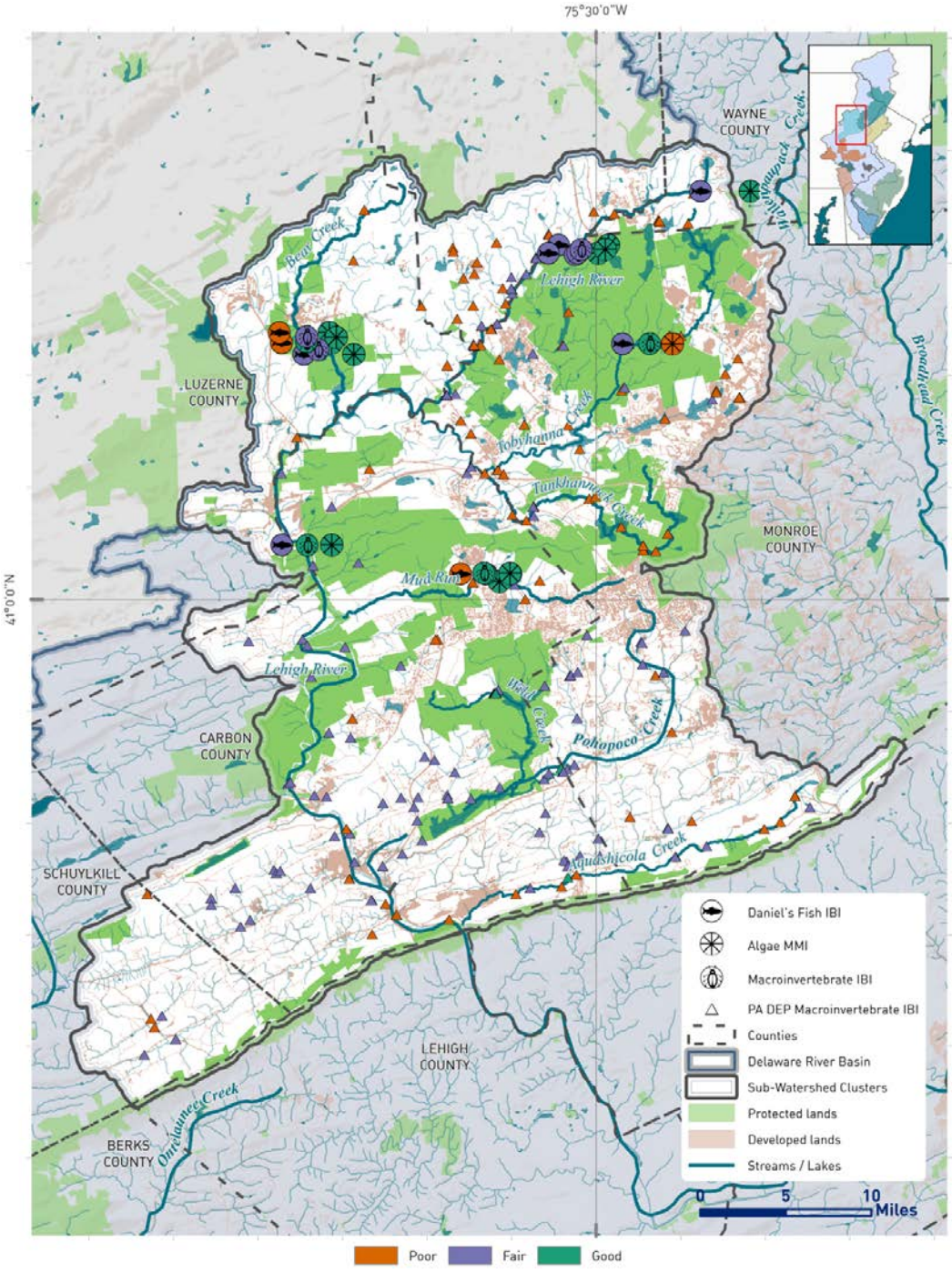
Baseline conditions of the

UPPER LEHIGH

Delaware River Watershed Initiative

Indices of Biological Integrity: An index of biological integrity (IBI) is a collection of metrics which describe the structure and function of an ecosystem based on its biota. Metric values are converted to scores and yield a total IBI score. These scores can be translated into easily-interpreted regional quality classifications.



*Circle icons represent 2013-2014 DRWI sampling sites. Number of ANS/Stroud WRC sites = **13**; Cluster Group sites = **32**.*

Multiple Indicators: Data collection includes chemical parameters as well as biota. Water chemistry alone can either over exaggerate or fail to detect changes from brief pollution events, but biota provide information on year-round water and habitat quality. Different biota respond differently to stressors. Analyzing data on multiple groups of biota tells a more complete story of ecosystem structure and function in relation to landscape variables and human activities.

Rating	Daniels Fish IBI	PADEP Macro-invertebrate IBI	Algae MMI
Poor	0 – 35	0 – 45	0 – 3.33
Fair	35.1 – 46	45.1 – 74	3.34 – 6.66
Good	46.1 – 60	74.1 – 100	6.67 – 10

Notable Fish & Significance to IBI

Longnose Dace *(Rhinichthys cataractae)*
Insectivore, intermediate tolerance to non-specific stressors

Margined Madtom *(Noturus insignis)*
Insectivore, intermediate tolerance to non-specific stressors

Common Shiner *(Luxilus cornutus)*
Generalist feeder, intermediate tolerance to non-specific stressors

Average Daniels Fish IBI Score:
39.44 (Fair)

Notable Algae & Significance to IBI

Achnanthidium minutissimum
Nutrient sensitive, grazer and scour resistant

Achnanthidium rivulare
Nutrient tolerant, neutral pH optimum, grazer and scour resistant

Cocconeis placentula
Moderate nutrient tolerance, grazer and scour resistant

Average Algae MMI Score:
7.55 (Good)

Notable Macroinvertebrates & Significance to IBI

Riffle beetles: *Promoresia*
Require fast-flowing waters, pollution sensitive, scrapers

Microcaddisflies: *Stactobiella*
Somewhat pollution sensitive, scrapers

Black flies: Simuliidae
Those present here are pollution sensitive, collector-filterers

Average Macroinvertebrate IBI Score:
78.60 (Good)

THE ACADEMY OF NATURAL SCIENCES
of DREXEL UNIVERSITY
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UPPER LEHIGH

Cluster Organization

Partners: Audubon Pennsylvania, Natural Lands Trust, The Nature Conservancy, North Pocono CARE, Pocono Heritage Land Trust, Wildlands Conservancy*. (*ULC monitoring partner)

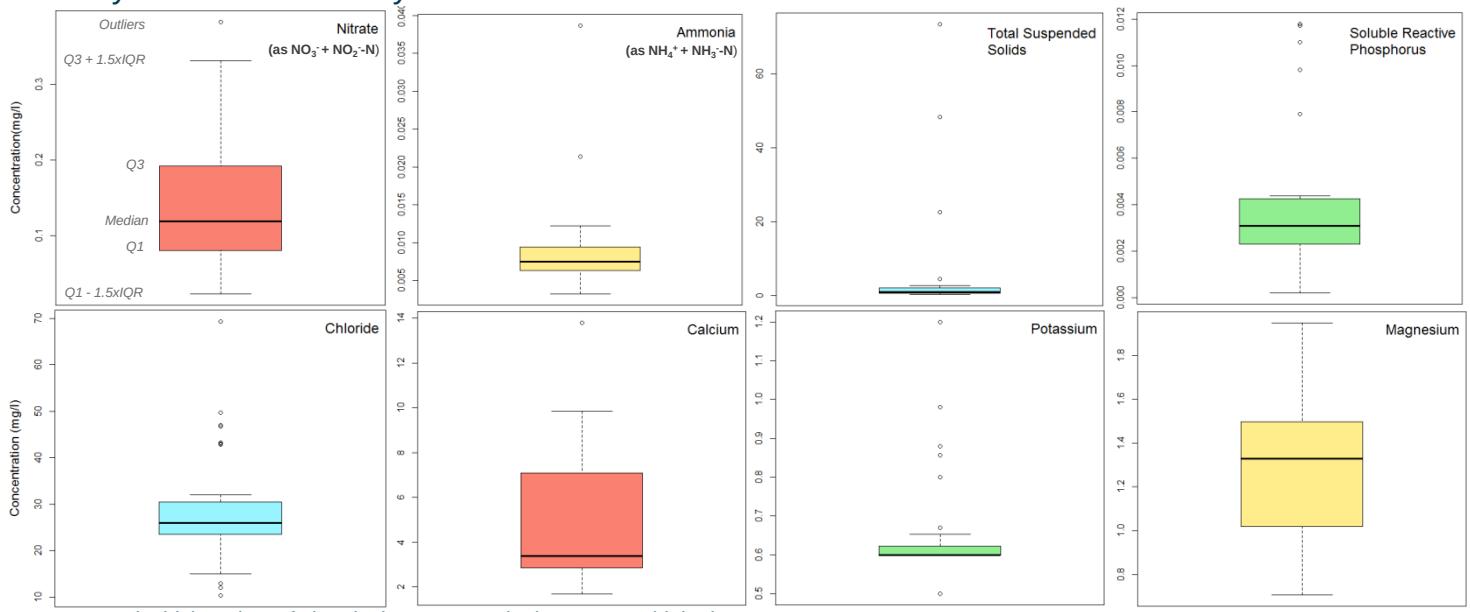
Strategy: Prevent degradation of existing water quality conditions through preservation of forested and wetland areas, with emphasis on enhancing connectivity of protected lands; promote conservation and stewardship at the municipal and county levels; restoration of degraded stream corridors through dam removal.

Monitoring Objectives: Characterization of the Lehigh's sub-drainages; comparing conditions above and below the region of acid mine drainage inputs; assessing effectiveness of land preservation as a means of water quality protection.

Habitat Assessment

In-stream habitat assessments are a composite of variables including flow type descriptions, particle size classifications and embeddedness estimations. These features interact to influence biotic communities. Reaches sampled in the Upper Lehigh cluster were had similar amounts of riffle (35%), glide (34%; fast-flowing but not as choppy as riffle) and pool (28%; still or backflow) flow types. Flow type is often reflected in both substrate particle size and how embedded particles are. Particle size and embeddedness then, in turn, partially determine the area of habitat available for fish, macroinvertebrates, and algae within a reach. In the Upper Lehigh cluster, the dominant particle sizes were cobble (38%) and small boulders (22%). The coarse gravel, cobbles, and boulders present were about 42% embedded (covered in fine sediment; high percentages can indicate erosion of upstream land). Overall this cluster was given a habitat grade of suboptimal.

Summary of Water Chemistry Parameters



Box-and-whisker plots of chemical parameters in the Upper Lehigh cluster.

There were 33 seasonal sampling events performed by the Academy of Natural Sciences and Stroud Water Research Center at 13 sites from 2013 to 2014. All samples at all sites met nitrate criteria for cold water fisheries (<3.1 mg/L nitrate). Also, all samples were below 0.05 mg/L soluble reactive phosphorus (SRP) – a widely-referenced maximum for suitability for aquatic life. Some of the highest SRP concentrations in the cluster were from Bear Creek, which drains an area that is heavily forested (80%) but has pockets of development (7.2%).

Total suspended solids (TSS) should be below 25 mg/L to support cold water fisheries. All samples at all sites achieved this, with most samples between 0.25 and 2.75 mg/L TSS. However, some samples in the Lehigh River sub-watershed were statistical outliers. Three sites were sampled around the confluence of Rucks Run and the Lehigh River main stem: site RR1, on the Lehigh, upstream of the confluence (4.4 mg/L); site RR2, downstream of the confluence (0.6 mg/L); and the tributary, Rucks Run (site RR3, 22.5 mg/L). Sites RR1 and RR2 were sampled on back-to-back days, but Ruck's Run (RR3) was sampled weeks later. Rain events or in-stream activity can lead to increased levels of TSS, but there was no significant rain event prior to any of the sites' sample dates. The Lehigh River sub-watershed faces many possible sources of disturbance, such as dams and development, but the values might also be attributed to human error. With only one sample per site, a conclusion cannot be made at this time. Other sites with high TSS concentrations were a Bear Creek tributary (48.3 mg/L TSS) and Mud Run (73.6 mg/L TSS). Both sites capture areas that are highly forested (Bear Creek tributary 71%, Mud Run 80%) but face pressure from housing developments and light urbanization (Bear Creek tributary 24%, Mud Run 19%).

All sampling events achieved levels of chloride considered safe for aquatic life under chronic exposure (<230 mg/L, EPA), but Rucks Run (RR3) produced the highest concentration of chloride (69.4 mg/L). Chloride can be related to urban land use via road salts and wastewater treatment plants. The site is downstream of a major highway, and forested areas that are undergoing development. Ammonia concentration and its effects on freshwater communities is highly variable; upper limits of concentrations suitable for aquatic life can range from 0.07 to 2.0 mg/L total ammonia (EPA) depending on temperature, pH and species. All sampling events in this cluster met the total ammonia criterion, with concentrations below 0.07 mg/L. Weathering is the main source of calcium (from limestone), magnesium (from igneous rocks that include biotite and pyroxene), and potassium (from igneous and silicate rocks including feldspar) in freshwater streams. Their concentrations vary depending on rainwater and pollution as well as local geology, with ion concentrations in igneous geographies roughly half those of sedimentary landscapes. Downstream this variation becomes less notable than in headwaters, and ion concentrations increase overall (Allan and Castillo, 2007).