RICE CREEK WATERSHED STREAM HEALTH EVALUATION PROGRAM (SHEP) REPORT

2006/2007 BENTHIC MACROINVERTEBRATE STREAM MONITORING

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A Collaborative Effort
The Stream Health Evaluation Program partners include The Minnesota Pollution Control Agency, Friends of the Mississippi River, Minnesota Waters, Rice Creek Watershed District, Anoka Conservation District, University of Minnesota, City of Lino Lakes, Anoka Parks, Volunteer Stream Monitoring Partnership, the Higher Education Consortium for Urban Affairs, and The Minnesota Community Foundation.

Rice Creek Watershed Stream Health Evaluation Program
2006 Field Summary

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1.0 BACKGROUND

Over the past 15 years the MPCA has been developing new protocols and indices for the biological assessment of streams. Due to the fact that aquatic organisms express a range of tolerances to environmental conditions, biological assessment can be a powerful quantitative tool in understanding the health of water resources. Biological monitoring, by surveying aquatic organisms that grow, develop and reproduce over time, provides for a more complete picture of the ecological health of our waters.

In 1997, in collaboration with local partners, MPCA scientists developed a citizen wetland monitoring program based upon these bioassessment techniques. This Wetland Health Evaluation Program (WHEP) is now an award winning and nationally recognized program that uses citizen volunteers to monitor the biological health of local wetlands. Multiple layers of quality control and the use of rigorous protocols assure scientifically valid monitoring results. Volunteers enjoy the program and often become more engaged in wetland and watershed issues and stewardship within their communities.

1.1 A New Model

The Stream Health Evaluation Program (SHEP) is a new model for volunteer stream monitoring in the state of Minnesota. Modeled after WHEP, SHEP uses trained volunteers to evaluate the biological health of streams using advanced bioassessment protocols and indices specifically developed for this region. The program thoroughly monitors volunteer data collection and lab identification techniques to ensure compatibility with established protocols. Complete data cross-checks and programmatic evaluation ensure accurate and timely data that is quality certified.

The Stream Health Evaluation Program (SHEP) provides local communities and watershed organizations with a premier volunteer benthic macroinvertebrate monitoring program that produces reliable data and actively engages citizens in the work of the watershed.

SHEP, a new model for water quality assessment:

- Monitors the health of valuable water resources
- Uses research-based multiple index metrics
- Professionally trains adult volunteers
- Utilizes multiple levels of quality control to ensure quality results
- Provides relevant, reliable data to local decision makers
- Engages citizens in water resource management and assessment
- Promotes water resource health to community members
- Promotes partnership between local governments, state agencies and community residents.

1.2 Rice Creek SHEP

SHEP was implemented in a pilot phase into the Rice Creek Watershed District in the Summer and Fall of 2006. SHEP was led by Friends of the Mississippi River (FMR) and Minnesota Waters (MN Waters) in partnership with the RCWD, MPCA, the Anoka Conservation District and Anoka County, with support from the City of Lino Lakes, the Higher Education Consortium on Urban Affairs (HECUA), The University of Minnesota Water Resources Center, Hennepin County Environmental Services and local land owners.

Program activity was funded through grants from the Minnesota Pollution Control Agency, The Minnesota Community Foundation and through contributions from program partners including Friends of the Mississippi River, Minnesota Waters, Anoka County Parks and the University of Minnesota Water Resources Center.

The project recruited 28 adult volunteers organized in three teams to monitor a total of six sites in the Fall of 2006. These sites, at Hardwood Creek, Rice Creek, and the inlet/outlet of Locke Lake, were chosen in part to gauge the effects of recent restoration and stewardship activity on these sites.

The SHEP monitoring protocol was divided into two sections: a physical habitat assessment and a biological assessment of benthic macroinvertebrates. Volunteers participated in 1.5 days of training, covering the in-stream physical assessment and macroinvertebrate collection methods, and laboratory macroinvertebrate identification procedure.

Each volunteer team collected physical assessment data and benthic macroinvertebrate samples at a site above and below recent restoration activity in the Rice Creek Watershed. In addition, each team also cross-checked one sampling site previously sampled by another team.

After macroinvertebrate collection was completed, volunteers participated in laboratory analysis sessions to identify samples. The samples were later cross-checked by professionals, and results were reported to program partners, local governments and made available to the general public.

