Phase I Ecological Study: Station Selection, Biological Assessment, and Data Integration

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Overview: Phase I Ecological Study

Initial station selection process

Phase I sampling regime

Baseline biological assessments

Initial Station Selection Process

Three-step process

- Targeted approach to select sample reaches
- Physical habitat characterization and scoring along reaches
- Selection of distinct riffle/pool unit as sampling station within each reach

Initial Station Selection Process (continued)

Targeted river segments based on

- Historical data review
  - Concentration of mercury in
    - Surface water
    - Sediment
    - Biota
- Geomorphology and other physical characteristics (wetlands, depositional features)
- Proximity to physical and chemical stressors (sewage outfall, AMD, former DuPont Waynesboro facility)
- Proximity to former DuPont Waynesboro facility
- Proximity to historic and or current data collection areas

Phase I Descriptive Sampling Locations

16 initial stations

- Study area (13)
  - South River station nomenclature based on river mile from Waynesboro facility
- Reference areas (3)
  - Two locations on North River
  - One location on South River upstream of the former Waynesboro facility

One riffle/pool unit selected within each scored reach

- Riffle/pool unit integrates localized influences and physical features
- Riffle/pool unit allows collection of data from primary habitat types in river

Physical Habitat Characterization and Scoring

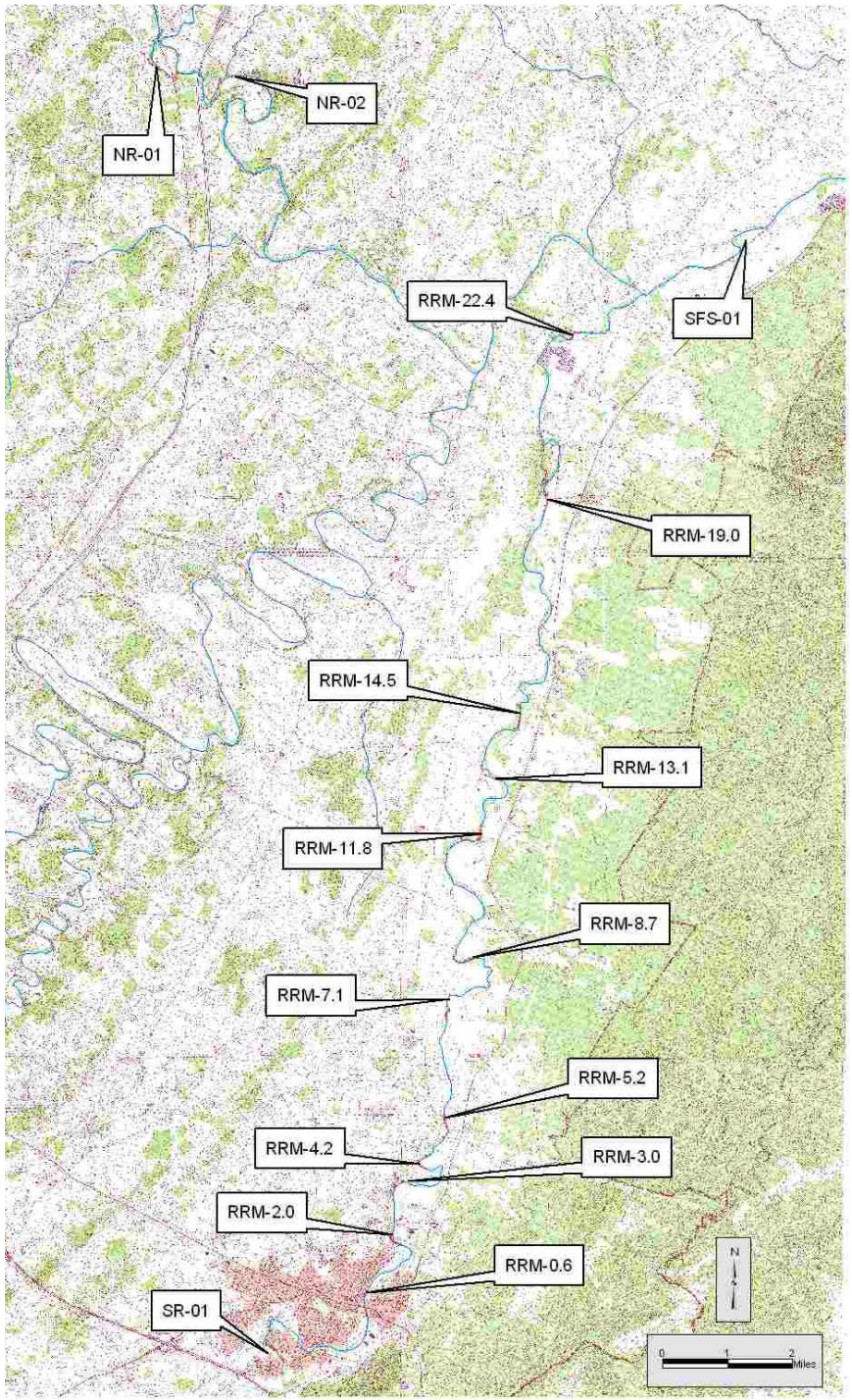
Scoring Protocol

- Habitat characteristics based on EPA Rapid Bioassessment Protocols (RBPs)
- 30Xs the wetted channel width scored (approx. 0.6 - 1.6 kilometers)
- Scoring used to determine/justify reference and study area locations
- Characterization used to select riffle/pool unit for baseline assessments and media sampling

Habitat Characteristics

Epifaunal Substrate / Available Cover
Embeddedness
Velocity/Depth Regime
Sediment Deposition
Channel Flow Status
Channel Alteration
Frequency of Riffles (or bends)
Bank Stability
Vegetative Protection
Riparian Vegetative Zone Width
Pool Substrate
Pool Variability

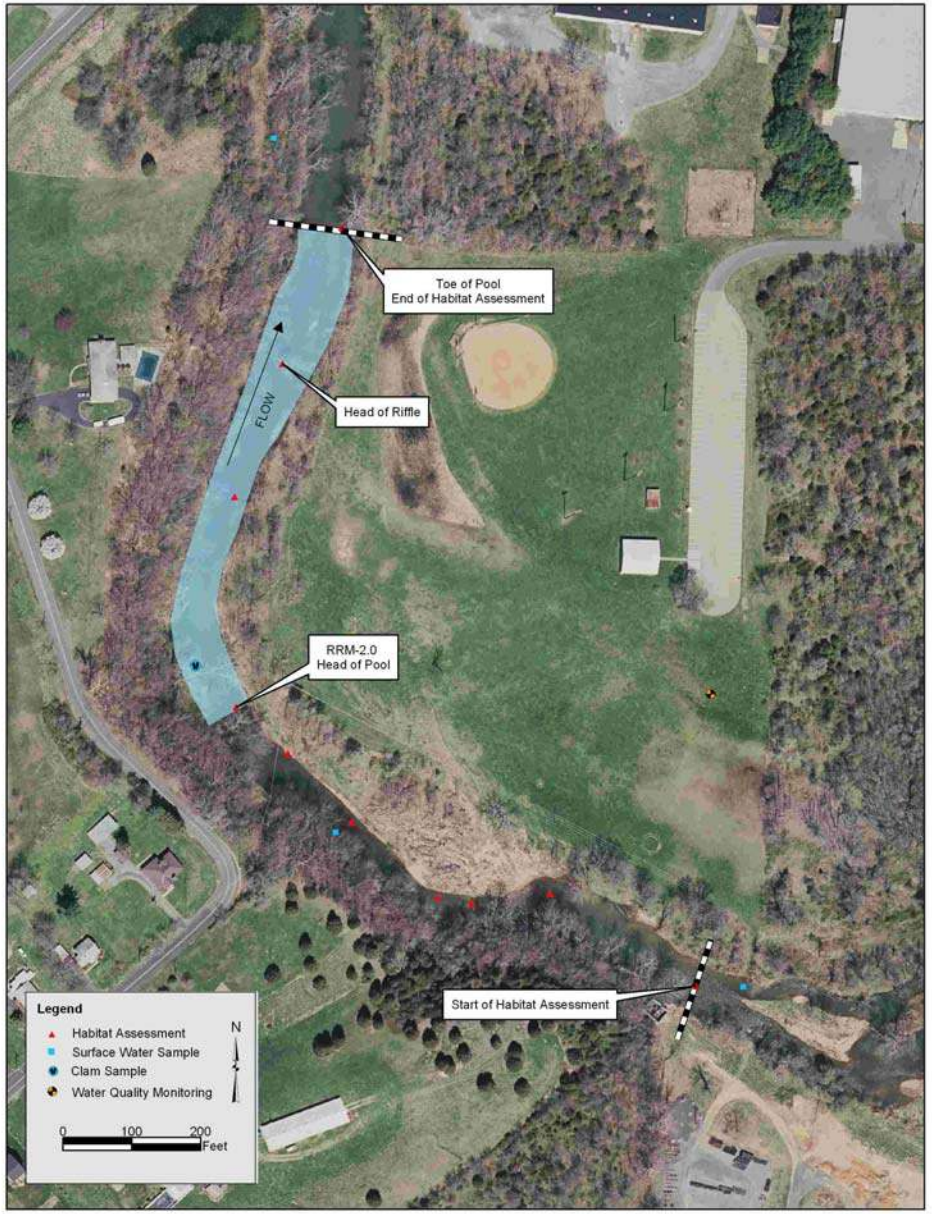
Descriptive Sampling Locations: Overview



