**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.
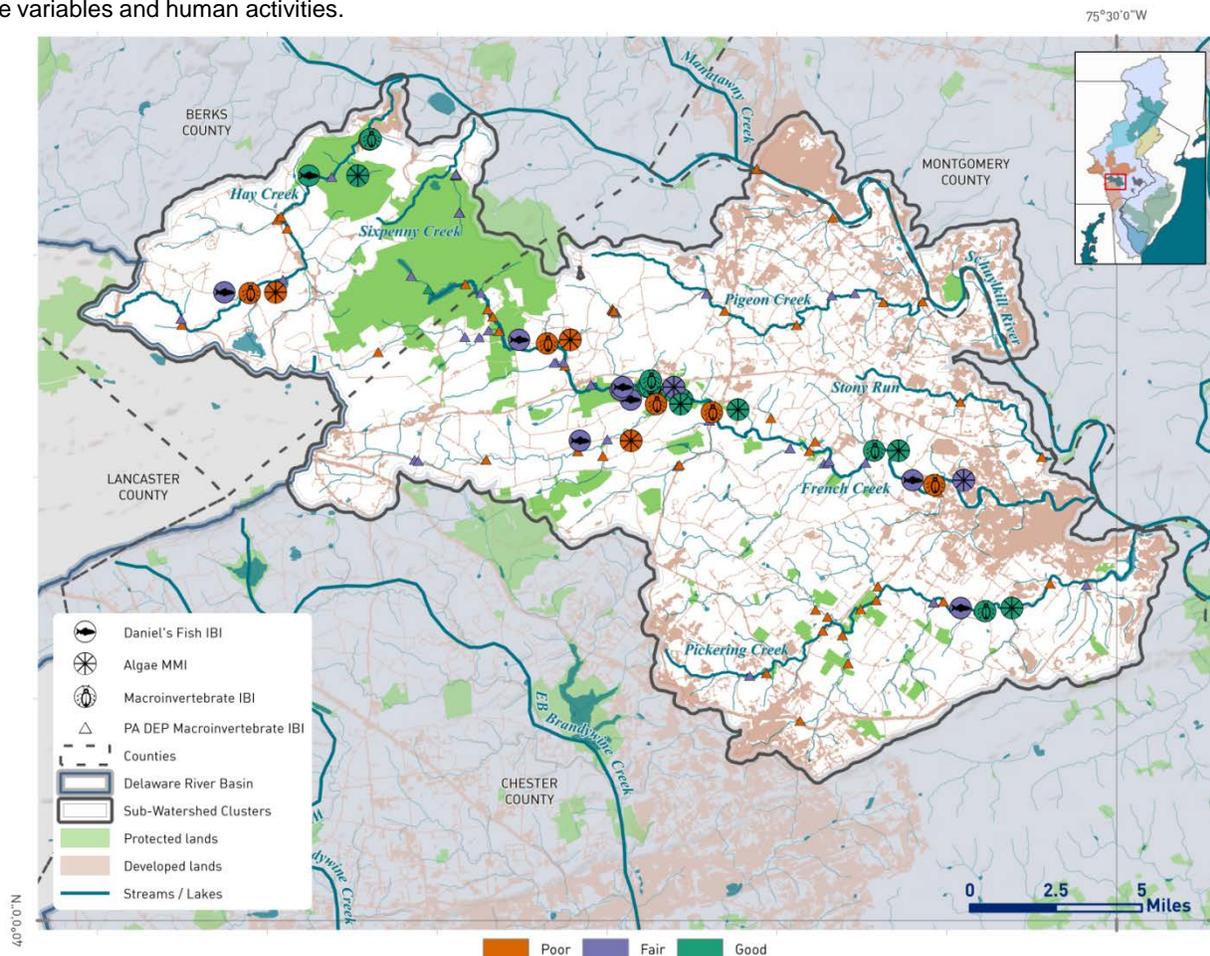
Circle icons represent 2013-2014 DRWI sampling sites. Number of ANS/Stroud WRC sites = 5; Cluster Group sites = 54.

Poor   Fair   Good

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

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.

Notable Fish & Significance to IBI

Blacknose Dace *(Rhinichthys atratulus)*
  Generalist feeder, tolerant to non-specific stressors.

Cutlip Minnow *(Exoglossum maxillingua)*
  Insectivore, intolerant to non-specific stressors.

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

Average Daniels Fish IBI Score:
43.56 (Fair)

Notable Algae & Significance to IBI

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

Tabellaria flocculosa
  Nutrient sensitive, low pH optimum, grazer and scour resistant.

Brachysira brebissonii
  Nutrient sensitive, low pH optimum, moderately grazer and scour resistant.

Average Algae MMI Score:
6.55 (Fair)

Notable Macroinvertebrates & Significance to IBI

Midges: Chironomidae
  Those present range from pollution sensitive to pollution tolerant, collector-gatherers

Black flies: Simuliidae
  Those present here range from pollution sensitive to tolerant, collector-filterers

Crane flies: *Antocha*
  Somewhat pollution sensitive, shredders

Average Macroinvertebrate IBI Score:
73.57 (Fair)

THE ACADEMY OF NATURAL SCIENCES
of DREXEL UNIVERSITY
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Cluster Organization

Partners: Audubon Pennsylvania, Berks Nature, Chester County Water Resources Authority*, French and Pickering Creeks Conservation Trust*, Green Valleys Watershed Association*, Natural Lands Trust, Partnership for the Delaware Estuary, Stroud Water Research Center*. (*SHC monitoring partners)

Strategy: Preserve water quality through acquisition of targeted properties and stewardship of protected lands via best management practices; integrate landowners and municipalities with existing conservation techniques utilized by regional conservation organizations; use modeling to contribute to analysis of monitoring data and to identify streams and/or parcels of high priority for land conservation.

Monitoring objectives: Monitoring related to land protection parcels, intending to show water quality improvement resulting from stewardship of newly-protected land; in some cases, assessing the impact of development upstream of protected parcels. Monitoring is done through professional programs, local organizations and volunteers.

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 Schuylkill Highlands cluster were dominated by glide (45%; fast-flowing but not as choppy as riffle) and pool (34%; 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 Schuylkill Highlands cluster, the dominant particle sizes were cobble (27%), coarse gravel (17%) and sand (16%). The coarse gravel, cobbles, and boulders present were about 60% embedded. Overall this cluster was given a habitat grade of sub-optimal.

Summary of Water Chemistry Parameters
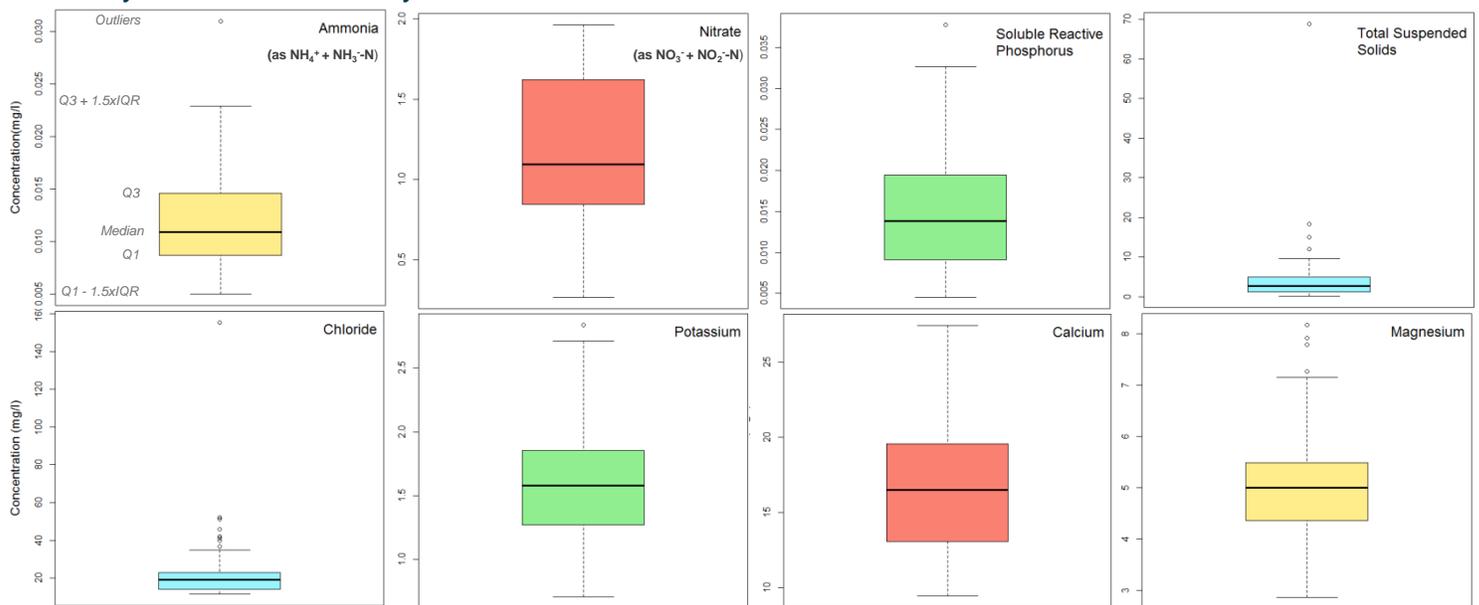
Box-and-whisker plots of chemical parameters in the Schuylkill Highlands cluster.

There were 46 seasonal sampling events performed by the Academy of Natural Sciences and Stroud Water Research Center at 12 sites from 2013 to 2014. One summer sampling event on French Creek produced the cluster's highest concentrations of total suspended solids (68.8 mg/L TSS) and soluble reactive phosphorus (0.38 mg/L SRP). TSS should be below 25 mg/L (NJ DEP) for cold water fisheries and below 40 mg/L for warm water communities. All other sites in the cluster achieve cold-water fisheries criteria for TSS. Though it has the highest SRP concentration, the French Creek sample (and all others in the cluster) were less than 0.05 mg/L SRP – a widely-referenced maximum concentration for suitability for aquatic life. An "integrative" site, the site on lower French Creek captures the majority of its drainage (163 km^2 of 183 km^2) – upstream of Phoenixville – and includes a mix of agriculture (29%) and forest (46%) that is reflective of the entire cluster (25% agriculture, 40% forested). Agriculture can correlate to increased SRP, TSS and nitrate. All samples at all sites met nitrate criteria for cold water fisheries (<3.1 mg/L nitrate).

All sampling events met recommended criteria for chloride concentrations considered safe for aquatic life under chronic exposure (230 mg/L, EPA). The highest reported value was from a winter sampling event on Pickering Creek (155.5 mg/L). High chloride concentrations can be related to urban land use via wastewater treatment plants or road salts. This was the only winter sample from that site analyzed to date; Pickering Creek samples during other seasons were between 36.7 and 52.3 mg/L chloride. The site is downstream of farms (31%) and housing developments (23%). 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).