1.3 The Rice Creek Watershed

Watershed Districts are special purpose units of local government whose boundaries follow those of a natural watershed. The Rice Creek Watershed District was established in 1972 to conserve and restore the water resources of the District for the beneficial use of current and future generations. It is a governmental organization managed by a Board of Managers appointed by the county commissions of Anoka, Ramsey, and Washington Counties.

The Rice Creek watershed drains portions of Anoka, Hennepin, Ramsey, and Washington Counties. The watershed occupies portions of Arden Hills, Birchwood, Blaine, Centerville, Circle Pines, Columbia Heights, Columbus, Dellwood, Falcon Heights, Forest Lake, Fridley, Grant, Hugo, Lauderdale, Lexington, Lino Lakes, Mahtomedi, May Township, Mounds View, New Brighton, New Scandia Township, Roseville, St. Anthony, Shoreview, Spring Lake Park, White Bear Lake, White Bear Township and Willernie.

Rice Creek's principal tributaries are Hardwood Creek, which drains an area of 44 square miles in the cities of Hugo, Forest Lake, and Lino Lakes; and Clearwater Creek which drains a 62 square mile area of White Bear Lake, White Bear Township, Hugo, Lino Lakes, and Centerville. Both tributaries join Rice Creek in Anoka County as part of the Rice Creek Chain of Lakes.

The Rice Creek has its source at Clear Lake in the city of Forest Lake and flows generally southwestwardly through Anoka and Ramsey Counties, through the cities of Columbus, Lino Lakes, Circle Pines, Shoreview, Arden Hills, Mounds View, New Brighton and Fridley. It joins the Mississippi River at Manomin County Park in Fridley. The creek drops about 84 feet along its course, with most of the drop occurring in the 8 miles upstream of its mouth.

About 10 percent of the watershed's surface area is occupied by lakes, the largest of which are White Bear Lake and Bald Eagle Lake. About 13 percent of the watershed consists of wetland areas.

2.0 METHODS

2.1 Volunteer Recruitment

Volunteer recruitment efforts were led by staff from Friends of the Mississippi River in partnership with Rice Creek Watershed District Staff. Recruitment of volunteers was conducted through news releases, list serves, flyers, city and county publications, presentations, tabling at events and through communication with interested volunteers in existing local programs.

A total of 28 SHEP volunteers were recruited for this program. Volunteers were divided into three teams. Each team was lead by a Team Leader. Team Leaders are an integral part of SHEP and were selected by project staff. Team Leaders received a small stipend and were responsible for managing monitoring activities and communication within his/her team.

An analysis of volunteer recruitment methods showed that volunteers entered the program through a variety of sources. Roughly 32% registered through direct contact with Friends of the Mississippi River. Notices in local print media produced 24% of volunteers, while the Master Naturalists Program (20%) and Master Gardeners Program (4%) were additional sources of volunteer interests. Roughly 20% of volunteers discovered the program through other means including word of mouth.

2.2 Team Assignment

SHEP volunteers were assigned to one of three teams. Team leaders, team members and monitoring location assignments are listed below.

Team One:
Monitoring Location: Hardwood Creek
Cross-Check Location: Locke Lake
Team Leader: Gary Averbeck
Team Members: Don Solick, Renee Solick, Jen Almond, Jim Bukowski, Mike Zelenak, Sarah Rolee, Tere O'Connell, Wayne LeBlanc, Catherine Nicholson

Team Two:
Monitoring Location: Rice Creek
Cross-Check Location: Hardwook Creek
Team Leader: Gwen & Frank Neumann
Team Members: Barbara Bor, Bob Bartlett, David Weidmyer, Don Vegoe, Glenn Fuchs, Hiyala Indiga, Julie Glanton, Ralph Butkowski, Sarah Sevcik.

Team Three:
Monitoring Location: Locke Lake.
Cross-Check Location: Rice Creek
Team Leader: Cathi Lymna-Onka

Team Members: Bethany Blick, Mary Budde, Ed Doberstein, Nancy Wilberts, Doug Anderson, Bill Radmer, Marilyn Radmer

2.3 Training

Advanced volunteer training is essential to the success of SHEP. Volunteers participated in 1.5 days of training, covering the in-stream physical assessment and macroinvertebrate collection methods, and laboratory macroinvertebrate identification procedure.

The first training session, held on August 23rd 2006 at the Wargo Nature Center in Lino Lakes, covered physical assessment protocols and featured macroinvertebrate collection methods under the guidance of MPCA and MN Waters staff.

