Access to the floodplain and river in this area is primarily through the 12-acre Top Soil Depot Site, where solid waste, primarily a paper byproduct kaofin, was disposed, stored, and handled since the mid-1980s. The site has been an ongoing subject of legal action by the New Jersey Department of Environmental Protection (NJDEP, 2010) and is not accessible without permission from the court or NJDEP, pending cleanup (Petrick, 2012). Only visual observations were made in this area via boat and land adjacent to the PVWC Dam. Based on photos and visual observations, substrates along the left downstream bank appeared to be coarse (Types 3-6). A survey location within a small area upstream of Pequannock Dam and west of Aquatic Park (Figure 5) indicated coarse substrate (Type 3), but it could not be confirmed for the entire area due to inaccessibility by boat.

Previous Characterizations

The findings of the substrate mapping survey are consistent with prior findings on physical characterization of sediments in the survey area (Civil Dynamics, 2012). Several sediment samples from current survey areas were previously collected as a part of the Feasibility Study for the removal of the Pequannock and Pompton Dams (Civil Dynamics, 2012). Sediment samples were collected for analytical or physical characterizations in 2004, 2011, and 2012, as summarized below.

Seven samples were collected for physical characterization of the substrate in the Ramapo River within the current survey area extending from just below the Pompton Lake Dam to just above the Pompton Dam (Civil Dynamics, 2012). Substrate consistency and depth of the river bottom were probed at regular intervals with a long pole and representative grab samples were collected using a petite Ponar® clamshell-style dredge. Physical characterization samples were submitted for particle size analysis, which indicated that one sample was well-graded gravel with some sand and the remaining six samples were poorly-graded sand. With the exception of one sample that contained 9% fine-grained sediment (< 0.063 mm particle size diameter), samples contained less than 5% fines. These results, coupled with visual observations, indicated that the sediment in the river is generally sand and gravel (bed load material), with little to no fine-grained material.

Analytical characterization of surficial sediments for chemicals, including total mercury (THg), was conducted by Civil Dynamics in areas upstream of the feeder dams. Sampling and analysis of sediments focused on locations closer to the feeder dams because these locations had a greater likelihood of containing fine-grained sediment deposits, as the 2011 physical characterization indicated that upstream sediments were generally sand and gravel (Civil Dynamics, 2012). In the Ramapo River upstream of the Pompton Dam, one sample was collected in October 2004 adjacent to the right wing wall at the dam. Six additional samples were collected in April 2012 in areas upstream of the Pompton Dam. Within the branch of the Ramapo River that flows southwest-south from where the channel braids near Aquatic Park, one analytical sample was collected immediately upstream of the spillway at the Pequannock Dam (October 2004) and three additional samples were collected upstream of the Pequannock Dam (April 2012). Samples were submitted for chemical analyses, including THg analysis. Sampling locations with available sediment THg concentrations are provided in the Figures 5 through 9.

Sediment data collected during multiple sampling events in the Ramapo River main channel and the branch of the Ramapo River that flows from the channel braid near Aquatic Park indicate relatively low THg concentrations in surface sediment intervals when compared to concentrations measured in Pompton Lake (ARCADIS et al., 2013; CRG, 2006; CRG, 2008; Exponent, 2003). Concentrations of THg in surficial sediments collected upstream of the Pompton Dam in 2012 ranged from 0.11 to 0.34 mg/kg[1]; the 2004 sample collected adjacent to

[1] Sediment concentrations are expressed on a dry weight basis.

the right wing wall of the Pompton Dam contained 2.4 mg THg/kg. In the branch of the Ramapo River that flows to the Pequannock Dam, concentrations were less than 0.53 mg THg/kg, with the exception of the sample collected upstream of the spillway of the dam that contained 1.4 mg THg/kg (Civil Dynamics, 2012).

Analytical data were not available to evaluate the potential contribution of material from the Top Soil Depot Site to mercury in sediment within the Pompton River downstream of the Pompton Dam. As stated above, this site has been the subject of legal action by the NJDEP for the disposal, storage, and handling of solid waste, primarily kaofin, which was reported to have entered the river adjacent to the site (NJDEP, 2010; Justia, 2008). In 2008, a settlement was apparently reached for a removal action at the site (NJDEP, 2008). In May 2012, another settlement was reached between NJDEP and 20 trucking companies to remove as much as 22,000 cubic yards of fill and solid waste that was allegedly delivered to the site since 2009, in violation of court orders (Petrick, 2012). The potential impacts of the Top Soil Depot Site on sediment quality within the river could not be assessed because site-specific analytical data were not identified; however, the site represents a potential source of sediment-associated contaminants to the Pompton River downstream of the Pompton Dam.

Proposed Sampling Locations

The geospatial datasets generated by the substrate mapping survey identify the distribution of sediments within the surveyed area and support the selection of sampling locations for additional THg characterization. The purpose of sediment sampling downstream of the Pompton Lake Dam is to characterize concentrations of THg and other physical characteristics to support the CSM with regards to potential downstream sediment transport of mercury from Pompton Lake. As previously stated, fine-grained deposits will be the focus of the analytical sampling program due to the association of mercury with fine-grained sediments. Based on the findings of the substrate mapping and the limited historical dataset, areas of fine-grained substrates are generally located immediately upstream of the Pequannock Dam, between the Pequannock and Pompton Dams, and downstream portion of PVWC Dam south of Riverside Park.

Based on these findings, 30 discrete samples (Figures 2 through 12) are proposed to characterize THg concentrations in sediments within the approximately three miles segment of the Ramapo River and Pompton River downstream of the Pompton Lake Dam to Riverside Park. The proposed sampling locations are selected to coincide with areas of fine substrates (Types 1 or 2). Higher densities of sampling locations are proposed in areas upstream of Pompton Dams because these areas have larger fine-grained sediment deposits. Higher sampling densities are also proposed along the branch of the Ramapo River that flows to the Pequannock Dam because these areas may be a transport pathway from the main channel of the Ramapo River during high flow conditions. Results of the proposed samples will also allow comparisons with previous samples collected within these areas to identify potential temporal variability in sediment THg concentrations.

Surface and subsurface sediments within the study area will be characterized based on the analyses proposed in Table 2. Surficial sediment samples will be collected at proposed sampling locations using a petite Ponar grab sampler (sampling area 36 square inches). Sediment depths will be measured at each sampling location. If the depth of sediment is at least 10 inches at the sampling location, a sediment core sample will be collected using a 2-inch diameter AMS sediment corer or equivalent coring device advanced by hand. Sediment cores will be advanced to refusal and subsurface samples will be sectioned at the following intervals within the recovered core:

- 6 inches to a minimum of 10 inches and a maximum of 12 inches, depending on the depth of recovery; and
- 18 inch intervals thereafter (e.g., 12 – 30 inches) to the depth of recovery.

As presented in Table 2, surface samples will be analyzed for THg, total organic carbon (TOC), and grain size distribution; subsurface samples will be analyzed for THg only.

References

ARCADIS, O'Brien & Gere, Parsons, and URS. 2013. Draft Technical Memorandum: Conceptual Site Model. Pompton Lake Acid Brook Delta Project. DuPont Pompton Lakes Works. June 2013.

Civil Dynamics. 2012. Feasibility Study for the Removal of Pompton Dam and Pequannock Dam. Prepared by Civil Dynamics, Inc. for the State of New Jersey Division of Property Management and Construction (DPMC). Project No. P1079-00. June 2012. Accessed at: http://www.nj.gov/dep/damsafety/docs/pomtpon-pequannock-dam-removal-feasibility-study-final201206.pdf

DuPont CRG. 2008. Revised Remedial Investigation Report. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey.

DuPont CRG. 2006. Draft Remedial Action Proposal for Acid Brook Delta Sediments.

EPA. 2012. RCRA Corrective Action Permit Modification I: Statement of Basis. December 2012.

Exponent. 2003. Revised. Acid Brook Delta Ecological Investigation Phase 2 Report. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey.

Justia. 2008. New Jersey Department of Environmental Protection v. Marcal Paper Mills, et al. January 23, 2008. Accessed online on October 10, 2013 at: http://law.justia.com/cases/new-jersey/appellate-division-unpublished/2008/a3551-06-opn.html

Leeder. 1982. Sedimentology: Process and Product. George Allen and Unwin Ltd, London, UK.

NJDEP. 2008. Notice to Receive Interested Party Comments on Settlement for Potential Spill Act Liability and Other Environmental Issues in Bergen County. Accessed on 10 October, 2013 at: http://www.state.nj.us/dep/srp/legal/marcal200804notice.pdf

NJDEP. 2010. Passaic River Flood Advisory Commission Acknowledgment of Comments. Accessed on 10 October, 2013 at: http://www.nj.gov/dep/passaicriver/docs/comments.pdf

Petrick. 2008. Long-sought agreement reached on cleanup of polluted Wayne site. THE RECORD. Tuesday, May 8, 2012 Last updated: Tuesday May 8, 2012, 6:35 PM. Accessed on 10 October, 2013 at: http://www.northjersey.com/wayne/Long-sought_agreement_reached_on_cleanup_of_polluted_Wayne_site.html

Tables

Table 1
Summary of Predominant Substrate Types
Ramapo River and Pompton River Substrate Mapping
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works
Morris and Passaic Counties, New Jersey

Substrate Type	Mapped Sediment Area (acres)	Percentage of Mapped Area (%)
1) Silts and Clays	2.66	5.4%
2) Fine Sands	1.387	2.8%
3) Medium / Coarse Sands and Granules	17.55	35.7%
4-6) Pebbles, Cobbles, Boulders, Bedrock	27.5	56.0%

Table 2
Proposed Sediment Analyses
Ramapo River and Pompton River Substrate Mapping
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works
Morris and Passaic Counties, New Jersey

Sediment Classication	Objective	Sample Intervals	Sampling Approach	Number of Sample Locations	Total Number of Samples	Proposed Analyses[3]
Fine-grained sediment deposits	Characterize THg concentrations and sediment characteristics in current and historically deposited fine-grained sediments.	Surface	Petite Ponar Grab Sampler	30	30	THg TOC Grain Size % Solids
		Subsurface[1]	2-inch Diameter Core	TBD[2]	TBD[2]	THg % Solids

Notes:

1, Subsurface samples will be collected in fine-grained deposits with sediment depths greater than or equal to 10 inches. Sample intervals will include 6 - 10 or 12 inches and every 18 inches thereafter to the depth of recovery in the sediment core.

2, The number of sampling locations and number of subsurface samples will be determined in the field based on the depth of sediment measured in fine-grained deposits.

3, Total mercury (THg) will be analyzed by USEPA SW-846 Method 7471A; total organic carbon (TOC) will be analyzed by Lloyd Kahn; grain size distribution will be measaured by ASTM D422.

Figures

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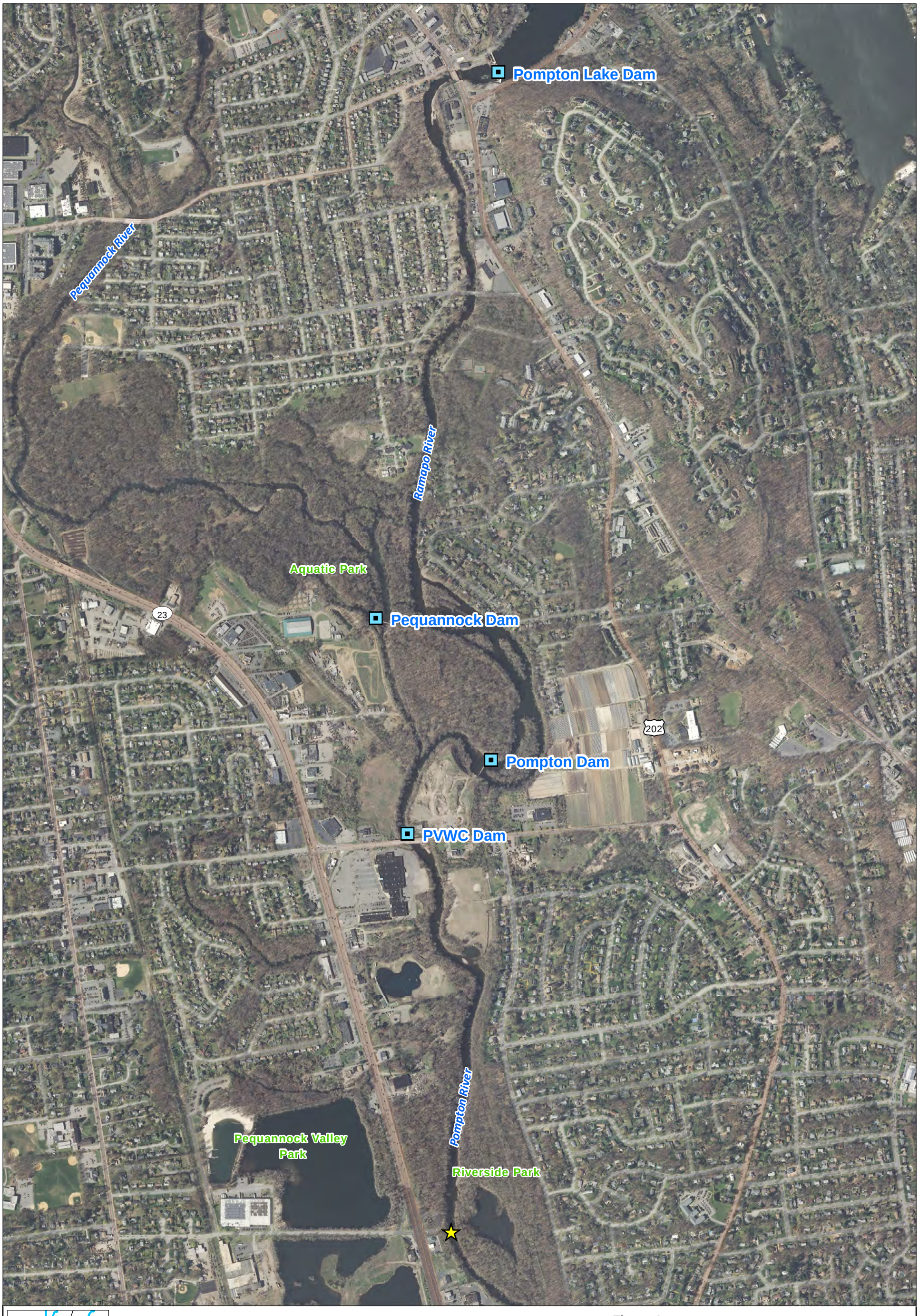