RRM – 2.0

Station characteristics

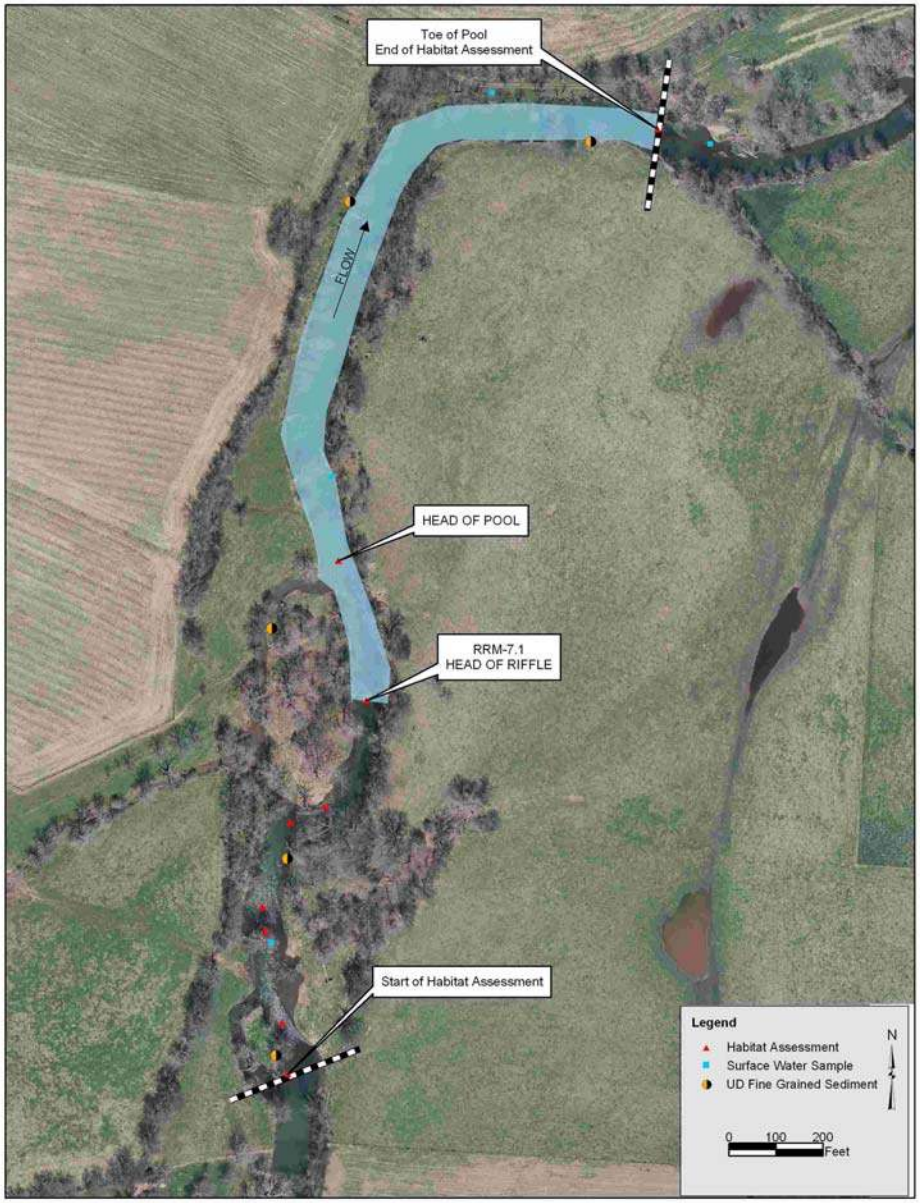
- Adjacent to Basic Park
- Floodplain “washover” feature
- Downstream of
  - Oxbow channel re-entry
  - Active river channel area (i.e., eroded banks)
  - Waynesboro sewage treatment plant outfall



