

Aquatic Invertebrate Biological Assessments
Phases 1 & 2 - 2001



AQUATIC INVERTEBRATE BIOLOGICAL ASSESSMENTS

Phase 1, Interim Report, October 2001

BIOLOGICAL ASSESSMENT OF AQUATIC INVERTEBRATE COMMUNITIES OF STREAMS
TRIBUTARY TO THE EMSWORTH DAM POOL (PITTSBURGH POOL) ON THE OHIO,
ALLEGHENY, AND MONONGAHELA RIVERS, AND TO THE POOLS
OF DAMS #2 AND #3 ON THE MONONGAHELA RIVER

Prepared by:

Michael Koryak, Limnologist
Linda J. Stafford, Biologist
U.S. Army Corps of Engineers
Pittsburgh District
3 Rivers - 2nd Nature
Studio for Creative Inquiry
Carnegie Mellon University

For more information on the 3 Rivers – 2nd Nature Project, see <http://3r2n.cfa.cmu.edu>

If you believe that **ecologically healthy rivers are 2nd Nature** and would like to participate in a river dialogue about water quality, recreational use and biodiversity in the 3 Rivers Region, contact:

Tim Collins, Research Fellow
Director 3 Rivers - 2nd Nature Project
STUDIO for Creative Inquiry
412-268-3673
fax 268-2829
tcollins@andrew.cmu.edu

Copyright © 2002 – Studio for Creative Inquiry, Carnegie Mellon

All rights reserved

Published by the STUDIO for Creative Inquiry,
Rm 111, College of Fine Arts, Carnegie Mellon University
Pittsburgh PA 15213
412-268-3454
fax 268-2829
<http://www.cmu.edu/studio>

First Edition, First Printing

Co-Authors

Tim Collins, Editor

Partners in this Project

3 Rivers Wet Weather Incorporated (3RWW)
 Allegheny County Health Department (ACHD)
 Allegheny County Sanitary Authority (ALCOSAN)

3 Rivers - 2nd Nature Advisors
Reviewing this Project

John Arway	Chief Environmental Services, PA Fish and Boat Commission
Wilder Bancroft	Environmental Quality Manager, Allegheny County Health Dept.
Bob Bingham	Professor Art, Co-Director, STUDIO for Creative Inquiry, CMU
Don Berman	Environmental Consultant,
Jacqui Bonomo	V.P. Conservation Programs, Western Pennsylvania Conservancy
James Davidson	Laboratory Manager, Allegheny County Health Dept.
David Dzombak	Professor, Civil and Environmental Engineering, Carnegie Mellon
Mike Koryak	Limnologist, U.S. Army Corp of Engineers
Mary Kostalos	Professor Biology, Chatham College
Michael Lambert	Director Three Rivers Rowing
Edward Muller	Professor of History, University of Pittsburgh
Jan Oliver	Wet Weather Program Director, ALCOSAN
Beth O'Toole	Director, Pittsburgh Voyager
Tom Proch	Biologist, PA Department of Environmental Protection
John Schombert	Director 3 Rivers Wet Weather
Lisa Schroeder	Director, River Life Task Force
Dan Sentz	Environmental Planner, Pittsburgh Department of City Planning
Joel Tarr	Caliguiri Professor of History and Public Policy, Carnegie Mellon
Steve Tonsor	Professor of Biological Science, University of Pittsburgh
Davitt Woodwell	V.P. Pennsylvania Environmental Council
Jeanne Vanbriesen	Asst. Professor, Civil & Environmental

TABLE OF CONTENTS

Executive Summary

I.	Introduction	1
	A. Purpose of Study	1
	B. Authority	1
	C. Sponsors and Participants	1
	D. Tasks	2
	E. Water Quality in Urban/Suburban Areas	4
	F. Stations Locations	6
	G. Methods	7
II.	Results and Discussion	
	A. Chemical Results and Discussion	8
	B. Biological Results and Discussion	9
	1. Selection of Metrics and Reference Stations	9
	2. Condition Score Ranking	11
	3. Incidental Observations and Trends	13
	Additional Non-Quantitative Station Results	14
III.	Conclusions	
	A. Recommendations	16
	B. Additional Invertebrate Sampling Stations	16
	C. Fish Data Collection	16
	D. Data Analysis	17
	E. Information Sharing	18
	F. References	19
	G. Figure	21
	Figure 1. Results of Aquatic Bioassessments, Graph Showing Phase 1 Tentative Condition Scores @ the 35 Stations Sampled in Year 2001 Beginning with the Reference Station & Ending with the most Severely Impaired Station.	
	H. Tables	T1-1
	Table 1. Three Rivers – Second Nature, Aquatic Invertebrate Biological Assessment, List of Streams to be Sampled during Years 2001, 2002, and 2003	
	Table 2. Three Rivers-Second Nature, Biological Sampling Stations, May/June 2001.	
	Table 3. Three Rivers-Second Nature, Field and Laboratory Parameters Measured at each Station During the Phase 1 Bioassessment Survey of May/June 2001.	
	Table 4. Three Rivers-Second Nature, Aquatic Invertebrate, Rapid Biological Assessment Comparative Scoring, Phase 1.	

VIII.

Appendices:

A1-1

Appendix A. Three Rivers-Second Nature, Results of Chemical Field Measurement and Laboratory Analyses of Samples Collected During the Bioassessment Surveys May/June 2001.

Appendix B. Three Rivers-Second Nature, Results of Rapid Biological Assessments Sampling, May/June 2001.

Appendix C. Three Rivers-Second Nature, Biological Sampling, Incidental Field Observations.

Appendix D. Photographs of Bioassessment Stations Sampled in May/June 2001.

Executive Summary

Aquatic macroinvertebrate communities are sensitive indices of stream water quality and ecological health. In the first phase of a three-year effort to conduct invertebrate-based bioassessments of urban/suburban streams within Allegheny County Pennsylvania, chemical and invertebrate samples were collected during the spring of 2001 at 35 stations on 33 different streams. All of these stations were located near the mouths of streams tributary to the navigation pools of Emsworth Locks and Dam, Monongahela River Locks and Dam #2, and Monongahela River Locks and Dam #3.

Chemically, the study streams tended to be alkaline, hard, and mineralized. The mean values for pH, alkalinity, acidity, hardness, and conductivity were 7.79, 130.7 mg/l as CaCO₃, 8.9 mg/l as CaCO₃, 390.8 mg/l as CaCO₃, and 1215 uhmos/cm, respectively. Calcium concentrations averaged 109 mg/l and sodium 100 mg/l. Concentrations of ammonia and metals (especially iron and aluminum) were elevated at a number of stations. These parameters suggest widespread influences of alkaline: mill slag leachates, highway deicing salts, and sewage contamination, and, at some locations, acid mine drainage from bituminous coal mines (both strip and deep mines).

More than 15,000 invertebrate organisms from 67 different taxa were collected, identified, and enumerated at the 35 stations. Condition scores were then developed from the invertebrate data for each station, where a score greater than 80% indicates that a stream is non-impaired, 60-79% slightly impaired, 40-59% moderately impaired, and less than 39% severely impaired. All of the 35 stream stations examined were impaired to various degrees; 42.8% severely impaired, 37.2% moderately impaired, and 20% slightly impaired. While it is disappointing that there were no streams without measurable degradation, it is still encouraging that 20% of the streams examined were only slightly impaired, and that 37.2% were moderately impaired. The diversity of aquatic life found in these streams during the first phase of the 3R2N bioassessment exceeds what might have been expected from historical memories and impressions of these urban waterways as industrial waste conduits and/or open sewers. While no attempt was made to collect fish, they were incidentally collected during the invertebrate sampling at seven stations, and incidentally observed at eleven other stations. The seven streams that were only slightly impaired, and their condition scores, were: 1) Pine Creek, 71.3%; 2) Mingo Creek, 66.2%; 3) Dry Run, 66.2%; 4) Sandy Creek, 63.7%; 5) West Run, 62.0%; 6) Chartiers Creek, 61.3%; 7) and Guyasuta Run, 60.0%.

**THREE RIVERS-SECOND NATURE
AQUATIC INVERTEBRATE BIOLOGICAL ASSESSMENT**

Phase I

Interim Report

Biological Assessments of Aquatic Invertebrate Communities of Streams Tributary to the Emsworth Dam Pool (Pittsburgh Pool) on the Ohio, Allegheny, and Monongahela Rivers, and to the Pools of Dams #2 and #3 on the Monongahela River

I. Introduction

I.A. Purpose of Study

The purpose of this study is to support the Three Rivers-Second Nature (3R2N) initiative by performing invertebrate bioassessments of streams in Allegheny County, Pennsylvania. The assessments will be used to characterize and rank the water quality and health of the ecosystem of these streams. The general goals of the 3R2N initiative are to generate interest in protecting/restoring Allegheny County, Pennsylvania urban streams, including those that are buried and/or culverted, and their riparian corridors for multiple benefits.

I.B. Authority

The authority for U.S. Army Corps of Engineers participation in this study is Section 22 of the Water Resources Development Act of 1974 (Public Law 93-25 as amended). This statute authorizes the Corps of Engineers to assist states and local governments in the preparation of plans for the development, utilization, and conservation of water and related land resources, and for recovering cost shares of the program from non-federal entities.

I.C. Sponsors and Participants

The 3R2N initiative is a partnership between Carnegie Mellon University's STUDIO for Creative Inquiry and the Three Rivers Wet Weather Demonstration Project (TRWW). This initiative is supported by the Allegheny County Health Department (ACHD) and the Allegheny County Sanitary Authority (ALCOSAN). The Allegheny County Health Department is the Section 22 Study cost-sharing signatory. The TRWW project was established in 1997 to assist 51 communities in Allegheny County, Pennsylvania, currently under regulatory scrutiny to eliminate Sanitary Sewer Overflows (CSOs). The program has expanded to assist all 83 communities in the ALCOSAN service area by funding wet weather remediation projects.

Other members in the 3R2N Advisory Board and partnership include the Pittsburgh Water and Sewer Authority, Pittsburgh City Planning, The University of Pittsburgh, Chatham College, the Rocky Mountain Institute, and others. 3R2N has funding for five years from the Heinz Endowments and the Pittsburgh Foundation.

I.D. Tasks

This report was prepared by Michael Koryak, and Linda J. Stafford with the assistance of Rosemary J. Reilly and Paul Magnuson, all from the U.S. Army Corps of Engineers, Pittsburgh Districts Water Management Section. The basic tasks to be performed by the U.S. Army Corps of Engineers, Pittsburgh District, in support of the 3R2N effort, are to conduct rapid biological invertebrate-based assessments of at least 57 stream locations within, or which drain into, waters of Allegheny County, Pennsylvania. This data will then be used to characterize the quality of the study streams.

In addition to their intrinsic values and importance as food for fish and other forms of aquatic life and often non-aquatic life, benthic macroinvertebrate communities are also highly responsive indices of water quality. Macroinvertebrate quality evaluations are based on the principal that the invertebrate communities of non-degraded streams are composed of many different types of organisms, including pollution intolerant taxa such as mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera, or EPT organisms). The invertebrate communities of polluted streams, on the other hand, are dominated by a small number of pollution tolerant taxa such as sludge worms and bloodworms (Annelida and Chironomidae, or AC organisms). Between the extremes are numerous organisms with intermediate tolerances.

I.E. Reasons for Bioassessments

Bioassessments may be used within a planning and management framework to prioritize water problems for more stringent assessments and to document "environmental recovery" following control action. Some of the advantages of using biosurveys for this type of monitoring are:

- 1) Biological communities reflect overall ecological integrity (i.e., chemical, physical, and biological integrity). Therefore, biosurvey results directly assess the status of a waterbody relative to the primary goal of the Clean Water Act.
- 2) Biological communities integrate the effects of different pollutant stressors and thus provide a holistic measure of their aggregate impact. Communities also integrate the stresses over time and provide an ecological measure of fluctuating environmental conditions. Assessing the integrated variable pollutant inputs offers a particularly useful approach for monitoring non-point source impacts and the effectiveness of certain Best Management Practices.