Figure 1
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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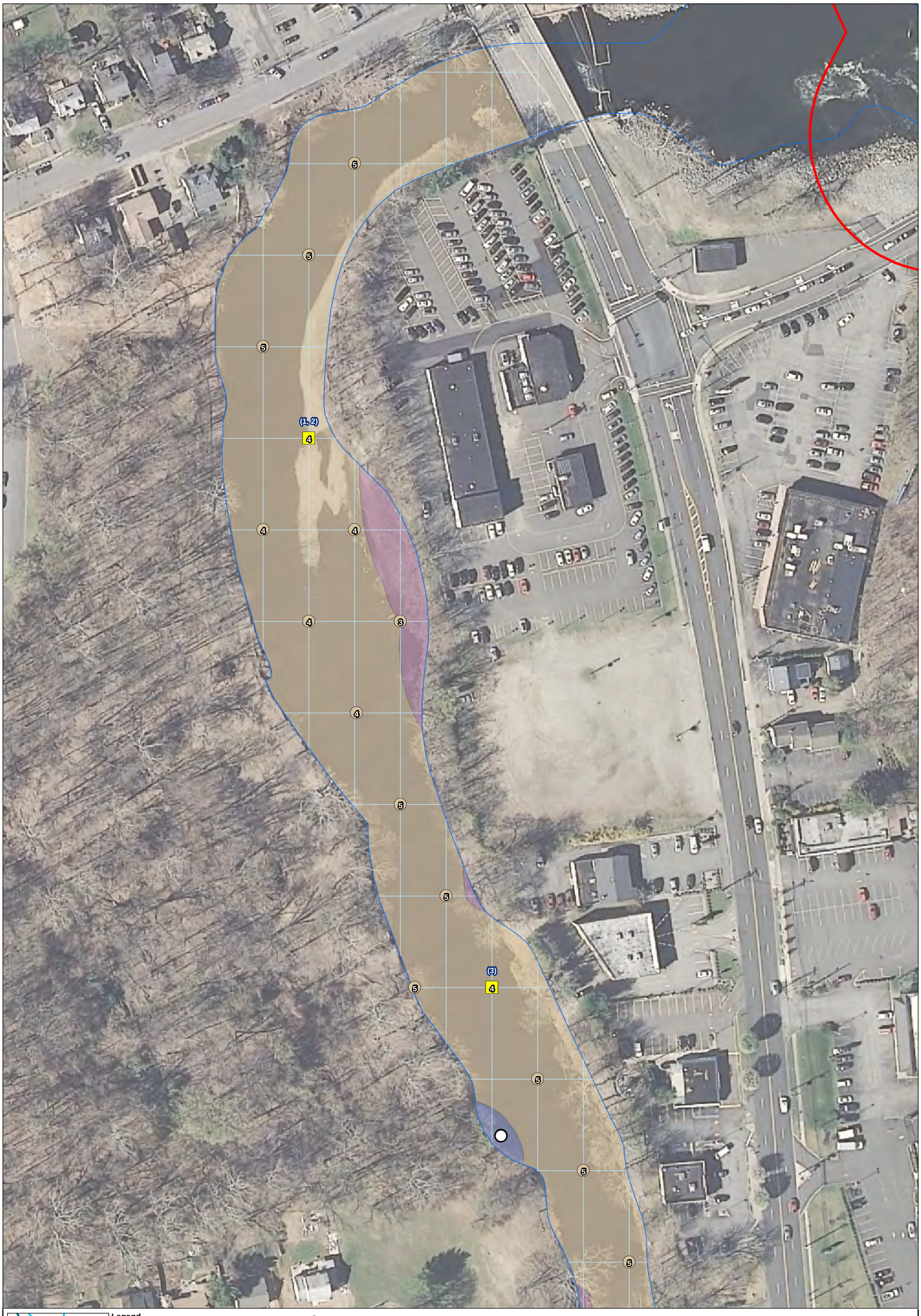

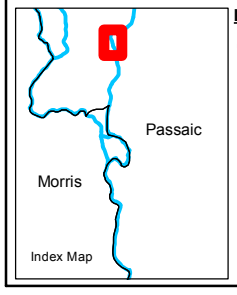

Legend

- Proposed Sediment Sampling Locations
- Historical Samples w/ Hg Concentrations (Civil Dynamics, 2012)
- Large Woody Debris
- 4 — Survey Location (Substrate Type)
- (1,2) — Photographic Log Reference
- 4 — Survey Location with Photo (Substrate Type)
- Access Points
- Dam
- Downstream Study Area Extent
- 150' Safety Buffer Near Dams

Substrate Types

- 1) Silt/Clay
- 2) Fine Sand
- 3) C. Sand/Granule
- 4-6) Pebbles, Cobble, Boulder, Bedrock
- Unmapped

0 50 100 Feet

1 inch = 100 feet

Figure 2
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations Downstream of Pompton Lake Dam to Riverside Park DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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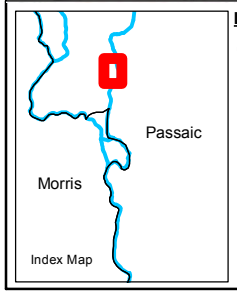

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Substrate Types

- 1) Silt/Clay
- 2) Fine Sand
- 3) C. Sand/Granule
- 4-6) Pebbles, Cobble, Boulder, Bedrock
- Unmapped

0 50 100 Feet

1 inch = 100 feet

Figure 3
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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Figure 4
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake
Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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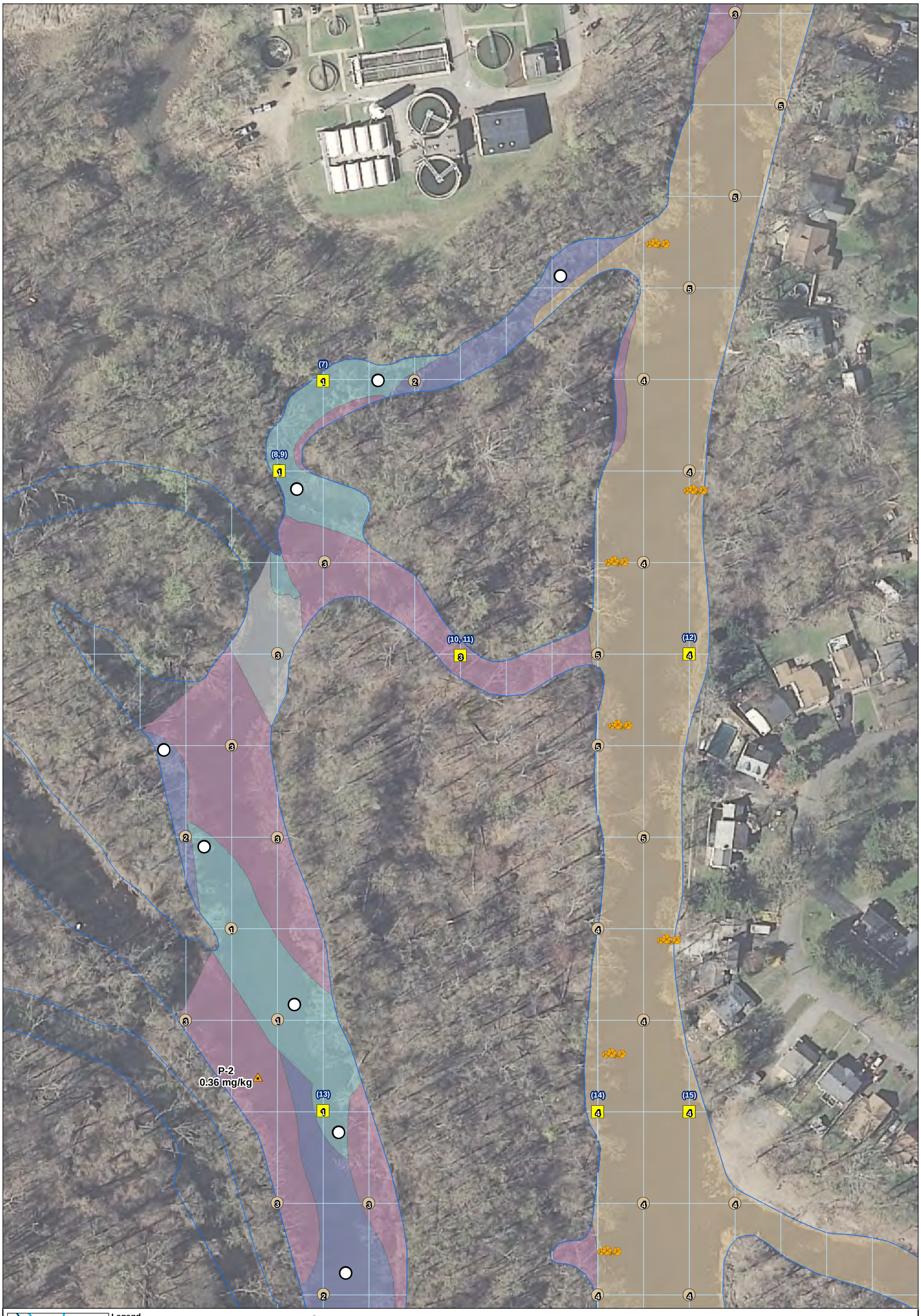

Figure 5
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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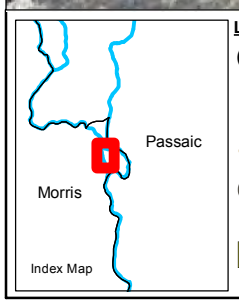
P-4
0.32 mg/kg

P-1
0.53 mg/kg

Pequannock Dam
1.5 mg/kg

Pequannock Dam



Legend

- Proposed Sediment Sampling Locations
- Historical Samples w/ Hg Concentrations (Civil Dynamics, 2012)
- Large Woody Debris
- Survey Location (Substrate Type)
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Figure 6
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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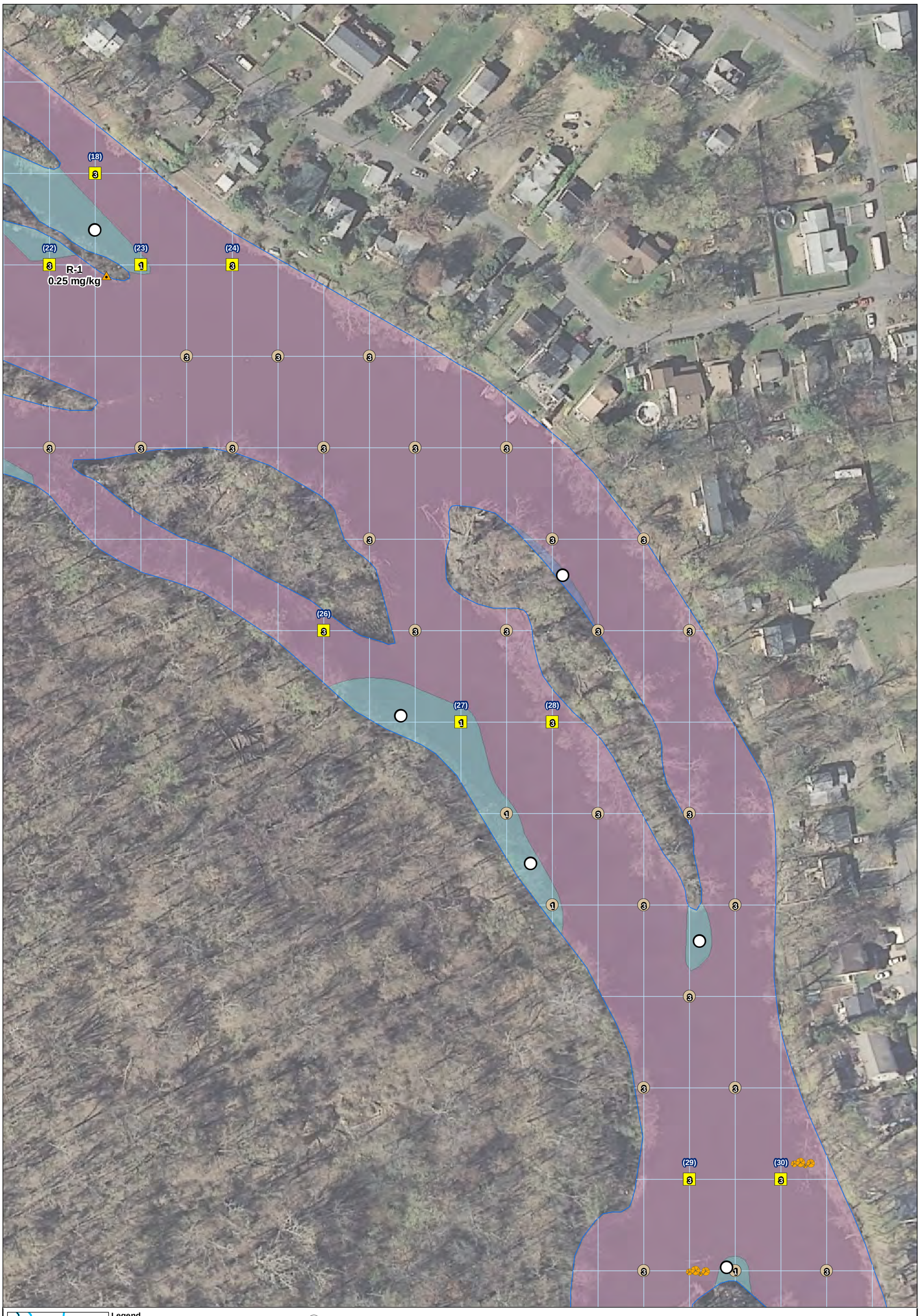