RRM – 7.1

Station characteristics

- Adjacent to agricultural land
- Braided channel with Porterfield Run confluence
- River reach includes fine-grained sediment deposits



Phase I Sampling Objectives

Descriptive sampling

- Provide a baseline understanding of physical, chemical, and biological data for study
- Integrate sample stations for habitat assessments, community surveys, and physical and biological media

Experimental sampling

- Targeted sampling activities focused to episodic events, atmospheric features, and/or other river features
- Sampling designed to provide additional data regarding mercury concentrations in specific media types

Descriptive Sampling Regime

Integration of physical media

- Surface water
- Sediment

Integration of biological media

- Filamentous algae
- Corbicula
- Crayfish
- Aquatic Insects
  - Diptera, Trichoptera, Ephemeroptera
- Forage fish
  - Centrarchidae (*Lepomis auritus*)
  - Cyprinidae (Minnow)
  - Percidae (*Etheostoma* spp.)

DUPONT

Descriptive Sampling Regime (continued)

Media of Investigation	Analytes/ Data Needs	Sampling Method / Interval
Physical Media		
Surface Water	TOC, pH, TSS, major ions, ammonia nitrogen, THg, MeHg, selected metals, PAHs, and organo. pesticides	Direct grab 1-ft below the surface along the thalweg at the end of the pool; filtered and unfiltered samples for metals, THg and MeHg
Sediment	Grainsize, organic carbon, mineral characteristics, pH, THg, MeHg, selected metals, and PAHs.	Gravel sweeping method over quantified area
Biological Media		
Macro-algal	Selected metals, MeHg, and THg	Artifical substrates in areas with open canopy, targeted at the end of pool; composite samples
Aquatic Invertebrates (samples to be collected within and adjacent to sediment sampling areas were possible)		
Corbicula	Selected metals, MeHg, and THg	Direct collection within sample segment; composite sample from same size class
Crayfish	Selected metals, PAHs, MeHg, and THg	Direct collection within sample segment; composite sample from same size class
Diptera Ephemeroptera Trichoptera	MeHg and THg	Direct collection within sample segment; composite sample of 10 individuals from same size class, per station, per species type
Forage Fish (juvenile and adult fish < 100-mm Total Length)		
Centrarchidae (*Lepomis auritus*) Cyprinidae (Minnow) Percidae (Etheostoma spp.)	Selected metals, MeHg, and THg	Electrofishing within sample segment; composite of 10 individuals, per station, per species type

Descriptive Sampling Regime (continued)

Descriptive Sampling Locations	Potential Local Stressors						Physical Influences			Media Sampling Analyte Group			
	Urban Impacts / Stormwater	Waynesboro Site	Sewage Treatment Outfall	Anthropogenic Input	Agricultural Runoff	Acid Mine Drainage	Tributary Confluence	Flood Plain / Wetland	Braided Channel	Misc.	THg and MeHg	Selected Metals	Org. Pest. and PAHs
STUDY AREA													
RRM 0.6	X	X						X		X	X	X	X
RRM 2.0	X	X	X					X		X	X		
RRM 3.0	X	X		X				X		X	X		
RRM 4.3		X						X		X	X	X	X
RRM 5.3		X						X		X	X		
RRM 7.1		X			X			X	X	X	X		
RRM 8.7		X			X		X	X		X	X	X	
RRM 11.8		X			X	X	X	X		X	X	X	X
RRM 13.1		X			X			X	X	X	X		
RRM 14.6		X					X	X	X	X	X		
RRM 19.0		X					X	X	X	X	X		
RRM 22.4	X	X						X	X	X	X		
SFS 01		X						X		X	X	X	X
REFERENCE													
SR 01	X						X	X		X	X	X	X
NR 01								X		X	X	X	X
NR 02			X					X		X	X	X	X

Descriptive Sampling Regime (continued)

Activity Schedule:

X –SW, SED, crayfish

XY –SW, SED, Algae, Inverts.

XYZ –SW, SED, Algae, Inverts., Fish

* - If sampling activities adversely impact a location, frequency may be altered.

Descriptive Sampling Locations*	Monthly Sampling Schedule (2005-2006)											
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun .	Jul.	Aug.	Sep.	Oct.
STUDY AREA												
RRM 0.6	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 2.0	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 3.0	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 4.3	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 5.3	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 7.1	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 8.7	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 11.8	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 13.1	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 14.6	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 19.0	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
RRM 22.4	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
SFS 01	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
REFERENCE												
SR 01	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
NR 01	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY
NR 02	X	X	XY	X	X	X	XYZ	X	X	XYZ	X	XY

Experimental Sampling Regime

Sampling activities to examine mercury concentrations and ancillary parameters in

- Surface waters during episodic storm events (2006-2007)
- Atmospheric particulates (June 2005-May 2006)
- Fine-grained sediment deposits (2006-2007)
- Floodplain and wetland soils in targeted features (2006-2007)
- Submerged aquatic plant tissues (2006)

Experimental Sampling Regime (continued)

Media of Investigation	Analytes/ Data Needs	Sampling Method / Interval
Physical/Biological Media		
Surface Water Storm Event	TOC, pH, TSS, major ions, ammonia nitrogen, THg, MeHg	Full storm hydrographs will be provided at three stations with a goal of four storm events. Adaptive sampling plan to collect data for a range of storms and precipitation events, (target goal of four events with surface water data collected synoptically)
Vascular Plant Tissue	Loss on ignition (LOI), MeHg and THg	Samples will be collected at descriptive stations as available.
Fine Grained Sediment Deposits	Grainsize, organic carbon, mineral characteristics, pH, MeHg and THg	Surficial bulk sediment collection (0-1.0-inch) in despositional areas as identified by surveys conducted by studies at University of Deleware and field observations
Wetland Sediment/Floodplain Soil	Grainsize, organic carbon, mineral characteristics, pH, MeHg and THg	Bulk sediment collection in wetland and flood plain features. Collection of 0-1.0 inch interval or greater depending on characteristics of deposited feature.
Air	Hg vapor and particulate Hg	Air pump iodated carbon with 0.8 micron filter; monthly average concentrations

Baseline Biological Assessment

Physical habitat scores in conjunction with assessments of

- Riparian vegetation and aquatic plant community
- Macroinvertebrate community
- Fish community

Biological Assessment Surveys

Riparian and aquatic vegetation community

- Survey conducted in late summer (August 2006)
- Survey transects/percent coverage along reaches

Macroinvertebrate community

- Surveys conducted in spring and late summer (May and August 2006)
- RBP-based community sampling methods (VADEQ stream survey methods)

Fish community

- Survey conducted in late summer (August 2006)
- RBP-based community sampling methods (electrofishing with block nets)