- 3) Routine monitoring of biological communities can be relatively inexpensive, particularly when compared to the cost of assessing toxic pollutants, either chemically or with toxicity tests.
- 4) The status of biological communities is of direct interest to the public as a measure of a pollution free environment, while reductions in the chemical pollutant loadings are not as readily understood by the layman as positive environmental results.
- 5) Where criteria for specific ambient impacts do not exist, biological communities may be the only practical means of evaluation.

The advantages of using benthic macroinvertebrates for bioassessments are:

- 1) Macroinvertebrate communities are good indicators of localized conditions. Because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life, they are particularly well suited for assessing site-specific impacts (upstream-downstream studies).
- 2) Macroinvertebrate communities integrate the effects of short-term environmental variations. Most species have a complex life cycle of approximately one year or more. Sensitive life stages will respond quickly to stress, the overall community will respond more slowly.
- 3) Degraded conditions can often be detected by an experienced biologist with only a cursory examination of the macroinvertebrate community. Macroinvertebrates are relatively easy to identify to family; many "intolerant" taxa can be identified to lower taxonomic levels with ease.
- 4) Sampling is relatively easy, requires few people, inexpensive gear, and has no detrimental effect on the resident biota.
- 5) Benthic macroinvertebrates serve as a primary food source for many recreational and commercially important fish.
- 6) Benthic macroinvertebrates are abundant in most streams. Many small streams(1st and 2nd order), which naturally support a diverse macroinvertebrate fauna, only support limited fish fauna.
- 7) Most State water quality agencies that routinely collect biosurvey data focus on macroinvertebrates. Many states already have background macroinvertebrate data (OEPA, 1998).

I.F Water Quality in Urban/Suburban Areas

As the bioassessments will be utilized to characterize water quality and other aquatic ecosystem health parameters of Allegheny County streams, it is appropriate to provide some general and specific background on the water quality of streams that drain urban/suburban environments. The type and concentrations of compounds found in certain bodies of water are closely linked to land use in surrounding areas. In fact, water in urban settings seems to

have a characteristic chemical makeup or “signature” that is different than that found in agricultural or other settings. Chemical makeup correlates with the chemicals used in a setting, or watershed.

The U.S. Geological Survey’s National Water Quality Assessment (NAWQA) sampling of streams and shallow ground water in urban areas shows that:

- 1) Concentrations of total phosphorous are generally higher in urban streams than in other settings, commonly exceeding the U.S. Environmental Protection Agency’s desired goal to control excessive plant and algae growth
- 2) Insecticides occur at higher frequencies, and usually at higher concentrations in urban streams than in agricultural streams. Most common are diazinon, carbaryl, chlorpyrifos, and malathion.
- 3) Urban streams have the highest frequencies of occurrence of DDT (dichlorodiphenyltrichloroethane), chlordane, and dieldrin in fish and sediment, and the highest concentrations of chlordane and dieldrin. DDT is an insecticide that was commonly used in the United States until the early 1970s to control mosquitoes and other insects. Chlordane and aldrin (the parent compound that breaks down to dieldrin) were used widely until the late 1980s to control termites. Despite downward trends in some areas, these persistent organochlorine insecticides are still found at elevated levels in bed sediment and fish in urban streams throughout the United States.
- 4) Volatile organic compounds (VOCs), used in plastics, cleaning solvents, gasoline, and industrial operations, occur widely in urban ground water throughout the United States. At least one VOC was detected in 47 percent of wells sampled in urban areas. The four most frequently detected of the 60 measured VOC compounds are the industrial solvents trichloroethene, tetrachloroethene, the gas additive methyl tert-butyl ether (MTBE), and trichloromethane (also known as chloroform), which is a solvent and a byproduct of the disinfection of drinking water.
- 5) Concentrations of selected trace elements are also elevated in populated urban settings, most likely caused by emissions from industrial and municipal activities and the widespread use of motor vehicles. For example, streambed-sediment and reservoir-sediment samples collected from the Chattahoochee River Basin and analyzed for total lead and zinc concentrations indicate that population density, which is strongly related to traffic density, is a predictor of lead and zinc concentrations in the environment (Hirsch et al, 2001).

Locally, streams draining urban industrial portions of the Upper Ohio River Valley can suffer from a plethora of insults including: a legacy of polluted drainage from past mining and industrial activities; leakage of sanitary wastes from old and poorly maintained sewer systems; combined storm/sanitary sewer overflows (CSOs); shock loads of deicing chemicals from airports and highways following winter thaws; filling, channelization and culverting; dry-weather desiccation from extensive drainage activities; and sudden and violent storm surges from impervious urban surfaces that tend to down cut channels and degrade habitat. However, of these many urban/suburban insults, the influence of

mineralized (largely CaSO_4) alkaline leachates emerged in this study as a major and previously unappreciated, unique chemical "signature" of local urban drainage.

Cyclic sequences of Pennsylvanian sandstone, shale, and claystone, with thin beds of limestone and coal, are exposed in the study area. Local drainage from these formations is typically slightly acidic and moderately mineralized, yielding CaSO_4 dominated waters. Sams and Beer (2000) characterized the median SO_4 concentration of streams in the upper Ohio River drainage basin that are not underlain by coal at about 20 mg/l, with SO_4 yields of about ten tons/km²/yr. Much higher median annual concentrations and yields can occur, however, in coal mining areas.

In addition to minerals associated with the underlying Pennsylvanian geologic formations, various anthropogenic materials also influence the chemical composition of local urban runoff. These include extensive exposed cement surfaces, which can leach alkaline calcium salts. Also as a consequence of the industrial history of the region, steel mill slags were and continue to be frequently utilized as aggregates in cement and bituminous asphalt construction, as well as placement of highway shoulder berms, driveway and parking lot fills, and as a railroad grade ballast. Slag leachates are typically calcium sulfate dominated and often extremely alkaline (U.S. Army Corps of Engineers, 1989 and 2000). A commonly used alternative to slag for fills and aggregate in the region is crushed limestone (CaCO_3). All of these contribute to a strong alkaline and CaSO_4 dominated chemical fingerprint for urban drainage.

Another significant chemical signature of small urban/suburban streams with a high percentage of impervious areas in their watersheds is deicing salts. The study area is located in a highly dissected portion of the unglaciated Appalachian Plateaus Physiographic Province. Normal total annual precipitation is 37 inches, and the monthly normal is highest in July (3.6 inches) and lowest in February (2.4 inches). Average annual snowfall is 44 inches, and snow cover is subject to melting throughout the winter season. In other words, the study area is located in a very hilly "ice belt", where repeated and copious applications of deicing salts in the winter would be anticipated. Koryak (et al, 2001) demonstrated that winter season urban deicing salt runoff events in this region can produce salinity concentrations that can result in osmoregulatory stress for susceptible freshwater organisms.

I.G. Station Locations

Fifty-seven candidate streams to be sampled were tentatively selected and prioritized by the 3R2N team, of which 33 were sampled during Phase 1 of this study. While it is anticipated that this cursory list might be revised as the study progresses, at least 57 streams will be assessed. Streams selected for all phases of the study are listed in TABLE 1. Detailed descriptions of the 33 streams and 35 stations sampled in the Year 2001 phase of the study are provided in TABLE 2. Photographs of each sampling station reach are shown in APPENDIX D.

There are 35 stations listed for the 33 streams examined in 2001 because two stations were collected on two of the study streams. On Peters Creek, stations were sampled both upstream and downstream of the discharge of a wastewater treatment plant (WWTP). On Coal Bluff Run, stations were sampled upstream and downstream of a major source of acid mine drainage (AMD).

Station sampling reaches were located as near as possible to the mouths of the study streams, in areas upstream of backwater influences of the navigation dams, and with at least one stony riffle in each sampling reach. At a number of stations, finding suitable unculverted reaches upstream of backwater from the navigation pools forced us to locate stations at considerable distances upstream from the mouth of the study streams. Because of these criteria, the 3R2N bioassessment stations were not located in precisely the same stream reaches as the 3R2N tributary bacteriological stations, which were sampled in a separate study effort.

One exception to the "as close as possible to the mouth" criteria for selecting station locations is the Turtle Creek station. This station was located on Turtle Creek upstream of the confluence of Thompson Run, a large (17.9 sq. mile drainage area) tributary to Turtle Creek, to assess these two streams separately.

A potential source of confusion in the stream nomenclature is the fact that there are at least four different streams in Allegheny County that are called Thompson Run. Two of these streams were sampled in the 2001 bioassessment survey. As previously mentioned, one of them is a tributary of Turtle Creek, which was sampled at a station in the community of Turtle Creek. The second Thompson Run is a tributary of the Monongahela River that was sampled in Duquesne, Pennsylvania. Throughout the text and tables of this report, the two will be referred to as Thompson Run/Turtle Creek and Thompson Run/Duquesne. It is also important to make a distinction between two other streams with similar names, Pine Creek and Pine Run.

In addition to the 35 Phase 1 sampling stations (described in TABLE 2), at the request of the 3R2N team, an additional station on Sheraden Park Run, in the Sheraden area of the City of Pittsburgh was examined in 2001. The request to sample this very small stream came late in the summer of 2001, after it had almost dried-up. Since the unculverted, open reach of this stream was short, it was not possible to quantify the invertebrate community of the Sheraden Park station. However, some observations on the quality of this stream will be discussed in the "Results" Section of this report (Section II).

I.H. Methods

The benthic invertebrate analyses were conducted following protocol developed by the U.S. Environmental Protection Agency, as refined by the Ohio Environmental Protection Agency (OEPA), for stream quality Rapid Biological Assessments (RBAs), with appropriate modifications and adjustments to local conditions. Sensitive EPT

(Ephemeroptera, Plecoptera, and Tricoptera) organisms were identified to genus, and sometimes to species level, and tolerant AC (Annelida and Chironomidae) organisms to family taxonomic levels. Hilsenoff Family Biotic Indices (FBIs) and other metrics, as well as a condition score, were developed for each station. Additional information on the selection of metrics is discussed in the "Results" Section of this report (Section II).

To eliminate possible seasonal interference when comparing different stations or different years of data for the same station, collection of benthic invertebrate samples during the spring season (April-June) is preferred. Sampling early in the year also has the advantage of usually documenting the highest invertebrate diversity and productivity that will occur in a stream during the year.

Unless otherwise stated, the total biological sampling effort at each station was ten minutes (two samples, five minutes each). Station reach lengths and widths were measured and are reported in TABLE 2, along with related percentages of riffle/run versus pool segments at each station. Expediency drove the choice of sampling methodology. Hester-Dendy *in situ* sampling was not considered feasible due to the high probability of disturbance. Because so many of the streams sampled were very small and narrow with embedded substrates, rather than a kick net, surber samples with one-foot widths were used with an upstream movement kick net methodology, and hand, rather than foot disturbances were used at all stations to collect invertebrates. Areas of the stream substrate that were sampled station were estimated for each station, but numbers of organisms collected per sampling time period is probably a much better measure for comparison of relative standing crop.

Companion field measurements of water temperature, field pH, dissolved oxygen concentration, and specific conductance were measured at each station, and samples were collected for laboratory analyses. A list of the chemical parameters examined is presented in TABLE 3.

II. Results and Discussion

The results of chemical field measurements and laboratory analyses of samples collected during the 2001 phase of the bioassessment effort are presented in Appendix A. The raw invertebrate data collected during this phase is presented in Appendix B. Appendix C contains incidental field observations and notes made at the various stations during the field effort. These observations include: notes on vertebrates (i.e. fish, salamanders, and snakes, etc.) either incidentally collected or observed during the invertebrate sampling; the occurrence of obvious sewage problems evident by observations or odors; evidence of acid mine drainage or slag leachate impacts; and information provided by the public.

II.A. Chemical Results and Discussion

The chemical data in Appendix A characterizes the urban streams of the study area as alkaline, hard, and mineralized. For the 36 stations (the Sheraden Park Run station is included in the chemical analyses), field pH values ranged from pH 6.79 to 10.43, and averaged 7.79. The lowest pH was in Coal Bluff Run, downstream of a source of acid mine drainage. The most elevated pH was in Nine Mile Run, downstream of a large mill slag dump. Total alkalinity ranged from 7.3 to 224.9 mg/l as CaCO₃, and averaged 130.7 mg/l as CaCO₃. The lowest alkalinity was in Coal Bluff Run, downstream of a mine discharge. The highest alkalinity was measured in Perry Mill Run. Total acidity values ranged from 0 to 173.2 mg/l as CaCO₃, and averaged 8.9 mg/l as CaCO₃. Nine Mile Run and Turtle Creek both had zero acidities and the highest acidity measured was in Coal Bluff Run downstream of a mine discharge. Exclusive of this single value, the average acidity for the other 35 study streams was 4.1 mg/l as CaCO₃. Field conductivities ranged from 841 to 2265 uhmos/cm, and averaged 1215 uhmos/cm. The lowest value was measured on Mingo Creek and the highest on Pigeon Creek. Hardness values ranged from 207.8 to 688.7 mg/l as CaCO₃, and averaged 390.8 mg/l as CaCO₃. The lowest hardness was measured in Pine Creek and the highest in Coal Bluff Run downstream of the mine discharge.

These pH, alkalinity, conductivity, and hardness values would be considered very high in local nonurbanized streams, and are part of the local urban drainage chemical fingerprint. They are exceptionally elevated considering that the samples were collected during spring season flows when they might be expected to be seasonally low. Summer low-flow surveys of these streams would have probably resulted in even higher values.

Calcium concentrations ranged from 58 to 210 mg/l, and averaged 109 mg/l. Sodium concentrations ranged from 26 to 320 mg/l, and averaged 100 mg/l. The average calcium to sodium ratio was very low (1.09:1), indicating residual chemical influences from previous winter highway deicing activities over extensive portions of the stream drainage basins. Previous studies of highly urbanized local streams showed that Ca/Na ratios during dry weather could be less than one, whereas local streams with few paved road surfaces in their drainage basins could have Ca/Na ratios of over four (Koryak et al, 2001). Elevated ammonia concentrations at numerous streams are indicative of widespread impacts from sewage.

High concentrations of metals were evident at some stations. The most grossly metal polluted station was the one in the acid mine drainage influenced reach of Coal Bluff Run. Total iron, aluminum, nickel, zinc, and lead concentrations at this station were 78,000 ug/l, 7,500 ug/l, 130 ug/l, 170 ug/l, and 44 ug/l, respectively. It is not surprising that no macroscopic life forms were able to survive in this stream. It was also the only station where selenium (10 ug/l) was detected, and one of two stations where arsenic (21 ug/l) was found. The other stream, Sunfish Creek, was also significantly mine drainage polluted. At Sunfish Creek the arsenic concentration was 5 ug/l, which was barely above the detection level.

Concentrations of other metals were elevated in some study streams. The substrate of Sunfish Creek was covered with a thick orange sludge of iron oxides, and the iron concentration of its water was 24,000 ug/l. In certain areas of the streambed in Kelley Run, there were visible white aluminum oxide accumulations, and an aluminum concentration of 1,800 ug/l was measured there. Aluminum concentrations in Sheraden Park Run, Streets Run, Homestead Run, and Thompson Run/Duquesne were 1,700 ug/l, 1,600 ug/l, 1,300 ug/l, and 1,300 ug/l, respectively. Becketts Run, Streets Run, and Sheraden Park Run also had iron concentrations of 4,100 ug/l, 3,400 ug/l and 1,700 ug/l, respectively.

Metals were also collected from a high volume (300 gal/min.) spring discharge that entered Thompson Run/Duquesne immediately downstream of the biological station on this stream. The spring had a field pH of 11.62 and a field conductivity of 2561 uhmos/cm. It is notable that this spring also had positive detections of arsenic (27 ug/l) and selenium (20 ug/l).

II.B. Biological Results

II.B.1. Selection of Metrics and Reference Stations

In the development of the condition scores to rank the health of streams sampled, the choice of metrics to be used is critical. The Hilsenhoff Family Biotic Index (FBI), as well as most other metrics used by investigators who conduct aquatic invertebrate based rapid biological assessments, was developed to reflect the responses of invertebrate communities to sewage pollution and agricultural enrichment of streams. Sewage is certainly a problem in many Allegheny County streams, and is of great interest to 3R2N and its partners. However, the unique chemical fingerprints and highly unusual aquatic invertebrate communities of the local urban/suburban industrialized study area suggest that other metrics also be considered. The selection of alternate metrics that can be used to simultaneously quantify the influence of mixes of sewage, deicing salt runoff, acid mine drainage, and mineralized and highly alkaline urban/industrial leachates, is challenging. To meet this challenge, we have introduced three new metrics: percent EPT organisms exclusive of Baetidae mayflies; 2) total number of organisms collected; 3) and percent *Gammarus*.

Mayflies are sensitive water quality indicators, but not all mayfly nymphs are equally sensitive to the same pollution parameters. All local mayfly genera and species appear to be very sensitive to acid mine drainage, and typically none are found in streams with ambient pH values suppressed below pH 6 (Koryak, Stafford, Reilly, and Sykora, 1998). Relative to other mayflies, however, Baetidae nymphs are somewhat tolerant of organic pollution. In most cases this variable tolerance does not significantly influence or unbalance invertebrate community assessments, and Baetidae are typically included as EPT organisms. Locally, the situation is much different, and a number of mineralized and extremely alkaline streams are swarming with Baetidae mayfly nymphs. While this group is sensitive to acidic conditions, and relatively tolerant of organic pollution, they are apparently highly tolerant of very alkaline waters and can overwhelmingly dominate the invertebrate communities of such stressed waters. Therefore, we feel that a percent EPT organisms exclusive of Baetidae metric is highly appropriate for assessing and ranking of local urban streams. Chambers and Messinger (2001) apparently came to the same conclusion and used such a metric to assess the urban/industrial waters of the Kanawha River Basin.

In reference to the second of the three new metrics, organic pollution usually results in low diversity, but large numbers of A/C organisms. Therefore, large total numbers of organisms are typically equated with degradation. In our study area, however, low numbers of all organisms in very stressed streams was a major problem. In one stream downstream of an acid mine drainage discharge, Coal Bluff Run, there was no macroscopic life. Therefore, it is appropriate in this study to introduce a metric that places a positive value on standing crop.

The third new metric is percent of the crustacean *Gammarus*. Like Baetidae mayflies, *Gammarus* are not normally considered to be highly pollution tolerant organisms. But as with Baetidae, they can dominate the community of very alkaline local urban drainages. At one station sampled in 2001, Tasse Hollow, *Gammarus* was the only invertebrate collected. The collection rate there was over 130 individuals per minute. Therefore, a negatively rated *Gammarus* metric is also an appropriate metric to assess the health of local urban streams. In this analysis, the percent of all non-crustacean organisms was used as a metric.

The metrics used to develop the condition scores for the examined streams were 1.) taxa richness as a percent of the reference station, 2.) total number of organisms as a percent of the reference station, 3.) % EPT organisms, 4.) % non-AC organisms, 5.) % EPT organism exclusive of Baetidae mayflies, 6.) % non-crustacean organisms and 7.) modified Hilsenoff Family Biotic Index as a percent of the reference station. Other metrics, such as Shannon-Weaver Diversity Indices, were developed but not utilized for scoring in this initial phase of the study. Alternate scoring metrics may be considered in later phases of the study.

The selection of reference stations is another important decision that can influence the results of invertebrate RBA scores. Comparison with a non-impaired, high quality reference stream in the same ecoregion is necessary. In this study, however, in order to generate reasonable standards and realistic goals, rather than holding up a pristine stream of the unglaciated Appalachian Plateaus as a standard, it would be appropriate to consider the urban/suburban

environment of the Allegheny County portion of the upper Ohio River drainage basin as a distinct ecoregion, and to utilize a stream of this ecoregion as a reference. Because Pine Creek was unique in this set of stations as being classified as "Approved Trout Waters" by the Pennsylvania Fish and Boat Commission, and had a relatively healthy invertebrate community, Pine Creek was selected as an urban/suburban stream reference station.

II.B.2. Condition Score Ranking

Invertebrate community metrics and condition scores for the 35 stream stations examined in the year 2001, phase 1 of the study are shown, compared, and ranked on TABLE 4. Figure 1 is a bar graph ranking of the condition scores of the study streams. A score greater than 80% indicates that a stream is non-impaired, 60-79% slightly impaired, 40-59% moderately impaired, and less than 40% severely impaired. All of the 35 streams stations examined were impaired to various degrees; 42.8% severely impaired, 37.2% moderately impaired, and 20% slightly impaired. Assigning a score of zero to Coal Bluff Run downstream of a source of acid mine drainage, where it did not support any invertebrate aquatic life, condition scores ranged from a high of 71.3% for Pine Creek to a low of 0.0% for lower Coal Bluff Run. The average condition score was 45.1%, where any score below 39% is considered to be severely degraded.

Acid mine drainage has been identified as the single most severe source of water quality degradation in the region. It is not unexpected then that the Coal Bluff Run station sampled downstream of a large mine discharge was the most severely degraded stream assessed during this phase of the study. Upstream of this source Coal Bluff Run only had a condition score of 37.9%. Nevertheless, it supported nine different taxa of aquatic invertebrates, and salamanders were observed in the stream. Downstream of the confluence of the coal mine discharge, there was no macroscopic life in Coal Bluff Run. In contrast, the discharge from a large, but apparently efficient wastewater treatment plant (WWTP) on Peters Creek, had only a minor negative impact on the benthic macroinvertebrate community of Peters Creek. Downstream of the WWTP, the invertebrate community condition score of Peters Creek only decreased from 48.9% to 45.0%.

II.B.3. Interpretation of Condition Scores

Comparisons with the results of other urban stream studies contribute to the interpretation of the results of this first phase Allegheny County, Pennsylvania bioassessment of urban streams. Probably the most powerful and pertinent data comes from nearby urban communities in Ohio.

Yoder and Rankin (1996) performed bioassessments of 110 sites in urban and suburban locations in Ohio. They used both fish and invertebrate assessments relative to non-impaired high quality streams. Forty-six sites (42%) reflected poor or very poor performances. Of the sites classified as being impacted by urban land use and pollution sources, only two sites attained the applicable biocriterion. Poor or very poor performance was reflected by the

majority of the urban impacted sites (85%). More than 40% of the suburban sites were impaired with many of these reflecting the impact of new developments for housing and commercial uses. The severity of biological impairments within urban areas was also influenced by stream size, as measured by watershed area, with the most severe effects occurring in watershed areas less than 20 square miles.

They concluded that CSOs are a major source of impairment in urban watersheds. Besides contributing raw sewage, CSOs can also include industrial wastewater that is discharged into the sewer system. Also, in many urban settings in Ohio, concentrations of chemicals in bottom sediments are frequently elevated compared to concentrations measured at site-specific control or regional reference sites. Contaminated sediments generally result from releases that enter the aquatic environment during regular and episodic releases from point sources (including CSOs and storm sewers) and/or periodic runoff events from urban non-point sources. A correspondence between increased sediment concentrations of heavy metals and decreased aquatic community performance was demonstrated.

In the interpretation of the results of this investigation of Allegheny County streams, it is important to maintain in perspective that the study was intended to be only an initial and very cursory assessment of the quality of local urban streams. There were very significant temporal and spatial limitations to the effort. Identification of higher quality reaches of these streams, or of specific sources of sanitary sewage, CSO, mine drainage, slag leachate or other insults to the study streams, would require a larger sampling station network than was employed in this assessment. The number of stations necessary would largely be a function of the size of the drainage area of the individual study streams, the complexity of land use patterns within each drainage basin, and the goals of the investigation. Also, while the results of invertebrate community sampling tends to integrate stresses over time, there are still seasonal impacts to water quality and biological communities. These include but are not limited to cold weather highway deicing salt runoff, and warm weather anoxia and elevated ammonia concentrations. These would best be documented by seasonal sampling.

With two exceptions, in this study only one chemical data set and one biological sample were collected from only one station near the mouth of each of 33 study streams. The two exceptions were Peters Creek where a station was also sampled upstream of a WWTP effluent, and Coal Bluff Run where a station was also sampled upstream of a large abandon coal mine discharge. The extra station on Coal Bluff Run definitely demonstrated that the coal mine drainage discharge totally decimated aquatic life in a short lower reach of the stream. Comparison of the results of the samples collected at the two stations on Peters Creek did not show any significant adverse impact downstream from the WWTP effluent. However, these single late spring sample results do not rule out the possibility that chlorination of the treated sewage discharged by the WWTP might have a measurable toxic influence on Peters Creek during other conditions. For instance, chlorine is less reactive and more persistent in cold water, and during cold weather low flow conditions more serious impacts to Peters Creek from chlorinated WWTP discharges might be anticipated.

II.B.4. Incidental Observations and Trends

Among the incidental observations listed in Appendix C is the presence of various vertebrates in the study streams. While no attempt was made to collect fish during the invertebrate survey, some fish were nonetheless incidentally captured in the invertebrate sampling nets at seven stations, and observed at an additional eleven stations (total 18 stations). Greenside darters and creek chubs were both captured at two stations, and blacknose dace at six stations. Observed fish were mostly large carp and schools of small unidentified fishes. Northern hog sucker were also present at the Pine Creek station. Electrofishing surveys of these streams would most certainly document the presence of numerous other species of fish.

Other vertebrates captured were northern dusky salamanders. Several gilled larval salamanders, which were likely larvae of spring salamanders, were also collected at Guyasuta Run. A northern water snake and a queen snake were both captured in the invertebrate sampling nets in Kelley Run. Muskrat and beaver signs were apparent at some stations. While no record was kept of birds observed, a number of kingfishers, Louisiana waterthrushes, warbling vireos, yellow warblers, mallard ducks and other water-associated birds were seen and/or heard. While casual, these incidental observations indicate that the small urban streams of the study area can potentially support a variety of interesting and valuable fish and wildlife species.

The wide range of invertebrate condition scores developed from the year 2001 data begs questions about trends. Unfortunately, the biology of small urban waterways has, in the past, been almost categorically ignored by researchers, and there is very little in the way of historical biological data available for quantitative comparisons. There is a general impression among the numerous local residents who spoke to the sampling crew, however, that the quality of these streams is improving, and some anecdotal evidence and a few scattered pieces of data support such optimistic speculations. One such anecdote was offered by a resident of the lower Crooked Run Valley. He said that he had lived along Crooked Run all of his life, and that he was certain that the small fish now swimming in this stream only first showed up there in 1999. Similarly, the sampling crew had previously collected Surber invertebrate samples from Thompson Run in Turtle Creek in the 1980's, and, at that time, found only a dense carpet of sludge worms inhabiting this grossly sewage polluted stream reach. In sharp contrast, in 2001, the Thompson Run/Turtle Creek station was found to support an aquatic invertebrate community of twelve different taxa. Oligochaeta aquatic worms, (which formerly overwhelmingly dominated the invertebrate community), were less than one percent of the 2001 sample, and numerous fish were swimming in the stream. As we were departing this station, three boys showed up with fishing rods and set up to fish in a scour pool below a drop structure in the stream. These observations suggest that substantial improvements in the water quality of the small urban stream of the study have occurred in recent years.

II.B.5 Additional Non-Quantitative Station Results

Additional stations examined at the request of the 3R2N team, but which were too small to sample quantitatively, were Heaths Run and Sheraden Park Run. Heaths Run in the Highland Park area was examined on

May 11, 2001 as a potential stream sampling location. However, only a very small headwater tributary of this stream was not culverted. This reach was upstream of the City of Pittsburgh's Public Yard Debris Drop-off, and the flow in this very short unculverted reach appeared to be maintained mostly by leakage from a sewerline. The invertebrate community of this reach was examined and found to be composed of flatworms, oligochaeta worms, leeches, and air breathing snails typically associated with sewage polluted waters.

The Sheraden Park site was not visited until July 18, 2001, after the flow of smaller local streams had been severely diminished by a period of very dry weather. A length of stream with some water pooled, but no apparent flow, was found and examined. Only three tolerant taxa of invertebrates were found along a 50 foot-long, 1.1 foot-wide length of stream where there was still water in the channel before this stream channel entered a culvert. The invertebrate community of this stream was limited to *Gammarus* and planaria, with a few aquatic sowbugs. Crayfish burrows were apparent, but no crayfish were collected. Many aquatic invertebrates emerge before the dry season, and others can burrow into the substrate when flows are low in small streams. Re-examination of this station during the spring season might produce a more biologically diverse sample.

III. Conclusions

Chemically, the study streams tended to be alkaline, hard, and mineralized. The mean values for pH, alkalinity, acidity, hardness, and conductivity were 7.79, 130.7 mg/l as CaCO₃, 8.9 mg/l as CaCO₃, 390.8 mg/l as CaCO₃, and 1215 uhmos/cm, respectively. Calcium concentrations averaged 109 mg/l, and sodium 100 mg/l. Concentrations of ammonia and metals (especially iron and aluminum) were elevated at a number of stations. These parameters are fingerprints of widespread influence of alkaline mill slag leachates, highway deicing salts, and sewage contamination, and, at some locations, acid mine drainage from bituminous coal mines.

More than 15,000 invertebrate organisms from 67 different taxa were collected, identified and enumerated at the 35 stations. Condition scores were then developed from the invertebrate data for each station where a score greater than 80% indicates that a stream is non-impaired, 60-79% slightly impaired, 40-59% moderately impaired, and less than 39% severely impaired. Scoring matrix and condition scores are shown in TABLE 4. All of the 35 stream stations examined were impaired to various degrees; 42.8% severely impaired, 37.2% moderately impaired, and 20% slightly impaired. While it is disappointing that there were no streams without measurable degradation, it is still encouraging that 20% of the streams examined were only slightly impaired, and that 37.2% were moderately impaired. The diversity of aquatic life found in these streams during the first phase of the 3R2N bioassessment exceeds what might have been expected from historical memories and impressions of these urban waterways as industrial waste conduits and/or open sewers. While no attempt was made to collect fish, they were incidentally collected during the invertebrate sampling at seven stations, and incidentally observed at eleven other stations.

The seven streams that were only slightly impaired, and their condition scores, were: 1) Pine Creek, 71.3%; 2) Mingo Creek, 66.2%; 3) Dry Run, 66.2%; 4) Sandy Creek, 63.7%; 5) West Run, 62.0%; 6) Chartiers Creek, 61.3%; 7) and Guyasuta Run, 60.0%. The seven most severely impaired streams were: 1.) Coal Bluff Run downstream of the AMD source (0.0%); 2.) Sunfish Run (26.2%); 3.) Thompson Run/Duquesne (26.6%); 4.) Pine Run (27.9%); 5.) Crooked Run (31.0%) Nine Mile Run (31.3%); 6.); and 7.) Turtle Creek (33.1%).

Family Biotic Index (FBI) scores, which tend to emphasize the impacts of simple sewage pollution, showed somewhat different ranking. The lowest FBI scores (highest quality) were 5.39 for Sandy Creek, and 5.51 for both Mingo Creek and Guyasuta Run. Excluding the Coal Bluff Run AMD station, the highest FBI scores (lowest quality) were 9.31 for Sawmill Run, 8.39 for Fallen Timber Run, and 7.13 for Crooked Run.

IV. Recommendations

IV.A. Additional Invertebrate Sampling Stations

3R2N has expressed an interest in expanding the original limited objectives of the program, which was to conduct initial biological assessments of the quality of the urban/suburban streams of Allegheny County, Pennsylvania. In addition to assessing and ranking the quality of these streams near their points of confluence with the Allegheny, Monongahela, and Ohio Rivers (as was performed for 33 streams in Phase 1 of the effort), in later phases of the study, they believe that there would be very considerable value to also assess the quality of the reaches of these streams at other additional locations within their respective drainage basins. They would like the program to be able to both identify potential higher quality tributaries and/or stream reaches within the watershed of the streams, and to document locations where serious degradation occurs. The purpose for documenting specific sources of stress and their impacts to the biological communities would be to identify and prioritize potential remediation actions. Therefore, it is recommended that the 3R2N team meet to develop a plan for conducting additional bioassessments in later phases of this study.

Implementation of a study to achieve these goals would probably involve, at a minimum, establishing stations on: 1) various headwater reaches of each stream; 2) all perennial tributaries of the study streams; 3) locations upstream and downstream of known potential problem sources, such as CSOs, slag dumps, and coal mine and chlorinated WWTP discharges; and 4) allowing the flexibility to sample at other locations where unanticipated sources of pollution might be discovered in the investigation process. The approximate total number of stations necessary to achieve these expanded goals would have to be determined by the 3R2N team planning effort, but probably, at a minimum it would require the establishment of a network of about 250 stations to reasonably approach satisfaction of the expanded objectives.

IV.B. Fish Data Collection

Incidental observations during the spring 2001 aquatic invertebrate assessment field surveys of local urban/suburban streams demonstrated that many of the streams now support resident fish life (APPENDIX C). Also, even when resident fish communities of local degraded streams are depauperate, reaches with access can nonetheless be routinely used by transient species from the nearby navigation system (Reference 9). Like invertebrates, fish can be used to assess stream quality. In addition, fish are familiar organisms, which are of great interest to the general public, and their status is more easily understood by layman as an index of quality. Therefore, it is recommended that the 3R2N bioassessment be augmented with fish data.

The advantages of using fish for bioassessment are (Reference 9):

1. Because they are relatively long-lived and mobile, fish are good indicators of long-term (several year) effects and broad habitat conditions.
2. Fish communities generally include a range of species that represent a variety of trophic levels (omnivores, herbivores, insectivores planktivores, piscivores). They tend to integrate effects of lower trophic levels; thus, fish community structure is reflective of integrated environmental health.
3. Fish are the top of the aquatic food chain and are consumed by humans, making them important subjects in assessing contamination.
4. Fish are relatively easy to collect and identify to the species level. Most specimens can be sorted and identified in the field and released unharmed.
 - Environmental requirements of common fish are comparatively well known.
 - Life history information is extensive for most species.
 - Information on fish distribution is commonly available.
5. Aquatic life uses (water quality standards) are typically characterized in terms of fisheries (coldwater, coolwater, warmwater, sports, forage)
 - Monitoring fish communities provides direct evaluation of "fishability", which emphasizes the importance of fish to anglers.
6. Fish account for nearly half of the endangered vertebrate species and subspecies in the United States.

Short-reach, single pass, backpack electrofishing samples of numerous small streams could be performed quickly and economically, and still provide a rough baseline characterization of the status of these fishery resources. Only a few of the larger study streams like Chartiers Creek and perhaps Turtle Creek might require a different sampling technique. Since sampling of these larger streams, which would be most appropriately performed by boat electrofishing, would involve increased time and cost to assess, 3R2N might wish to limit this effort to the smaller study streams.

IV.C. Data Analysis

As the database grows in subsequent study phases, biological community metrics which were initially used to analyze the results should be refined, and other analyses should also be employed. One example of an additional analytical approach would be to look for correlations between bioassessment condition scores and the percentage of impervious urban surface cover within each study watershed. CMU staff is now in the process of building a GIS database for the study area, which will include impervious land use areas in the watersheds of the study streams. When both the bioassessment and GIS work have been completed, there will be an excellent opportunity to intensify the analysis and interpretation of the data.

In regard to the chemical data collected, it would be tempting to try to correlate invertebrate condition scores developed during this study to the companion chemical data which was collected at each station along with the invertebrate samples. However the single companion chemical data set per station is limited because it does not reflect the high degree of fluctuation and aquatic life limiting extremes of the chemical parameters that would be expected to occur in response to seasonal and hydrologic variations. Therefore, except where obviously high concentrations of pollutants were detected, it is cautioned that considerable prudence be exercised in the interpretation of the companion chemical data. This data was collected only to provide a rough background characterization of the water chemistries of the study streams and, to provide direction for more intense monitoring activities in the future, as deemed appropriate.

IV.D. Information Sharing

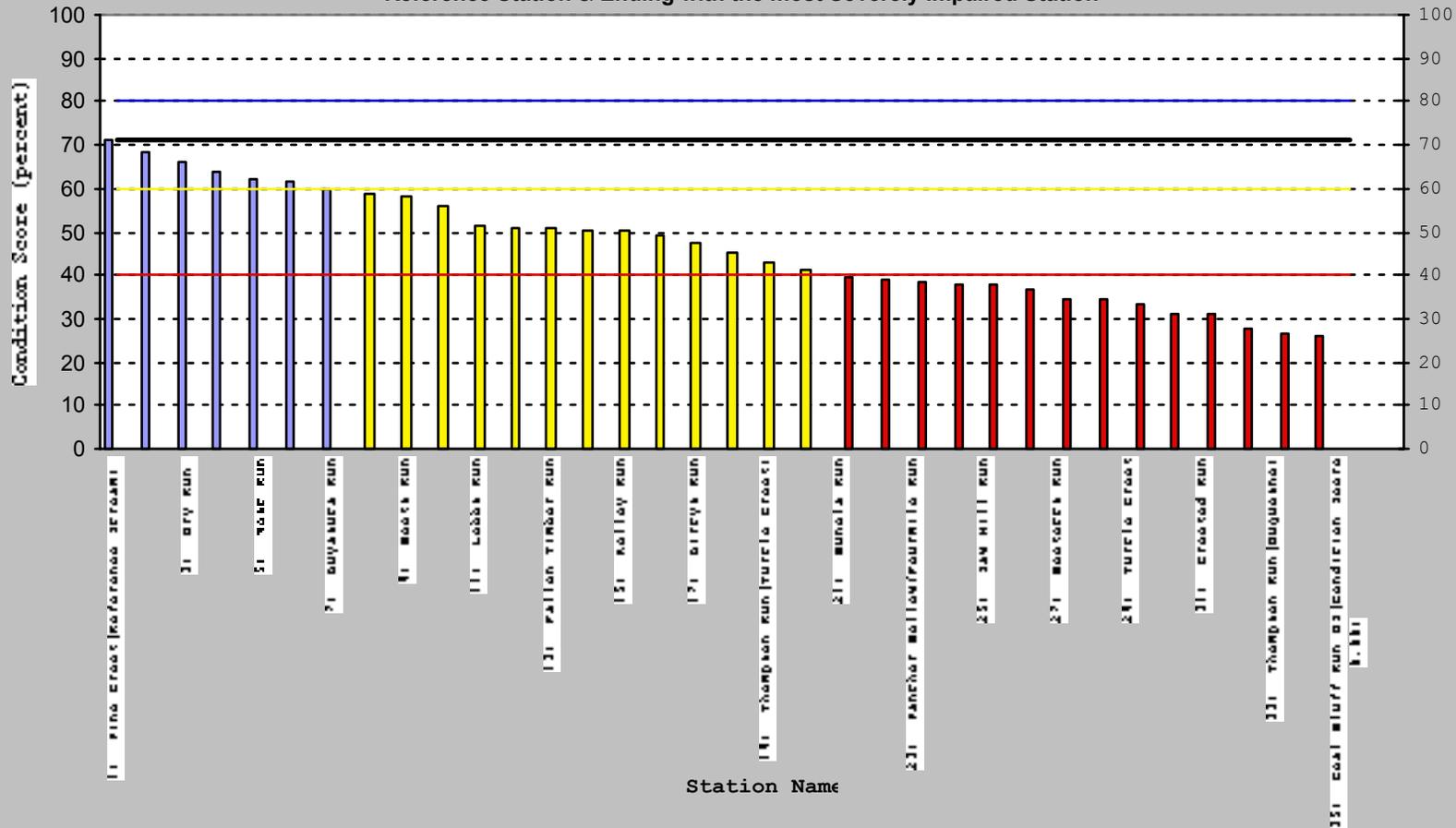
Opportunities to share the results of this study with the general public, local governments, and the scientific community should be pursued. One such timely opportunity to share this information would be to present a paper or poster presentation on the results at the 50th annual meeting of the North America Benthological Society, to be held in Pittsburgh in May of 2002. The focus of the society is stream and river science and ecology, with an emphasis on macroinvertebrates. As many as 1,000 scientists and students are expected to attend the Pittsburgh meeting. The meeting is to be hosted by the Pennsylvania Department of Environmental Protection, the Pennsylvania Fish and Boat Commission, Carnegie Museum, Duquesne University, and Pittsburgh Voyager.

REFERENCES

1. Collins T., D. Dzombak, J. Rawlins, K. Tamminga, S. Thompson, et al, 1998. Nine Mile Run Watershed Rivers Conservation Plan, City of Pittsburgh, Carnegie Mellon University, Carnegie Museum of Natural History, Pennsylvania State University.
2. Chambers, D.B., and T. Messinger. 2001. Benthic Invertebrate Communities and Their Responses to Selected Environmental Factors in the Kanawha River Basin, West Virginia, Virginia, and North Carolina. National Water Quality Assessment Program, Water Resources Investigation Report 01-4021. U.S. Department of the Interior, U.S. Geological Survey, Charleston, WV.
3. Edwards, G.M., P.E. Tennant and J.T. Lyons. 1998. Evaluation of Wet Weather Pollution Sources on Large Rivers Utilizing Biological Communities.
4. Hirsch, R.M., T.L. Miller, and P.A. Hamilton. 2001. Using Today's Science for Tomorrow's Water Policies. *Environment* 43(1):2-11.
5. Koryak, M., M.A. Shapiro, and J.L. Sykora. 1972. Riffle Zoobenthos in Streams Receiving Acid Mine Drainage. *Water Resources* 6: 1239-1247.
6. Koryak, Michael, Linda J. Stafford, Rosemary J. Reilly, and J.L. Sykora. 1998. Aquatic Insect Communities within the Drainage Basin of a Pennsylvania River Impacted by Acid Mine Drainage (1998). In Book of Abstracts, 6th European Congress of Entomology (Brunnhofner V. and Soldan T. eds.) August 23-29, 1998, Ceske' Budejovice, Czech Republic. Institute of Entomology of Academy of Sciences, University of South Bohemia, Czech Entomological Society.
7. Koryak, M., L.J. Stafford, R.J. Reilly, R.H. Hoskins, and M.H. Haberman. 1998. The Impact of Airport Deicing Runoff on Water Quality and Aquatic Life in a Pennsylvania Stream. *Journal of Freshwater Ecology*. 13(3):287-298.
8. Koryak, M., L.J. Stafford, R.J. Reilly, and M.P. Magnuson. 2001. Highway Deicing Salt Runoff Events and Major Ion Concentrations along a Small Urban Stream. *Journal of Freshwater Ecology*. 16(1):125-135.
9. Koryak, M., R.H. Hoskin, R.J. Reilly, and L.J. Stafford. 2001. The Impact of Above Grade Sewerline Crossings on the Distribution and Abundance of Fishes in Recovering Small Urban Streams of the Upper Ohio River Valley. *Journal of Freshwater Ecology*. 16(4): 591-598.

10. Ohio Environmental Protection Agency. 1988. Biological Criteria for the Protection of Aquatic Life: Volume II: Users Manual for Biological Field Assessment of Ohio Surface Waters. Ohio Environmental Protection Agency, Ecological Assessment Section, Division of Water Quality, Columbus, OH.
11. Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.
12. Sams, J.I. and K.M. Beer. 2000. Effects of Coal-Mine Drainage on Stream Water Quality in the Allegheny and Monongahela River Basins- Sulfate Transport and Trends. 99-4208, U.S. Geological Survey. National Water Quality Assessment Program, Lemoyne, PA.
13. U.S. Army Corps of Engineers. 2000. Nine Mile Run, Allegheny County, Pennsylvania, Aquatic Ecosystem Restoration, Water Quality and Aquatic Life. U.S. Army Engineer District Pittsburgh, Corps of Engineers, Pittsburgh, PA.
14. U.S. Army Corps of Engineers. 1989. Steel Mill Slag Leachate Characteristics and Environmental Suitability for use as a Streambank Protection Material. U.S. Army Engineer District Pittsburgh, Corps of Engineers, Pittsburgh, PA.
15. U.S. Army Corps of Engineers. 1987. Turtle Creek Local Protection Project, Allegheny County, Pennsylvania, Reconnaissance Report on Water and Sediment Quality and Aquatic Life Resources Pertinent to Major Rehabilitation of the Flood Reduction Channel. U.S. Army Corps of Engineers, Pittsburgh, PA.
16. Yoder, C.O., R.J. Miltner, and D. White. 2000. Using Biological Criteria to Assess and Classify Urban Streams and Develop Improved Landscape Indicators. pp. 32-34. In S. Minamyer, J. Dye, and S. Wilson(eds), National Conference on Tools for Urban Water Resources Management and Protection. U.S. EPA, Office of Resource Development, Cincinnati, OH. EPA/625/R-00/001.
17. Yoder, C.O. and E.T. Rankin. 1996. Assessing the Condition and Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds, pp. 201-227. *in* Roesner, L.A.(ed). Effects of Watershed Development and Management on Aquatic Ecosystems, American Society of Civil Engineers, New York, NY

Figure 1
Results of Aquatic Invertebrate Bioassessments
Graph Showing Phase 1 Tentative Condition Scores @ the 35 Stations Sampled in Year 2001 Beginning with the Reference Station & Ending with the most Severely Impaired Station



■ Bar Graph Showing Condition Score of Slightly Impaired Stream @ Sampling Station
■ Bar Graph Showing Condition Score of Moderately Impaired Stream @ Sampling Station
■ Bar Graph Showing Condition Score of Severely Impaired Stream @ Sampling Station
 Value of Reference Station (71.3%)
— Line Separating Slightly & Non-impaired Streams (No Stream in Survey was Rated Non-Impaired)

TABLE 1
THREE RIVERS-SECOND NATURE
AQUATIC INVERTEBRATE BIOLOGICAL ASSESSMENT
LIST OF STREAMS TO BE SAMPLED
DURING YEARS 2001, 2002, AND 2003

PHASE 1 YEAR 2001		PHASE 2 YEAR 2002	PHASE 3 YEAR 2003
Tributaries to the Pittsburgh Pool (Emsworth L/D Pool)	Tributaries to the Monongahela River (L/D #2 Pool RM 11-35)	Tributaries to the Allegheny River (L/D #2, Pool RM 5.5-28)	Tributaries to the Ohio River (RM 6.2-15.5)
1) Saw Mill Run	1) Turtle Creek	Squaw Run	Loweries Run
2) Chartiers Creek	2) Thompson Run (Turtle Creek)	Shoops Run	Little Sewickley Creek
3 Girtys Run	3) Thompson Run (Duquesne)	Bailey Run	Flaugherty Run
4) Pine Creek	4) Crooked Run	Plum Creek	Big Sewickley Creek
5) Sipes Run	5) Sandy Creek	Powers Run	Toms Run
6) Guyasuta Run	6) Pine Run	Riddle Run	McCabe Run
7) Panther Hollow (Fourmile Run)	7) Peters Creek	Bull Creek	Narrows Run
8) Becks Run	8) Wylie Run	Quigley Creek	Montour Run
9) Glass Run	9) Fallen Timber Run	Deer Creek	Kilbuck Run
10) Streets Run	10) Lobbs Run	Crawford Run	Shouse Run
11) West Run	11) Perry Mill Run	Big Pucketa Creek	Thorn Run
12) Nine Mile Run	12) Kelley Run	Sandy Ck	Moon Run
13) Homestead Run	13) Bunola Run	Unidentified Creek #1	
14) Tasseey Hollow	14) Coal Bluff Run	Unidentified Creek #2	
	15) Mingo Creek		
	16) Dry Run		
	17) Pigeon Creek		
	18) Sunfish Run		
	19) Becketts Run		

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		SAWMILL RUN	CHARTIERS CREEK	GIRTYS RUN	PINE CREEK	SIPES RUN	GUYASUTA RUN
TRIBUTARY TO		OHIO RIVER, LEFT BANK, RIVER MILE 0.8	OHIO RIVER, LEFT BANK, RIVER MILE 2.6	ALLEGHENY RIVER, RIGHT BANK, RIVER MILE 3.5	ALLEGHENY RIVER, RIGHT BANK, RIVER MILE 4.7	ALLEGHENY RIVER, RIGHT BANK, RIVER MILE 6.1	ALLEGHENY RIVER, RIGHT BANK, RIVER MILE 6.6
TOTAL DRAINAGE AREA *(mi ²)		19.4	277	13.4	67.3		0.98
STATION LOCATION		WEST END IN PITTSBURGH, PA	ABOVE WINDGAP BRIDGE IN KENNEDY TWP/ PITTSBURGH, PA	MILLVALE, PA	ETNA, PA	SHARPSBURG, PA	SHARPSBURG, PA
STATION NUMBER		0012	0014	0010	0006	0008	0004
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM	48.1	108.0	21.6		14.8	11.4
	MINIMUM	34.2	96.0	12.4		5.9	4.2
	MEAN	41.1	102.0	21.1		10.9	7.1
LENGTH OF STATION AND SAMPLING TIME	LENGTH (ft)	97	75	195	198	188	219
	RIFFLE/RUN (%)	100	100	75	70	70	80
	POOL (%)	0	0	25	30	30	20
	TIME (MIN)	10	10	10	10	10	10
STATION COORDINATES	LATITUDE						
	LONGITUDE						

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		PANTHER HOLLOW/ FOURMILE RUN	BECKS RUN	STREETS RUN	GLASS RUN	WEST RUN	NINE MILE RUN
TRIBUTARY TO		MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 3.4 (?)	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 4.5	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 6.0	STREETS RUN, LEFT BANK, RIVER MILE 0.4	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 6.8	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 7.6
TOTAL DRAINAGE AREA * (mi ²)				10.0	1.48	1.53	7.6
STATION LOCATION		INFLOW TO SCHENLEY PARK'S PANTHER HOLLOW LAKE IN PITTSBURGH, PA	PITTSBURGH, PA	HAYS IN PITTSBURGH, PA UPSTREAM OF THE CONFLUENCE OF GLASS RUN	HAYS IN PITTSBURGH, PA	HOMESTEAD, PA	DUCK HOLLOW IN PITTSBURGH, PA
STATION NUMBER		0028	0016	0020	0018	0022	0030
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM	6.6	14.3	18.2	5.8	11.1	15.5
	MINIMUM	1.1	5.8	12.1	1.6	3.2	4.6
	MEAN	3.6	9.3	13.9	3.8	8.1	11.8
LENGTH OF STATION AND SAMPLING TIME	LENGTH (ft)	277	240	383	278	315	217
	RIFFLE/RUN (%)	65	70	85	70	85	60
	POOL (%)	35	30	15	30	15	40
	TIME (MIN)	10	20	20	10	10	10
STATION COORDINATES	LATITUDE						
	LONGITUDE						

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		HOMESTEAD RUN (AKA WHITAKER RUN)	TASSEY HOLLOW	TURTLE CREEK	THOMPSON RUN (TURTLE CREEK)	THOMPSON RUN (DUQUESNE)	CROOKED RUN
TRIBUTARY TO		MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 8.8	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 9.7	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 11.5	TURTLE CREEK, LEFT BANK, STREAM MILE 1.8	MONONGAHELA RIVER, LEFT BANK, RIVER MILE (12.1?)	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 14.2
TOTAL DRAINAGE AREA *(mi ²)		2.34		148	17.9	5.46	3.63
STATION LOCATION		MUNHALL, PA	STATION ALONG WILKINS AVE IN BRADDOCK HILLS, PA	STATION LOCATED JUST UPSTREAM OF THE CONFLUENCE OF THOMPSON RUN IN TURTLE CREEK, PA	TURTLE CREEK, PA	DUQUESNE, PA	McKEESPORT, PA
STATION NUMBER		0024	0026	0052	0054	0034	0056
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM		5.3	70.0	26.1	21.5	12.4
	MINIMUM		1.8	70.0	13.5	11.9	2.2
	MEAN		3.1	70.0	20.8	16.8	8.1
LENGTH OF STATION AND SAMPLING TIME	LENGTH (ft)	247	191	65	191	161	174
	RIFFLE/RUN (%)	55	80	100	100	70	90
	POOL (%)	45	20	0	0	30	10
	TIME (MIN)	10	10	10	10	10	10
STATION COORDINATES	LATITUDE						
	LONGITUDE						

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		SANDY CREEK (CURRY HOLLOW)	PINE RUN	PETERS CREEK	PETERS CREEK	WYLIE RUN	FALLEN TIMBER RUN
TRIBUTARY TO		MONONGAHELA RIVER, LEFT BANK, RIVER MILE 17.0	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 18.6	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 19.7	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 19.7	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 22.1	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 22.7
TOTAL DRAINAGE AREA *(mi ²)				51.5	51.5	3.97	4.75
STATION LOCATION		DRAVOSBURG, PA	COAL VALLEY IN WEST MIFFLIN, PA	CLAIRTON, PA, UPSTREAM OF THE WWTP	CLAIRTON, PA, DOWNSTREAM OF THE WWTP	BLAINE HILL, LINCOLN, PA	ELIZABETH, PA
STATION NUMBER		0038	0040	0042	0043	0074	0072
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM	11.2	18.3	42.5	44.5	8.6	12.7
	MINIMUM	5.9	9.3	25.9	33.3	4.7	5.9
	MEAN	8.0	12.0	37.7	38.6	6.9	8.9
LENGTH OF STATION AND SAMPLING TIME	LENGTH (ft)	143	194	86	146	210	154
	RIFFLE/RUN (%)	100	100	100	90	60	70
	POOL (%)	0	0	0	10	40	30
	TIME (MIN)	10	10	10	10	10	10
STATION COORDINATES	LATITUDE						
	LONGITUDE						

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		LOBBS RUN	PERRY MILL RUN	KELLEY RUN	BUNOLA RUN	COAL BLUFF RUN	COAL BLUFF RUN
TRIBUTARY TO		MONONGAHELA RIVER, LEFT BANK, RIVER MILE 24.5	MONONGAHELA RIVER RIGHT BANK RIVER MILE 25.0	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 25.8	MONONGAHELA RIVER RIGHT BANK RIVER MILE 26.7	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 27.8	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 27.8
TOTAL DRAINAGE AREA *(mi ²)		3.92	4.02	2.25	1.09		
STATION LOCATION		CALAMITY HOLLOW IN FLOREFFE, PA	PANGBORN HOLLOW IN FORWARD TWP, PA	EAST OF BUNOLA IN FORWARD TWP, PA	BUNOLA IN FORWARD TWP, PA	UNION TWP, PA UPSTREAM OF MINE DISCHARGE	UNION TWP, PA DOWNSTREAM OF MINE DISCHARGE
STATION NUMBER		0044	0068	0066	0064	0046	0047
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM	9.9	14.8	7.2	10.0	4.0	9.8
	MINIMUM	3.9	7.2	4.8	8.4	1.3	2.7
	MEAN	7.4	10.5	5.9	11.8	3.4	5.6
LENGTH TO STATION AND SAMPLING TIME	LENGTH (ft)	145	242	166	132	175	146
	RIFFLE/RUN (%)	80	60	80	70	85	80
	POOL (%)	20	40	20	30	15	20
	TIME (MIN)	10	10	10	10	10	10
STATION COORDINATES	LATITUDE						
	LONGITUDE						

TABLE 2
THREE RIVERS - SECOND NATURE
BIOLOGICAL SAMPLING STATIONS
PHASE 1
MAY-JUNE 2001

STREAM NAME		MINGO CREEK	DRY RUN	PIGEON CREEK	SUNFISH RUN	BECKETTS RUN
TRIBUTARY TO		MONONGAHELA RIVER, LEFT BANK, RIVER MILE 29.8	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 31.1	MONONGAHELA RIVER, LEFT BANK, RIVER MILE 32.4	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 34.2	MONONGAHELA RIVER, RIGHT BANK, RIVER MILE 35.0
TOTAL DRAINAGE AREA *(mi ²)		22.2	1.99	59.2	1.55	3.12
STATION LOCATION		RIVER VIEW/ NEW EAGLE, PA	MONONGAHELA, PA	MONONGAHELA, PA	SUNNY SIDE, FORWARD TWP, PA	MILESVILLE, FORWARD TWP, PA
STATION NUMBER		0050	0078	0058	0062	0060
STREAM WIDTH ALONG STATION REACH (ft)	MAXIMUM	44.3	12.1	41.3	6.1	15.6
	MINIMUM	14.9	5.1	29.3	2.3	8.4
	MEAN	31.2	8.1	35.7	4.5	11.8
LENGTH TO STATION AND SAMPLING TIME	LENGTH (ft)	76	184	121	131	189
	RIFFLE/RUN (%)	85	70	60	100	85
	POOL (%)	15	30	40	0	15
	TIME (MIN)	10	10	10	10	10
STATION COORDINATES	LATITUDE					
	LONGITUDE					

*Drainage areas listed are from the Pennsylvania Gazetteer of streams except for Nine Mile Run whose DA is given in the Gazetteer as 6.07 sq. mi. but when checked was found to be 7.6 sq. mi.

TABLE 3
THREE RIVERS-SECOND NATURE FIELD AND LABORATORY PARAMETERS
MEASURED AT EACH STATION DURING THE PHASE 1 BIOASSESSMENT SURVEYS OF MAY/JUNE
2001

FIELD PARAMETERS	LABORATORY PARAMETERS
1) Water Temperature	METALS
2) pH	1) Total Aluminum
3) Dissolved Oxygen	2) Total Antimony
4) Specific Conductivity	3) Total Arsenic
	4) Total Barium
	5) Total Beryllium
	6) Total Cadmium
	7) Total Calcium
	8) Total Chromium
	9) Total Copper
	10) Total Iron
	11) Total Lead
	12) Total Manganese
	13) Total Magnesium
	14) Total Mercury
	15) Total Nickel
	16) Total Potassium
	17) Total Selenium
	18) Total Silver
	19) Total Sodium
	20) Total Zinc
	NUTRIENTS
	1) Total Kjeldahl
	2) Total Nitrate and Nitrite, Nitrogen as N
	3) Total Ammonia Nitrogen as N
	4) Total Phosphorous as P
	OTHER PARAMETERS MEASURED
	1) Specific Conductivity @ 25° C
	2) pH
	3) Phenolphthalein Alkalinity as CaCO ₃
	4) Hydroxide Alkalinity as CaCO ₃
	5) Bicarbonate Alkalinity as CaCO ₃
	6) Carbonate Alkalinity as CaCO ₃
	7) Total Acidity
	8) Total Hardness
	9) Turbidity
	10) Apparent Color

TABLE 4
THREE RIVERS-SECOND NATURE AQUATIC INVERTEBRATE
RAPID BIOLOGICAL ASSESSMENT COMPARATIVE SCORING
(PHASE 1)

Rank*	STREAM	#Taxa % Ref	# Organisms % Ref	% EPT	% Not AC	% # EPT- Baetis	% non- crustaceans	FBI*	Cond Score*
35	COAL BLUFF RUN DS	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
34	SUNFISH RUN	35.0	13.1	0.0	74.4	0.0	34.6	6.58	26.20
33	THOMPSON RUN (DUQUESNE)	35.0	18.6	1.8	3.6	0.9	100.0	6.06	26.60
32	PINE RUN	35.0	30.4	0.0	2.8	0.0	99.5	6.17	27.90
31	CROOKED RUN	45.0	11.5	10.3	51.5	1.5	66.2	7.13	31.00
30	NINE MILE RUN	35.0	8.8	3.8	36.5	3.8	100.0	6.04	31.30
29	TURTLE CREEK	35.0	21.3	14.3	27.0	0.8	100.0	6.02	33.10
28	TASSEY HOLLOW	5.0	100.0	0.0	100.0	0.0	0.0	7.00	34.20
27	BECKETTS RUN	55.0	44.9	0.4	78.5	0.4	29.2	6.79	34.70
26	STREETS RUN	55.0	3.9	23.9	71.7	6.5	58.7	6.89	36.60
25	SAWMILL RUN	25.0	100.0	0.2	0.5	0.0	99.7	9.31	37.60
24	COAL BLUFF RUN US	45.0	33.5	11.1	99.0	11.1	27.8	6.96	37.90
23	GLASS RUN	60.0	11.9	19.2	44.7	13.6	81.6	5.89	38.50
22	PANTHER HOLLOW/ FOURMILE RUN	45.0	80.4	2.5	99.6	2.5	4.7	6.96	39.10
21	BUNOLA RUN	60.0	20.5	11.6	97.5	11.6	35.5	6.51	39.4
20	WYLIE RUN	55.0	2.6	12.2	74.2	12.9	90.3	5.81	41.30
19	THOMPSON RUN (TURTLE CREEK)	60.0	34.5	22.1	36.3	17.2	88.2	5.96	43.00
18	PETERS CREEK DS	45.0	51.5	23.5	35.8	23.5	91.4	6.55	45.00
17	GIRTYS RUN	65.0	100	8.4	12.8	0.5	97.2	6.95	47.30
16	PETERS CREEK US	45.0	46.9	32.8	39.7	32.8	96.1	5.74	48.90
15	KELLEY RUN	100	58.5	6.9	85.9	5.8	44.2	6.85	50.20
14	PERRY MILL RUN	100	62.7	8.5	93.2	8.5	28.7	6.85	50.30
13	FALLEN TIMBER RUN	35.0	100.0	0.0	95.9	0.0	73.8	5.81	50.80

TABLE 4
THREE RIVERS-SECOND NATURE AQUATIC INVERTEBRATE
RAPID BIOLOGICAL ASSESSMENT COMPARATIVE SCORING
(PHASE 1)

Rank*	STREAM	#Taxa % Ref	# Organisms % Ref	% EPT	% Not AC	% # EPT- Baetis	% non- crustaceans	FBI*	Cond Score*
12	SIPES RUN	50.0	14.4	61.2	72.9	15.3	91.8	6.06	50.90
11	LOBBS RUN	100	71.5	11.0	80.1	8.2	38.9	6.52	51.60
10	HOMESTEAD RUN (aka WHITAKER RUN)	50.0	44.7	69.7	84.1	0.4	86.7	6.18	55.90
9	PIGEON CREEK	90.0	46.4	25.9	82.5	25.9	78.2	5.82	58.20
8	BECKS RUN	90.0	16.6	61.7	70.4	14.8	98.0	5.88	58.60
7	GUYASUTA RUN	77.3	47.2	46.2	86.7	40.1	62.4	5.51	60.00
6	CHARTIERS CREEK	55.0	62.7	44.7	61.7	44.7	99.0	5.70	61.30
5	WEST RUN	45.0	41.4	90.2	95.5	4.1	95.9	6.00	62.00
4	SANDY CREEK (CURRY HOLLOW)	50.0	9.5	75.0	80.4	59.1	98.3	5.39	63.70
3	DRY RUN	60.0	88.2	1.8	97.3	1.8	12.1	6.91	66.20
2	MINGO CREEK	100	69.0	41.7	55.2	41.7	89.5	5.51	66.20
1	PINE CREEK	100	100	53.8	63.4	13.9	96.8	5.82	71.30

*FBI was not used as a metric unit in
these condition scores

*Quality (conditions score) is inversely proportional to rank

APPENDIX A

THREE RIVERS-SECOND NATURE
RESULTS OF CHEMICAL FIELD MEASUREMENT AND
LABORATORY ANALYSIS OF SAMPLES COLLECTED DURING
THE PHASE 1 BIOASSESSMENT SURVEYS MAY/JUNE 2001

Results can be found on the web, at <http://3R2N.cfa.cmu.edu>.

APPENDIX B

THREE RIVERS SECOND NATURE
RESULTS OF RAPID INVERTEBRATE BIOLOGICAL ASSESSMENT SAMPLING
PHASE 1
MAY/JUNE 2001

Results can be found on the web, at <http://3r2n.cfa.cmu.edu>.

APPENDIX C

**THREE RIVERS SECOND NATURE
BIOLOGICAL SAMPLING
INCIDENTAL FIELD OBSERVATIONS**

APPENDIX C

**THREE RIVERS-SECOND NATURE
BIOLOGICAL SAMPLING
INCIDENTAL FIELD OBSERVATIONS**

SAWMILL RUN 31 May 01, 0915 hours. Sewage odor. Large carp in the creek at the end of the riffle.

CHARTIERS CREEK 31 May 01, 1230 hours. Female greenside darter collected in the net.

GIRTYS RUN 31 May 01, 1500 hours. Sewage odor. One blacknose dace collected in the nets. Our activities here attracted significant public attention and numerous questions about sewage problems and safety for the children and dogs who play in the creek.

PINE CREEK 31 May 01, 1400 hours. Numerous small fish and Asian clam shells in the stream, and signs of beaver activity along the banks. Except for 24 feet of riffle downstream of the low concrete dam, there was a relatively high degree of substrate embeddedness at this station. The dam was slightly higher than two feet high on the left descending bank, and about one foot high on the right descending bank.

SIPES RUN 30 May 01, 1530 hours. Strong sewage odor. A local observer informed us that the channel was "cleaned out" two months prior with bulldozers in the channel. He also stated that there are periodic "dumps" of dark brown water from an upstream source. Abundance of lawn grass chippings in the channel.

GUYASUTA RUN 30 May 01, 0930 hours. Three blacknose dace and two male greenside darters were collected in the nets, as well as two gilled salamanders which were likely northern spring salamander larvae.

**PANTHER HOLLOW/
FOURMILE RUN** 29 May 01, 1400 hours. Numerous bluegill and two largemouth bass (10-12") observed in the lake, plus a frog and a spotted sandpiper near the inflow. We were attacked by mobs of kids from the playground. They liked the crayfish.

APPENDIX C

**THREE RIVERS-SECOND NATURE
BIOLOGICAL SAMPLING
INCIDENTAL FIELD OBSERVATIONS**

BECKS RUN 24 May 01, 0830 hours. Strong sewage odor. Numerous empty caddisfly cases.

STREETS RUN 25 May 01, 1215 hours. One blacknose dace collected in the nets.

GLASS RUN 29 May 01, 0830 hours

WEST RUN 24 May 01, 1320 hours. Faint sewage odor, fish observed in the stream.

NINE MILE RUN 18 June 01 0930 hours. Sewage odor.

HOMESTEAD RUN 25 May 01, 0915 hours. Sewage odor.

TASSEY HOLLOW 29 May 01, 1030 hours. There are old tombstones in the stream channel. While the invertebrate sample consisted almost exclusively of *Gammarus sp.*, there were a few snails and planaria in the stream upstream of the confluence of a large spring that comes in from the left bank. The conductivity of this spring was 889 umhos/cm, compared with 1710 and 1459 umhos/cm conductivities in Tassey Hollow above and below the confluence of the spring, respectively.

TURTLE CREEK 18 June 01, 1145 hours. Numerous large carp observed in the stream and many larval fish collected in the nets. Hundreds of midge exuvia were observed and the stream substrate was covered with a dense growth of algae. The station was a 65 feet long accumulation of coarse materials that formed a riffle in the concrete paved channel.

APPENDIX C

**THREE RIVERS-SECOND NATURE
BIOLOGICAL SAMPLING
INCIDENTAL FIELD OBSERVATIONS**

THOMPSON RUN (TURTLE CREEK) 18 June 01, 1330 hours. Numerous small fish observed, and three boys were fishing in an upstream pool. Lots of grass chippings in the stream.

THOMPSON RUN (DUQUESNE) 13 June 01, 0945 hours. Sewage odors. This station was very complex. The biological sample was collected in the reach downstream of the high waterfall on Thompson Run, but upstream of the tunnel under the industrial park and upstream of all of the numerous discharges that enter the stream before it flows through the tunnel. These discharges include 15 flowing seeps coming in at a low elevation along the left descending bank (and others not then discharging). This collection of seeps all have red colored flowstones at their base. The flow from the largest seep was about 300 gpm and it had a conductivity of 2,561 umhos/cm and a pH of 11.62, indicating slag leachate. From the right descending bank there is a piped discharge with a flow of about 200 gpm. The conductivity and pH of this piped discharge were 849 umhos/cm, and pH 8.31, respectively. Just before Thompson Run enters the tunnel, it also receives two higher elevation, left bank discharges, one colored white and the other red. These merge before entering the stream. They have a combined flow of roughly 20 gpm, a pH of 8.44, and a conductivity of 789 umhos/cm.

CROOKED RUN 18 June 01, 1600 hours. Some fish were observed in the stream. The 4 Sure Auto Glass man says that he has lived there all of his life, and the fish only showed up two years ago.

SANDY CREEK (CURRY HOLLOW) 13 June 01, 1300 hours.

PINE RUN 13 June 01, 1430 hours.

PETERS CREEK (UPSTREAM OF THE WWTP) 19 June 01, 1030 hours.

APPENDIX C

**THREE RIVERS-SECOND NATURE
BIOLOGICAL SAMPLING**

INCIDENTAL FIELD OBSERVATIONS

**PETERS CREEK
(DOWNSTREAM OF THE
WWTP)** 19 June 01, 0930 hours. Small fish were observed to be abundant in the stream, especially near the right bank downstream of the WWTP. The rocks were black with diatom growths.

WYLIE RUN 26 June 01, 1600 hours. Sewage odor.

FALLEN TIMBER RUN 26 June 01, 1515 hours. Sewage odors. Small fish in the stream, and dense periphyton growths.

LOBBS RUN 14 June 01, 0915 hours. Station was at the inflow to a pool formed by a beaver dam. Also abundant muskrat sign. Fish present and blacknose dace collected in the nets.

KELLEY RUN 21 June 01, 1130 hours. One blacknose dace and four creek chubs collected in the nets, as well as one Queen snake and one northern water snake. Aluminum oxides are deposited in the middle of the station from a right bank source.

BUNOLA RUN 21 June 01, 1500 hours.

**COAL BLUFF RUN
(UPSTREAM OF THE
MINE DISCHARGE)** 14 June 01, 1200 hours. Adult northern dusky salamanders were abundant upstream of the mine discharge.

**COAL BLUFF RUN
(DOWNSTREAM OF THE
MINE DISCHARGE)** 14 June 01, 1200 hours. The substrate downstream of the mine discharge was cemented by a heavy deposit of iron and contained no apparent macroscopic aquatic life.

MINGO CREEK 14 June 01, 1530 hours. Lots of fish. A very nice looking stream.

DRY RUN 21 June 01, 1000 hours. Four blacknose dace and one creek chub collected in the nets.

APPENDIX C

**THREE RIVERS-SECOND NATURE
BIOLOGICAL SAMPLING
INCIDENTAL FIELD OBSERVATIONS**

PIGEON CREEK

19 June 01, 1530 hours. Numerous fish and Asian clam shell observed. A gentleman on the bridge said that the creek has carp, catfish, walleye, sauger, smallmouth bass, and bluegill. One young girl on the bridge said that "I like crayfish." Another stated "I'm not swimming in that creek if those things live in it."

SUNFISH CREEK

21 June 01, 1315 hours. Very heavy iron oxide deposition in channel and sewage odors.

BECKETTS RUN

21 June 01, 1200 hours. Rocks in the stream are stained by iron.

APPENDIX D

**THREE RIVERS SECOND NATURE
PHOTOGRAPHS OF BIOASSESSMENT STATIONS
SAMPLED IN MAY/JUNE 2001**



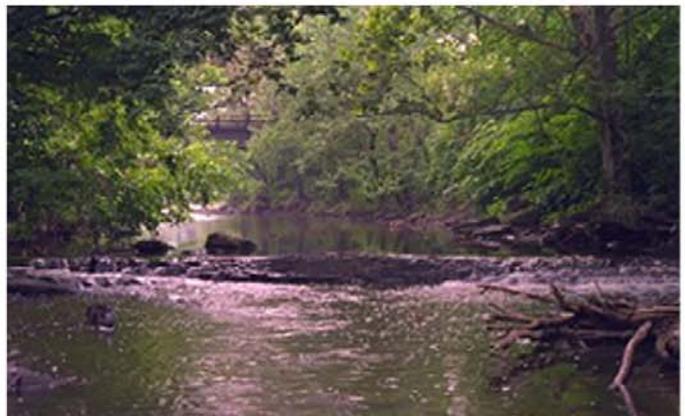
SAWMILL RUN
Station 0012



CHARTIERS CREEK
Station 0014



GIRTYS RUN
Station 0010



PINE CREEK
Station 0006



SIPES RUN
Station 0008



GUYASUTA RUN
Station 0004



FOURMILE RUN
Inflow to lake from bridge
Station 0028



BECKS RUN
Station 0016



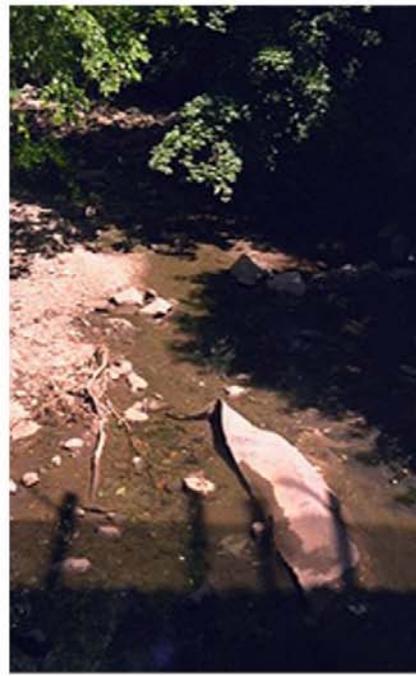
STREETS RUN
Station 0020



GLASS RUN
Station 0018



WEST RUN
Station 0022



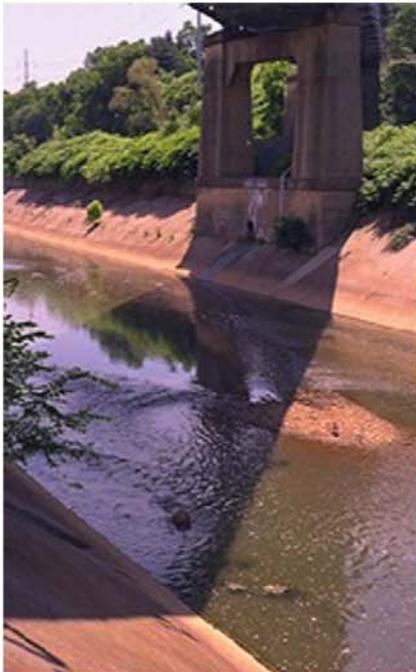
NINE MILE RUN
Station 0030



HOMESTEAD RUN
Station 0024



TASSEY HOLLOW
Station 0024



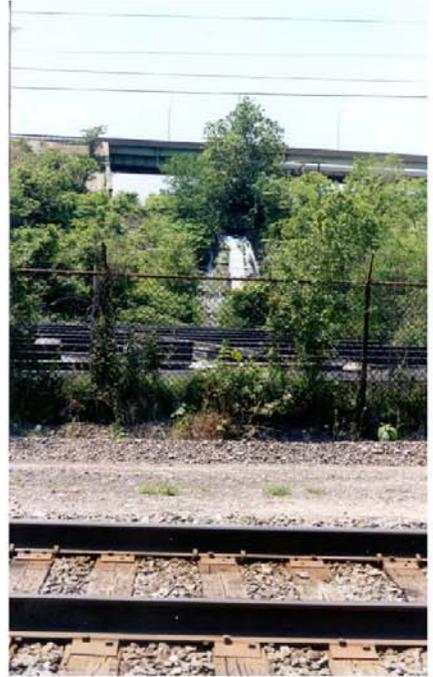
TURTLE CREEK
Station 0052



**THOMPSON RUN
(TURTLE CREEK)**
Station 0054



THOMPSON RUN (DUQUESNE)
Station 0034



**THOMPSON RUN
(DUQUESNE)
WATERFALL**



THOMPSON RUN (DUQUESNE)
SEEPS



CROOKED RUN
Station 0056



SANDY CREEK
Station 0038



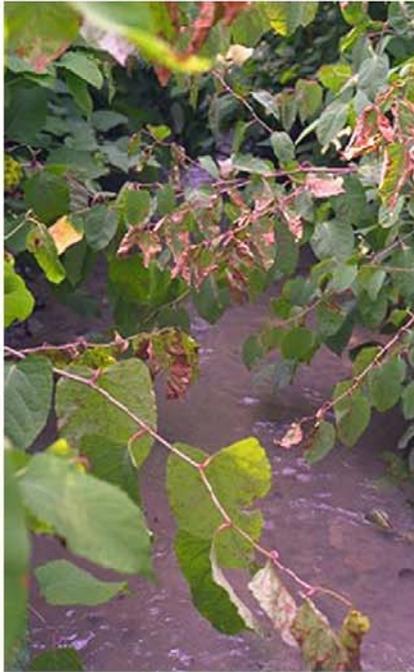
PINE RUN
Station 0040



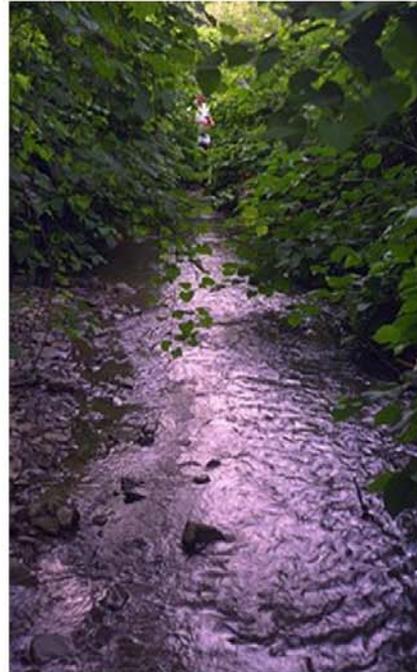
PETERS CREEK
(above waste water
treatment plant)
Station 0042



PETERS CREEK
(downstream of waste
water treatment plant)
Station 0056



WYLIE RUN
Station 0074



FALLEN TIMBER RUN
Station 0072



LOBBS RUN
Station 0044



PERRY MILL RUN
Station 0068



KELLEY RUN
Station 0066



**KELLEY RUN SUBSTRATE
WITH ALUMINUM OXIDE
PRECIPITATES**



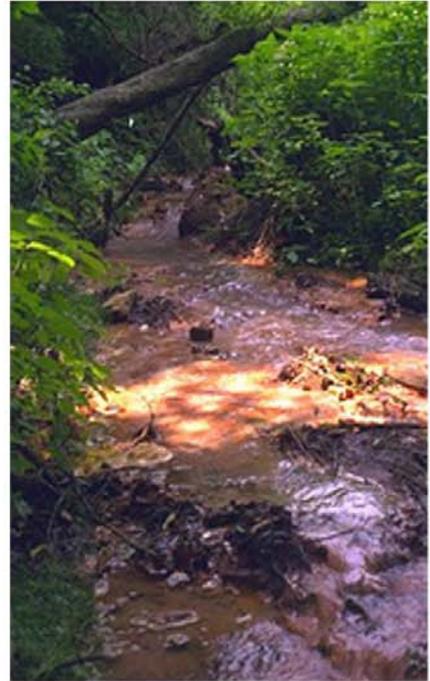
BUNOLA RUN
Station 0064



**COAL BLUFF RUN
UPSTREAM OF AMD**
Station 0046



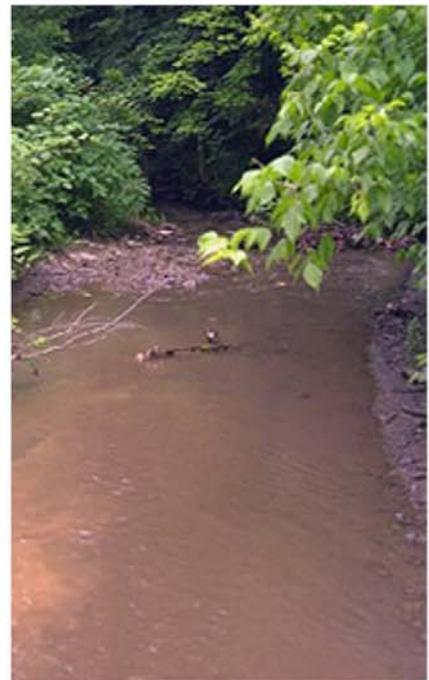
**AMD ENTERING COAL
BLUFF RUN**



**COAL BLUFF RUN
DOWNSTREAM OF AMD**
Station 0047



MINGO CREEK
Station 0050



DRY RUN
Station 0078



PIGEON CREEK
Station 0058



SUNFISH RUN
Statio 0062



BECKETTS RUN
Station 0060



SHERIDAN PARK RUN