Figure 7
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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R-2
0.15 mg/kg

R-3
0.34 mg/kg

Pompton Dam
2.4 mg/kg

Pompton Dam

R-4
0.22 mg/kg

R-5
0.2 mg/kg

R-6
0.11 mg/kg

(31)

(32)

(33)

N

Passaic

Morris

Index Map

Legend

- Proposed Sediment Sampling Locations
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- Photographic Log Reference
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Figure 8
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Downstream of Pompton Lake Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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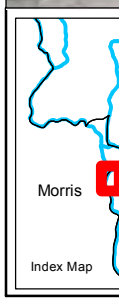
UNABLE TO ACCESS DURING SURVEY

TOP SOIL
DEPOT SITE

PVWC Dam
1.5 mg/kg

PVWC Dam



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Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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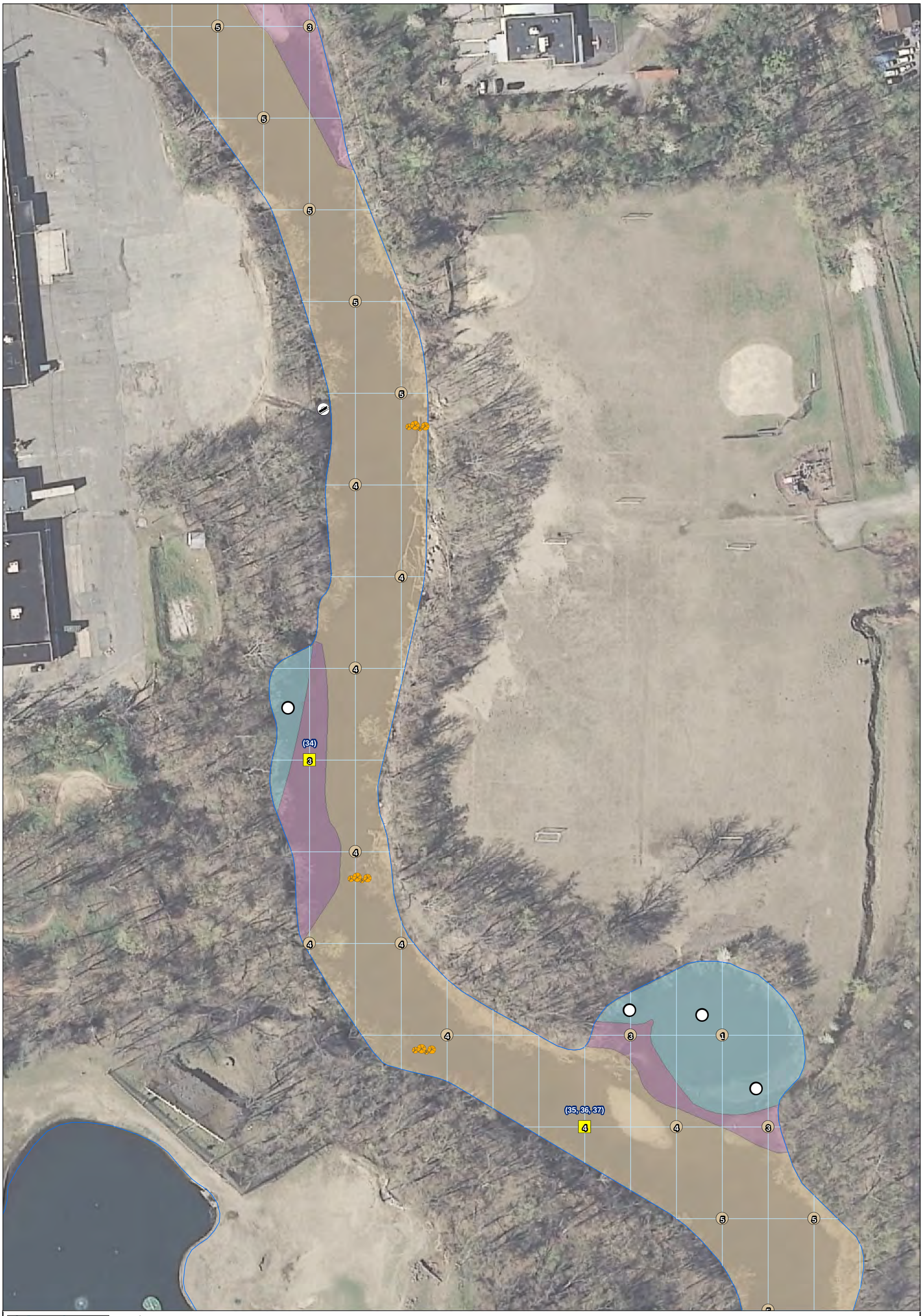