The second training session, held on August 26rd 2006 at the Wargo Nature Center, covered sample sorting and preparation, as well as lab identification technique. This session was also led by MPCA and MN Waters staff.

2.4 Site Selection

Stream monitoring sites were selected by RCWD staff. Stream monitoring locations were selected to include locations upstream and downstream of recent watershed restoration activity. A detailed description of the monitoring locations is available in section 4.0 of this report.

2.5 Field Sampling

SHEP volunteer teams monitored six stream sites across the Rice Creek Watershed during the fall of 2006. MPCA and MN Waters staff members performed site visits to assure monitoring is performed according to MPCA guidelines and protocols.

SHEP volunteers used the MPCA's multihabitat monitoring protocol at each monitoring location throughout the watershed. The multihabitat approach samples major habitats in proportional representation within each sampling reach. Benthic macroinvertebrates are collected systematically from all available in-stream habitats by jabbing with a D-frame dip net. At least 20 jabs were taken from across all major habitat types in the reach. Habitat types include snags and woody debris, vegetated banks, cobble, and sand/fine sediment bottom areas.

2.6 Lab Identification

SHEP teams sorted and identified macroinvertebrate samples during multiple lab sessions throughout September and October 2006. Lab Identification sessions were held in partnership with Anoka County Parks at the Wargo Nature Center in Lino Lakes, Minnesota.

Lab sessions identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kindgom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted and labeled prior to being submitted to project staff for quality control review.

2.7 Quality Assurance/Quality Control

Project coordinators visited each team a minimum of one time during field sampling. These visits were conducted to ensure the teams were following the correct protocols in collecting and preserving macroinvertebrates and conducting habitat assessments.

A Quality Assurance/Quality Control check was also performed on all macroinvertebrate samples identified by SHEP volunteers. Minnesota Waters staff performed a QA/QC check on 100% of the macroinvertebrates identified by all three teams. The overall success rate for the project was 95% correct.

2.8 Reporting of Results

Once data analysis was completed and project staff completed a quality check all volunteer data sheets for accuracy, FMR staff and volunteers presented a summary of the project to local municipal audiences upon request.

Project staff and volunteers reported results to the following boards and commissions:
The City of Lino Lakes Environmental Commission
The Lino Lakes City Council
The City of Shoreview Environmental Quality Commission
The City of Fridley Environmental Quality & Energy Commission

The final written program report will be made available through project partner websites and printed version will be made available for partners, volunteers, state & local agencies as well as interested citizens.

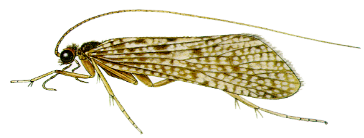
3.0 MONITORING TERMS

3.1 Monitoring Terms

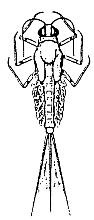
The descriptions below will help readers understand the results presented on the following pages.

Complete Metamorphosis - occurs in the Diptera, Megaloptera, Coleoptera, Trichoptera and Lepidoptera. The life cycle includes the following stages: egg, larva, pupa and adult.

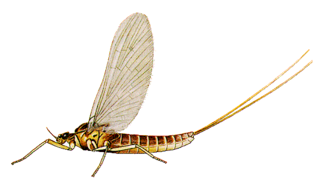
Trichoptera (caddisfly) larva



Trichoptera (caddisfly) Adult



Ephemeroptera (mayfly)



Larva*Ephemeroptera (mayfly) Adult*

Dominant Family -The family which comprises the largest single portion of the invertebrate sample.

Dominant Family % Overall - The dominant family's percentage of the total invertebrate sample. This metric indicates how dominant a single family is at a site. A high percent dominance is suboptimal. It indicates a less diverse community of macroinvertebrates.

EPT - The number of mayfly (**E**phemeroptera), stonefly (**P**lecoptera), and caddisfly (**T**richoptera) families in the sample. These families represent the pollution intolerant insects. A higher EPT score reflects better water quality than a lower one.

Family – In the taxonomic rank, family appears as follows: Phylum, Class, Order, Suborder, Family, Subfamily, Genus, and Species. An example of an order is "Mayflies or Ephemeroptera". An example of a family is Heptageniidae or Flat Head Mayfly. Family is the level of identification used in this protocol.

Family Biotic Index (FBI) – Each macroinvertebrate family is assigned a pollution tolerance number between 0 and 10 depending on its sensitivity to pollution. A score of zero indicates very sensitive to organic pollution. A 10 indicates very tolerant of organic pollution. The FBI for a site is the weighted average of the biotic indexes for all of the invertebrates in the sample. The FBI summarizes the various pollution tolerance values of all families in a sample. Pollution intolerant families such as stoneflies (FBI of 0 – 2) can only survive in excellent water quality. Pollution tolerant organisms such as leeches and aquatic earthworms can live in clean water or poor quality water. They have high FBI values (8 – 10). According to Hilsenhoff, who developed this metric, "Use of the FBI is advantageous for evaluating the general status of organic pollution in streams within a watershed for the purpose of deciding which streams or watersheds should be studied further." The lowest (best) FBI value reported by our monitoring was above Locke Lake (5.0). The highest (poorest) FBI value reported is 8.8 above the Rice Creek Remeander.

Index of Biotic Integrity (IBI): "A synthesis of diverse biological information that numerically depicts associations between human influence and biological attributes. It is composed of several biological attributes or 'metrics' that are sensitive to changes in biological integrity caused by human activities."
Source: Volunteer Surface Water Monitoring Guide, MPCA, 2003

Incomplete Metamorphosis - occurs in the Ephemeroptera, Plecoptera, Odonata and Hemiptera. The life cycle includes the following stages: egg, early instar larva, late instar larva and adult. This program monitors the larval stages of development.

Metric- A measure of stream health calculated using data from the macroinvertebrate monitoring. The family biotic index (FBI), EPT and number of families (family richness) are examples of metrics. Metrics are used to help analyze and interpret biological data. Metrics are often compared to charts that place the values into stream health categories.

Number of Families - The number of different benthic macroinvertebrate families found at the site, also known as family richness. In general, more diversity is better. Therefore a larger number of families may reflect a healthier community than a smaller number. The largest number of families (16) were discovered at the Hardwood Creek 'above' site, while the fewest number of families (8) were found at the Rice Creek 'below' sampling location.

Number of Organisms Identified- For the protocol that we use, it has been determined that a minimum of 100 organisms is required to confidently make an assessment. When less than 100 organisms are collected, the information is still useful, but we cannot be as confident about characterizing the site's health.

Water Quality - refers to anything that might affect the invertebrates living in the river for part of their life cycle (such as nutrients, oxygen, sediment, organic pollution, toxins, stream flow, and quality of habitat).

Source: Fortin Consulting, 215 Hamel Road, Hamel MN 55340

3.2 Hilsenhoff Family Level Biotic Index

The family level biotic index (FBI) for a site is the weighted average of the biotic indexes for all of the invertebrates in the sample. The FBI summarizes the various pollution tolerance values of all families in a sample. The FBI score for a particular monitoring site corresponds to a likely degree of organic pollution present at that location. As such, the FBI score is a useful tool for evaluating the general status of organic pollution in streams within a watershed.

Evaluation of water quality using Hilsenhoff's Family Level Biotic Index

Family Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.0	Very poor	Severe organic pollution likely

Source: Hilsenhoff, 1988

4.0 2006 FIELD SAMPLING RESULTS

4.1 Hardwood Creek

4.1.1 Existing Conditions

Hardwood Creek drains an area of 24 square miles in the cities of Hugo, Forest Lake, and Lino Lakes. Its headwaters drain from Rice Lake through Hardwood Creek before emptying into Lake Peltier at the head of the Chain of Lakes, which lies in the cities of Lino Lakes and Centerville.

Hardwood Creek is listed by the Minnesota Pollution Control Agency as impaired for aquatic life, due to sedimentation, low dissolved oxygen and nutrient enrichment. Studies indicate that approximately 30 percent or more of phosphorus load to Peltier Lake comes from Hardwood Creek.

In the summer of 2006, as part of an LCMR grant, three locations along Hardwood Creek that were identified through the TMDL as having severe bank erosion were stabilized and in-stream habitat improvement techniques were utilized. In 2007, three additional sites along the creek will also be stabilized. Currently, TMDL studies are on-going for both Hardwood Creek and Peltier

4.1.2 Site Map

Below is a map of the 2006 Hardwood Creek sampling locations. The pins correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

4.1.3 Sampling Methodology
Team Leader: Gary Averbeck
Team Members: Don Solick, Renee Solick, Jen Almond, Jim Bukowski, Mike Zelenak, Sarah Rolee, Tere O'Connell, Wayne LeBlanc, Catherine Nicholson

SHEP volunteers used the MPCA's multihabitat monitoring protocol at each monitoring location. At least 20 jabs were taken from across all major habitat types in the reach. MPCA and MN Waters staff members performed site visits to assure monitoring is performed according to MPCA guidelines and protocols.

Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted and labeled prior to being submitted to project staff for quality control review.

4.1.4 Field Sampling Results

Results for Hardwood Creek

Date	# Identified	Family Biotic Index	EPT	Number of Families	Dominant Family	Dominant Family % overall
Above restoration						
10/06/06	408	7.6	5	16	Hyallelidae	56%
Below restoration						
10/06/06	153	5.1	4	14	Heptageniidae	35%
QA/QC check – below restoration						
10/10/06	134	6.1	4	10	Hyallelidae	47%

Interpretation of the Hilsenhoff Biotic Index	
Above restoration	7.6
Below restoration	5.1
QA/QC check below restoration	6.1

Field sampling results produced a Family Biotic Index (FBI) score of 7.6 for the 'above restoration' site. This score suggests a high likelihood that the upstream reach of Hardwood Creek suffers from severe organic pollution.

The lower reach of Hardwood creek ('below restoration') recorded is greatly improved score of 5.1. This suggests that there is some fairly substantial pollution likely in this reach of stream.

The cross check produced a similar score for the 6.1 for the 'below restoration' site. This variation reflects natural stream monitoring variability and is within the statistical variability of this index.

4.2 Rice Creek Re-Meander

4.2.1 Existing Conditions

The Rice Creek Watershed District and Emmons & Oliver Resources, Inc recently completed the restoration of a significant reach of the Rice Creek. The project is entirely within Rice Creek North Regional Park and includes a stretch of Rice Creek located between Lexington Avenue and County Road I.

The goal of the project is to restore the historical winding flow path and surrounding wetland hydrology for this reach of stream, which was straightened in the early 1900's. Many benefits of this project, such habitat enhancement, water quality improvement and enriched recreation opportunities, have already begun to be realized.

4.2.2 Site Map

Below is a map of the 2006 Rice Creek Re-Meander sampling locations. The pins correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the ‘sampling site’ for the purposes of this report.

4.2.3 Sampling Methodology

Team Leaders: Gwen & Frank Neumann

Team Members: Barbara Bor, Bob Bartlett, David Weidmyer, Don Vegoe, Glenn Fuchs, Hiyala Indiga, Julie Glanton, Ralph Butkowski, Sarah Sevcik.

SHEP volunteers used the MPCA's multihabitat monitoring protocol at each monitoring location. At least 20 jabs were taken from across all major habitat types in the reach. MPCA and MN Waters staff members performed site visits to assure monitoring is performed according to MPCA guidelines and protocols.

Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Once identified, samples were sorted and labeled prior to being submitted to project staff for quality control review.

4.2.4 Field Sampling Results

Results for Rice Creek

Date	# Identified	Family Biotic Index	EPT	Number of Families	Dominant Family	Dominant Family % overall
Above restoration						
9/1/06	180	8.8	2	11	Coenagrionidae	87%
Below restoration						
9/1/06	117	8.3	2	12	Coenagrionidae	65%
QA/QC check – below restoration						
10/1/06	142	6.1	4	14	Simuliidae	48%

Interpretation of the Hilsenhoff Biotic Index	
Above restoration	8.8
Below restoration	8.3
QA/QC check below restoration	6.1

Field sampling results produced a Family Biotic Index (FBI) score of 8.8 for the upstream section ('above restoration'). This score suggests that severe organic pollution is likely in the upstream reach of Rice Creek.

The lower portion of the Rice Creek re-meander ('below restoration') recorded a score of 8.3. While this shows minor improvement from the upstream location, this score also suggests that severe organic pollution is likely in the downstream reach of the Rice Creek re-meander.

The cross check produced a similar score for the 6.1 for the 'below restoration' site. This variation reflects natural stream monitoring variability and is within the statistical variability of this index.

4.3 Locke Lake

4.3.1 Existing Conditions

Locke Lake is located just upstream of the Rice Creek Watershed's outlet to the Mississippi River. All outflow from the Rice Creek Watershed passes through Locke Lake and flows directly into the Mississippi River. Recent activity by the Rice Creek Watershed District has focused on installing shoreland restoration and shoreland stabilization measures on properties adjacent to Locke Lake.

4.3.2 Site Map

Below is a map of the 2006 Rice Creek Re-Meander sampling locations. The pins correspond to the midpoint of the sampled stream reach. Each stream reach sampled is referred to as the 'sampling site' for the purposes of this report.

4.3.3 Sampling Methodology

Team Leader: Cathi Lymna-Onka

Team Members: Bethany Blick, Mary Budde, Ed Doberstein, Nancy Wilberts, Doug Anderson, Bill Radmer, Marilyn Radmer

SHEP volunteers used the MPCA's multihabitat monitoring protocol at each monitoring location. At least 20 jabs were taken from across all major habitat types in the reach. Habitat types include snags and woody debris, vegetated banks, cobble, and sand/fine sediment bottom areas. MPCA and MN Waters staff members performed site visits to assure monitoring is performed according to MPCA guidelines and protocols.

Lab analysis identified the taxonomic classification of benthic macroinvertebrate samples from each sampling site. Using taxonomic keys, SHEP volunteers identified the Kingdom, Phylum, Class, Order and Family of macroinvertebrate organisms. Once identified, samples were sorted and labeled prior to being submitted to project staff for quality control review.

4.3.4 Field Sampling Results

Results for Locke Lake

Date	# Identified	Family Biotic Index	EPT	Number of Families	Dominant Family	Dominant Family % overall
Inlet to Locke lake						
9/28/06	95	5.0	2	12	Hydropsychidae	58%
Outlet from Locke lake						
9/28/06	111	5.3	3	8	Chironomidae	43%
QA/QC check – Outlet						
10/8/06	137	4.3	3	10	Hydropsychidae	85%

Interpretation of the Hilsenhoff Biotic Index	
Above Locke Lake	5.0
Below Locke Lake	5.3
QA/QC check below restoration	4.3

Field sampling results produced a Family Biotic Index (FBI) score of 5.0 for the upstream section (‘above restoration’). This score suggests that fairly substantial organic pollution is likely in this reach of stream.

The ‘Locke Lake below’ site recorded a score of 5.3. This score also suggests that fairly substantial organic pollution is likely in this reach of stream.

The cross check produced a similar score for the 4.3 for the ‘below restoration’ site. This variation reflects natural stream monitoring variability and is within the statistical variability of this index.

5.0 SHEP EVALUATION

5.1 Introduction

Guided by Dr. Julia Frost Nerbonne and Robby Schreiber, one graduate student and thirteen undergraduate students from the Higher Education Consortium for Urban Affairs (HECUA) Environmental Sustainability Program completed an evaluation of the first SHEP season in the Rice Creek Watershed District.

Through at least fifteen hours of transcribed interviews, fifty hours of participant observation, two short surveys, and extensive review of background information, students and staff at HECUA evaluated three core aspects of the Stream Health Evaluation Program:

1. **The volunteer experience**
   The *volunteer group* evaluated the experience of the SHEP volunteers to better understand volunteer interests and motivations. This group examined volunteer recruitment tools, volunteer engagement levels and volunteer expectations for data collection and data use. This group also evaluated programmatic volunteer support and determined if and how volunteers are willing to make a long-term commitment to the program.

2. **The efficacy of the data collected**
   The *technical group* researched the efficacy of the data that SHEP groups collected. Through interviews with professional biologists and local government staff, students assessed the ways that macroinvertebrate monitoring data can be used as a tool for understanding watershed change. This aspect of the study also provides recommendations on how citizen data can be best utilized, and analyzes several scenarios relating to enhanced data dissemination.

3. **The broader context in which the project is being conducted**
   The *broader context group* studied the value of the Stream Health Evaluation Program as it relates to public policy. Through interviews with local decision makers and residents, and review of city, county and watershed ordinances, students explored the broader context in which the SHEP program is running. What kinds of threats exist in this rapidly growing suburban area, and what kind of decisions are being made that could change the future of water resources in the area? Are decision makers prepared to make some of the changes necessary to protect the watershed? Why or why not? Are they open to the use of citizen data? How might SHEP be packaged most effectively to make a difference?

HECUA presented the results of their findings at a presentation to watershed stakeholders and SHEP representatives in December of 2006. This presentation was followed by a final report, which addressed findings in each of the above categories in detail.

5.2 HECUA Evaluation Executive Summary

Executive Summary
Population growth and land development in peri-urban areas can strongly affect water quality. