more inches of rain, making this the second wettest month in the state's history (The Pennsylvania State Climatologist, 2004; National Weather Service, 2005). The flooding occurred during the sampling for this subbasin report. The streams were allowed to subside before sampling resumed; however, the streams were still above normal flow, and many of the stream channels had been changed dramatically from scour and deposition. This flooding may have impacted the biological and habitat scores of streams sampled after these flooding events.

S. LeFevre

Photo at left: September Flooding of Juniata River and Crooked Creek from remnants of Hurricane Frances, Huntingdon, Pa.

Photo below: Confluence of Crooked Creek and Juniata River at normal flow, Huntingdon, Pa.

S. LeFevre

Methods Used in the 2004 Subbasin Survey

DATA COLLECTION

During the summer and fall of 2004, SRBC staff visited and collected samples from 101 sites throughout the Juniata River Subbasin. Appendix A contains a list with the sample site number, station name (designated by approximate stream mile), description of the sampling location, latitude and longitude, drainage in square miles, and subecoregion and drainage size category. Sites that also were sampled in 1995 are listed in blue with an asterisk. Sites that were sampled after the flooding in September are in bold print. Macroinvertebrate samples were taken at 81 sites. Staff could not sample 20 sites due to high water conditions. Habitat was rated at the sites where a macroinvertebrate sample was collected.

The sites were sampled once during this Year-1 sampling effort to provide a point-in-time picture of stream characteristics throughout the whole subbasin. Samples were collected using a slightly modified version of the USEPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (RBP III) (Barbour and others, 1999).

Water Quality

A portion of the water sample from each collection site was separated for laboratory analysis, and the rest of the sample was used for field analysis. A list of the field and laboratory parameters and their units is found in Table 2. Measurements of flow, water temperature, dissolved oxygen, pH, conductivity, alkalinity, and acidity were taken in the field. Flow was measured using standard U.S. Geological Survey methodology (Buchanan and Somers, 1969). Temperature was measured in degrees Celsius with a field thermometer. A Cole-Parmer Model 5996 meter was used to measure pH. Dissolved oxygen was measured with a YSI 55 meter, and conductivity was measured with a Cole-Parmer Model 1481 meter. Alkalinity was determined by titration of a known volume of sample water to pH 4.5 with

Table 2. *Water Quality Parameters Sampled in the Juniata Subbasin*

FIELD PARAMETERS	
Flow, instantaneous cfs[a]	Conductivity, µmhos/cm[c]
Temperature, °C	Alkalinity, mg/l
pH	Acidity, mg/l
Dissolved Oxygen, mg/l[b]	
LABORATORY ANALYSIS	
Alkalinity, mg/l	Total Magnesium, mg/l
Total Suspended Solids, mg/l	Total Sodium, mg/l
Total Nitrogen, mg/l	Chloride, mg/l
Nitrite - N, mg/l	Sulfate - IC, mg/l
Nitrate - N, mg/l	Total Iron, µg/l[e]
Turbidity, NTU[d]	Total Manganese, µg/l
Total Organic Carbon, mg/l	Total Aluminum, µg/l
Total Hardness, mg/l	Total Phosphorus, mg/l
Total Calcium, mg/l	Total Orthophosphate, mg/l

[a] cfs = cubic feet per second
[b] mg/l = milligram per liter
[c] µmhos/cm = micromhos per centimeter
[d] NTU = nephelometric turbidity units
[e] µg/l = micrograms per liter

0.02N H_2SO_4. Acidity was determined by titration of a known volume of sample water to pH 8.3 with 0.02N NaOH.

One 500-ml bottle and two 250-ml bottles of water were collected for laboratory analyses. One of the 250-ml bottles was acidified with nitric acid for metal analyses. The other 250-ml bottle was acidified with sulfuric acid for nutrient analyses. Samples were iced and shipped to the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Laboratories in Harrisburg, Pa.

Macroinvertebrates

Benthic macroinvertebrates (organisms that live on the stream bottom, including aquatic insects, crayfish, clams, snails, and worms) were collected using a modified version of RBP III (Barbour and others, 1999). Two kick-screen samples were obtained at each station by disturbing the substrate of representative riffle/run areas and collecting dislodged material with a one-meter-square 600-micron mesh screen. Each sample was preserved in 95 percent denatured ethyl alcohol and returned to SRBC's lab, where the sample was sorted into a subsample of at least 200 organisms. Organisms in the subsample were identified to genus, except for midges and aquatic worms, which were identified to family.

Table 3. *Water Quality Levels of Concern and References*

PARAMETERS	LIMITS	REFERENCE CODES
Temperature	>25 °C	a,f
D.O.	<4 mg/l	a,g
Conductivity	>800 µmhos/cm	d
pH	<5.0	c,f
Acidity	>20 mg/l	m
Alkalinity	<20 mg/l	a,g
TSS	>25 mg/l	h
Nitrogen	>1.0 mg/l	j
Nitrite-N	>0.06 mg/l	f,n,i
Nitrate-N	>1.0 mg/l	e,j
Turbidity	>150 NTU	h
Phosphorus	>0.1 mg/l	e,k
TOC	>10 mg/l	b
Hardness	>300 mg/l	e
Calcium	>100 mg/l	m
Magnesium	>35 mg/l	i
Sodium	>20 mg/l	i
Chloride	>250 mg/l	a
Sulfate	>250 mg/l	a
Iron	>1,500 µg/l	a
Manganese	>1,000 µg/l	a
Aluminum	>200 µg/l	c
Phos T Ortho	>0.05 mg/l	l,f,j,k

REFERENCE CODES/REFERENCE

a http://www.pacode.com/secure/data/025/chapter93/s93.7.html
b Hem (1970) - http://water.usgs.gov/pubs/wsp/wsp2254/
c Gagen and Sharpe (1987) and Baker and Schofield (1982)
d http://www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm
e http://www.uky.edu/WaterResources/Watershed/KRB_AR/krww_parameters.htm
f http://www.hach.com/h2ou/h2wtrqual.htm
g http://sites.state.pa.us/PA_Exec/Fish_Boat/education/catalog/pondstream.pdf
h http://www.epa.gov/waterscience/criteria/sediment/appendix3.pdf
i http://www.dec.state.ny.us/website/regs/part703.html
j* http://water.usgs.gov/pubs/circ/circ1225/images/table.html
k http://water.usgs.gov/nawqa/circ-1136/h6.html#NIT
l http://www.epa.gov/waterscience/criteria/goldbook.pdf
m based on archived data at SRBC
n http://srmwww.gov.bc.ca/risc/pubs/aquatic/interp/

** Background levels for natural streams*

Habitat

Habitat conditions were evaluated using a modified version of RBP III (Plafkin and others, 1989; Barbour and others, 1999). Physical stream characteristics relating to substrate, pool and riffle composition, shape of the channel, conditions of the banks, and the riparian zone were rated on a scale of 0-20, with 20 being optimal. Other observations were noted regarding weather, substrate material composition, surrounding land use, and any other relevant features in the watershed.

DATA ANALYSIS

Water quality was assessed by examining field and laboratory parameters that included nutrients, major ions, and metals (Table 2). The data collected were compared to water chemistry values that were at a level of concern based on current state and federal regulations, background levels for uninfluenced streams, or references for approximate tolerances of aquatic life (Table 3). Laboratory values were used when field and laboratory data existed for the same parameter. The difference between each value and the level of concern value from Table 3 was calculated for each site, and if the value did not exceed the level of concern value, the site was given a score of zero. If the level of concern value was exceeded, the difference was listed, and an average of all the parameters for each site was calculated. All sites that received a score of zero (no parameters exceeded the limits) were classified as "higher" quality. Sites that had a percentage value between zero and one were classified as "middle" quality, and sites that had a percentage value greater than one were classified as "lower" quality.

Six reference categories were created for macroinvertebrate and habitat data analysis based on drainage size, ecoregions, and subecoregions (Omernik, 1987; Omernik, 1992). All the sites were divided into small (< 100 square miles), medium (100 to 500 square miles), and large drainage areas (> 500 square miles). The small drainage areas were then grouped according to ecoregions and subecoregions. Based on the location of the sampling sites, the six reference categories used were 67a, 67b, 67c, 67d, 69a, and medium size drainage. None of the large drainage size area sites were sampled for macroinvertebrates due to the high flows after flooding.

Benthic macroinvertebrate samples were analyzed using seven metrics mainly derived from RBP III (Plafkin and others, 1989; Barbour and others, 1999): (1) taxonomic richness; (2) modified Hilsenhoff Biotic Index; (3) percent