Figure 10
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake
Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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Figure 11
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations
Downstream of Pompton Lake
Dam to Riverside Park
DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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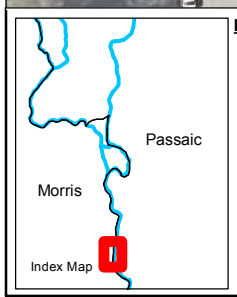
URS



Legend

- Proposed Sediment Sampling Locations
- Historical Samples w/ Hg Concentrations (Civil Dynamics, 2012)
- Large Woody Debris
- Survey Location (Substrate Type)
- Photographic Log Reference
- Survey Location with Photo (Substrate Type)
- Access Points
- Dam
- Downstream Study Area Extent
- 150' Safety Buffer Near Dams

Substrate Types

- 1) Silt/Clay
- 2) Fine Sand
- 3) C. Sand/Granule
- 4-6) Pebbles, Cobble, Boulder, Bedrock
- Unmapped

0 50 100 Feet

1 inch = 100 feet

Figure 12
Ramapo River/Pompton River Substrate Mapping and Proposed Sediment Sampling Locations Downstream of Pompton Lake Dam to Riverside Park DuPont Pompton Lakes Works

Morris and Passaic Counties, New Jersey

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Attachment A: Sediment Mapping Protocol

Riverbed Substrate Mapping Protocol
Ramapo River Investigation
DuPont Pompton Lakes Site

This protocol describes the approach that will be used to identify and map riverbed substrates in the Ramapo River below the Pompton Lake dam in Pompton Lakes, New Jersey.

The survey will extend for approximately three miles of the Ramapo River, from below the Pompton Lake dam (Figures 1 & 2). Detailed substrate mapping will not be conducted upstream of the Route Hamburg Turnpike bridge or within 150' upstream of downstream of the other dams within the reach.

The overall goal of this task is to identify and quantify the distribution of fine-grain sediments (silts, clays, fine sands) within the three mile reach of the Ramapo River below the Pompton Lake dam. Other key features such as stormwater outfalls, tributaries, submerged aquatic vegetation (SAV) and large woody debris (LWD) will also be documented.

This protocol is divided by task into the following sections:

- Equipment List
- Field Mapping Assessment
- Field Log Book and Field Sketch Maps

Equipment

The following equipment/supplies may be used to conduct substrate characterization field surveys:

- Field notebook/field sketch maps
- Pencils and waterproof/permanent marking pens
- Trimble® Geo-XH 6000 global positioning system (GPS)
- Camera and waterproof dry bags
- Field sediment grain size and texture guides
- Graduated sediment probe
- Ruler and measuring tapes
- Jon boat and necessary boating supplies (*e.g.,* anchor, paddles, motor, PFDs, etc.)
- Appropriate health and safety equipment

Field Mapping Assessment

The field mapping assessment will utilize the Trimble GPS unit to accurately map the spatial extent of riverbed substrate in the Ramapo River.

Substrate Mapping

- Field survey mapping will begin on the channel margin and work inward toward the center of the riverbed in an upstream-to-downstream direction. If water depths prohibit safely wading the reach a boat will be used to survey the area of concern.
- Substrate patches will be identified by the predominant coverage (>50%) of a sediment type. Determination of the predominant sediment type may require the measurement of the median axis width of several randomly selected particles within a patch. The six substrate types adopted from the Wentworth Scale (Leeder, 1982) are:

Type 1) Silts and Clays	< 0.063 mm
Type 2) Fine Sands	0.064 mm – 0.25 mm
Type 3) Medium / Coarse Sands and Granules	0.26 mm – 4.00 mm
Type 4) Pebbles	4.01 mm – 64.00 mm
Type 5) Cobbles and Boulders	64.01 mm – 4,096 mm
Type 6) Bedrock	> 4,096 mm

- Finer substrates will be worked between the thumb and forefinger to identify particle sizes.
- Substrate mapping will be performed at the highest resolution possible given the weather and hydrologic conditions at the time of survey. Generally, substrate patches greater than or equal to approximately 100 square feet will be mapped.
- Where surface water depths prohibit clear determination of substrate type, a probing rod will be used to probe the benthic layer at pre-determined points in order to identify substrate type. If predominate particle size cannot be determined with the probing rod alone, a petite Ponar® sampler will be used to retrieve for qualitative characterization/confirmation.
- Sediment types will be photo-documented at predetermined points (every fifth transect) to provide representative visual documentation of substrate type.
- The average depth of fine-grained deposits (*i.e.,* Type 1 and Type 2 substrates) will be estimated to approximate the volume and extent of accumulated sediment.
- Observations of any unique morphological features that describe sediment dynamics, such as the degree of embeddedness, imbrication, and sorting will be noted on the field sketch maps created in the preliminary geospatial assessment.

