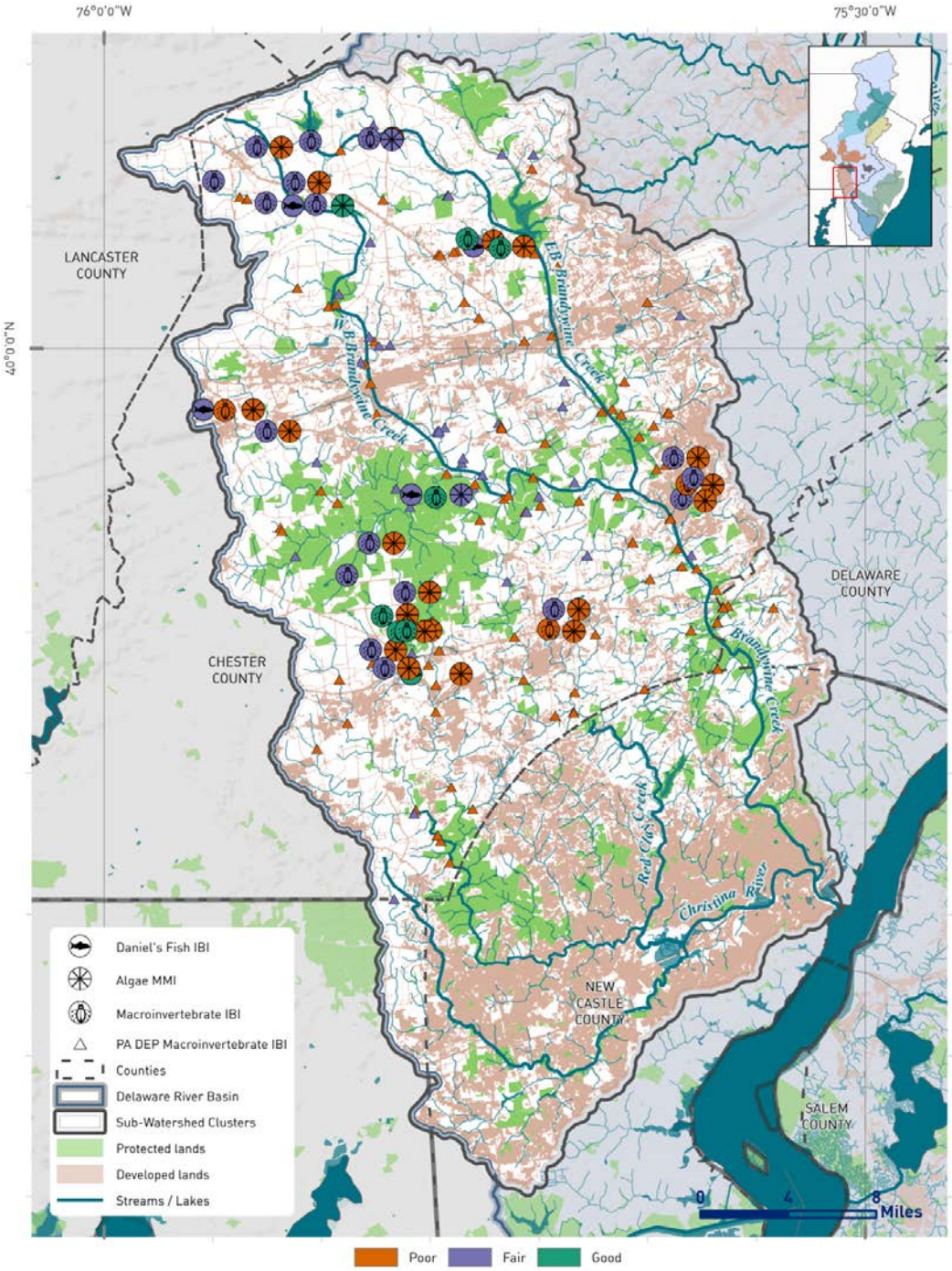
Baseline conditions of the

BRANDYWINE AND CHRISTINA

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 = ***25.***

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.

Notable Fish & Significance to IBI

White Sucker *(Catostomus commersoni)*
Generalist feeder, tolerant to non specific stressors

Tessellated Darter *(Etheostoma olmstedi)*
Insectivore, intermediate tolerance to non-specific stressors

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

Average Daniels Fish IBI Score:
43.20 (Fair)

Notable Macroinvertebrates & Significance to IBI

Midges: Chironomidae
Those present here are pollution tolerant, mainly collector gatherers.

Riffle beetles: Elmidae
Require fast-flowing waters, moderately pollution tolerant, algae scrapers

Spiny crawler mayflies: Ephemerellidae
Pollution sensitive, collector-gatherers or scrapers

Average Macroinvertebrate IBI Score:
60.00 (Fair)

Notable Algae & Significance to IBI

Achnanthidium rivulare
Nutrient tolerant, neutral pH optimum, grazer resistant

Nitzschia inconspicua
Nutrient tolerant, organic pollution tolerant, grazer resistant

Amphora pediculus
Nutrient tolerant, organic pollution sensitive, grazer resistant

Average Algae MMI Score:
2.15 (Poor)

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

THE ACADEMY OF NATURAL SCIENCES
of DREXEL UNIVERSITY

July 2016

BRANDYWINE AND CHRISTINA

Cluster Organization

Partners: Brandywine Conservancy, Brandywine Red Clay Alliance, Natural Lands Trust, The Nature Conservancy, Stroud Water Research Center*, University of Delaware. (*monitoring partner)

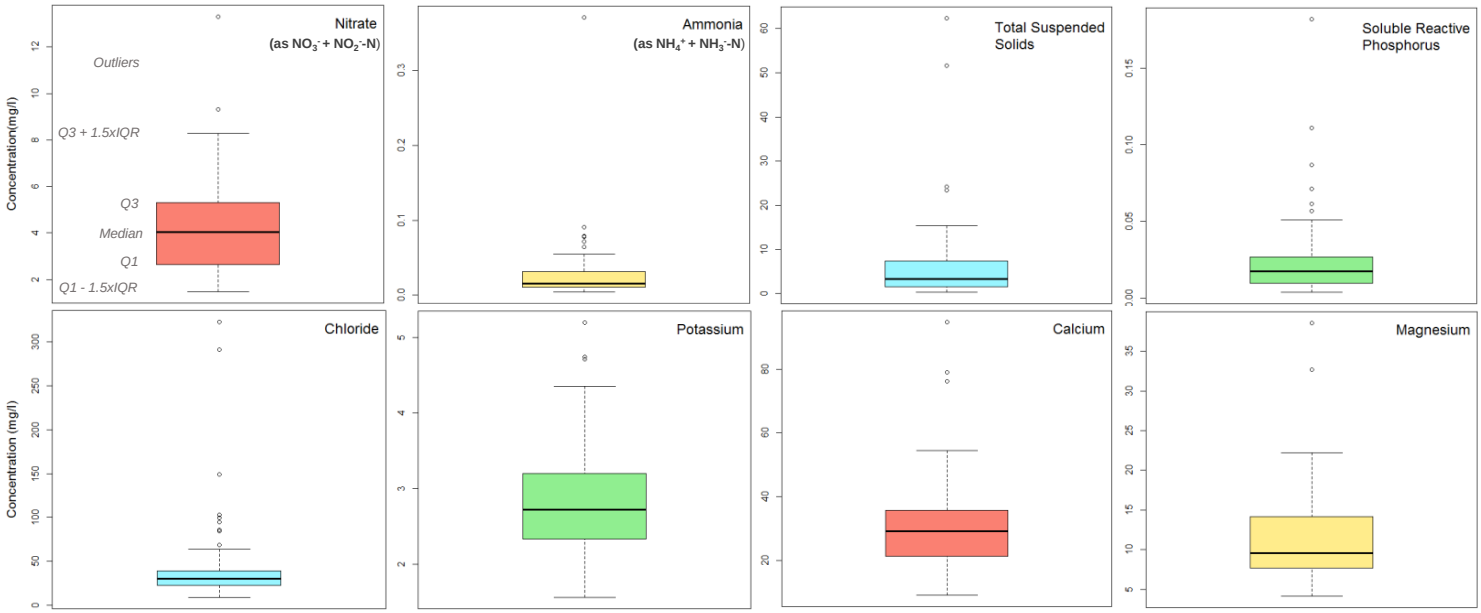
Strategy: Agricultural and urban restoration, direct land conservation, efforts related to land management plans, regulatory tools and funding. Pursuing conservation opportunities with high-impact potential to bolster ongoing restoration efforts on impaired reaches.

Monitoring Objectives: Collecting data before, during and after completion of projects, along with historical data, will produce a comprehensive idea of baseline conditions and help assess potential improvement in water quality resulting from on-the-ground actions.

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 Brandywine-Christina cluster were dominated by glide (53%; fast-flowing but not as choppy as a riffle) and pool (29%; still or backflow) flow types. The 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 Brandywine-Christina cluster the dominant particle sizes were sand (26%), cobble (23%) and gravel (19%). The coarse gravel, cobbles, and boulders present were about 70% embedded (covered in fine sediment; high percentages can indicate erosion of upstream land). Overall, this cluster was given a grade of suboptimal.

Summary Of Water Chemistry Parameters



Box-and-whisker plots of chemical parameters in the Brandywine and Christina cluster.

There were 69 seasonal sampling events performed by the Academy of Natural Sciences and Stroud Water Research Center at 25 sites from 2013 to 2014. One third met recommended nitrate criteria for cold-water fish communities (<3.1 mg/L); one third met criteria for warm-water fisheries (<4.9 mg/L, Minnesota PCA); and the remaining one third failed the criteria for nitrate. A spring season sample on East Branch Red Clay Creek produced the highest nitrate value (13.3 mg/L nitrate), but that stream met warm-water fisheries criteria for nitrate on other sample dates.

One site on the West Branch Brandywine Creek failed to meet criteria for nitrate and soluble reactive phosphorus (SRP) at all five sampling events (across all seasons). An “integrative” site, it captures a drainage that includes agricultural land (35%), a golf course, and the town of Honey Brook, Pa. (15%). Only two other sampling events in the cluster failed for SRP; the rest were below 0.05 mg/L– a widely-referenced maximum SRP concentration for suitability for aquatic life. Two samples from other sites on the West Branch Brandywine exceeded 40 mg/L total suspended solids (TSS), the maximum concentration set by NJ DEP for warm water (non-trout) fisheries. All other sampling events in the cluster met NJ DEP’s cold water (trout production) TSS criteria (<25 mg/L). Nitrate, SRP and TSS are indicative of agriculture – 27% of land use in this cluster – but can also come from urban sources (33% of cluster land use).

All but two samples (both on Plum Run) were below the maximum chloride concentration considered safe for aquatic life under chronic exposure (230 mg/L, EPA). Chloride can be related to urban land use via road salts and wastewater treatment. Ammonia concentration and its effects on freshwater communities is highly variable; upper limits for suitability for aquatic life can range from 0.07 to 2.0 mg/L total ammonia (EPA) depending on temperature, pH, and species. All samples in this cluster were below 0.07 mg/L total ammonia. Potential sources of ammonia are wastewater treatment plants, agricultural run-off and direct contamination from animals.

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).