Field Logbook and Field Data Sheet

Thorough, organized, and accurate records will be made using field logbooks and field maps to document findings. Information pertinent to the investigation will be recorded in the field logbook and/or field data sheets. Entries will include the following, as applicable:

- Project name and number
- Name of sampler and field personnel
- Date and time of survey
- Physical characteristics of the substrate

- Photograph log with comments and spatial locations
- Observations at the sampling site (e.g., weather conditions)

Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook or data sheet for a particular site. Site-specific recording will include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel.

References

Leeder, M. R. 1982. Sedimentology: Process and Product. George Allen and Unwin Ltd, London, UK.

Attachment B: Photographic Log

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
1	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sample Point – 6a
Top of cobble bar
Classification – 4
ID Type - Visual

Photo No.	Date:
2	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sample Point – 6b
Top of cobble bar
Classification – 4
ID Type - Visual

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
3	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point - 15
Transition to cobble along shoreline.
Classification – 4
ID Type – Visual /Ponar

Photo No.	Date:
4	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 19
Classification – 3
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
5	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -29
Classification – 3
ID Type – Visual /Ponar

Photo No.	Date:
6	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 48
Classification – 4
ID Type – Visual/Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
7	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -55
Classification – 1
ID Type – Visual /Probe
Silt substrate; sink ~1 foot while wading.

Photo No.	Date:
8	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point – 58a
Classification – 1
ID Type – Visual/Probe

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
9	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -58b
Classification – 1
ID Type – Visual /Probe

Photo No.	Date:
10	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 64a
Classification – 3
ID Type – Visual
Channel contained limited areas of fines.

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
11	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -64b
Classification – 3
ID Type – Visual
Channel contained limited areas of fines.

Photo No.	Date:
12	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 66
Classification – 4
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
13	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -77
Classification – 1
ID Type – Visual /Ponar

Photo No.	Date:
14	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 78
Classification – 4
ID Type – Visual /Ponar
Limited grab due to coarse material.

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
15	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -79
Classification – 4
ID Type – Visual /Probe

Photo No.	Date:
16	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 91
Classification – 4
ID Type – Visual /Probe

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
17	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -97
Classification – 3
ID Type – Visual /Probe
SAV throughout channel

Photo No.	Date:
18	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 99
Classification – 3
ID Type – Visual /Probe

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
19	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -100
Classification – 4
ID Type – Visual /Ponar
Limited grab collected

Photo No.	Date:
20	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 101
Classification – 4
ID Type – Visual /Probe
Shallow water

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
21	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -103
Classification – 3
ID Type – Visual /Ponar

Photo No.	Date:
22	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 104
Classification – 3
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
23	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -105
Classification – 1
ID Type – Visual /Probe

Photo No.	Date:
24	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 106
Classification – 3
ID Type – Visual /Probe
No photo – heavy veg.

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
25	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -109
Classification – 3
ID Type – Visual /Probe

Photo No.	Date:
26	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 128
Classification – 3
ID Type – Visual /Probe

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
27	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -133
Classification – 1
ID Type – Visual /Ponar

Photo No.	Date:
28	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 134
Classification – 3
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
29	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -144
Classification – 3
ID Type – Visual /Ponar
Numerous *corbicula*.

Photo No.	Date:
30	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 145
Classification – 3
ID Type – Visual /Ponar
Woody debris on bottom
limited material collected.

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
31	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point -156
Classification – 3
ID Type – Visual /Ponar
Coarse sand lost from Ponar grab.

Photo No.	Date:
32	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point – 157
Classification – 1
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
33	8/12/13-8/14/13

Substrate Type Classification:

1 (Silt/Clay)

Description:

Sampling Point -158
Classification – 1
ID Type – Visual /Ponar

Photo No.	Date:
34	8/12/13-8/14/13

Substrate Type Classification:

3 (Coarse Sand/Granule)

Description:

Sampling Point – 194
Classification – 3
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont Pompton Lakes Works	Ramapo River	18986472

Photo No.	Date:
35	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -201
Classification – 4
ID Type – Visual /Probe

Photo No.	Date:
36	8/12/13-8/14/13

Substrate Type Classification:

5 (Cobble/Boulder)

Description:

Sampling Point – 205a
Classification – 5
ID Type – Visual /Probe

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
37	8/12/13-8/14/13

Substrate Type Classification:

5 (Cobble/Boulder)

Description:

Sampling Point -205b
Classification – 5
ID Type – Visual /Probe

Photo No.	Date:
38	8/12/13-8/14/13

Substrate Type Classification:

5 (Cobble/Boulder)

Description:

Sampling Point – 210
Classification – 5
ID Type – Visual /Probe
Collected material with hand.

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
39	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -216a
Classification – 4
ID Type – Visual /Ponar

Photo No.	Date:
40	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 216b
Classification – 4
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
41	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -216c
Classification – 4
ID Type – Visual /Ponar

Photo No.	Date:
42	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 221
Classification – 4
ID Type – Visual /Ponar

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ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
43	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -225
Classification – 4
ID Type – Visual /Probe

Photo No.	Date:
44	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point – 227
Classification – 4
ID Type – Visual /Ponar

URS

ATTACHMENT B
PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
DuPont	Ramapo River/Pompton River, Morris and Passaic Counties, New Jersey	18986472

Photo No.	Date:
45	8/12/13-8/14/13

Substrate Type Classification:

4 (Pebble)

Description:

Sampling Point -233
Classification – 4
ID Type – Visual /Ponar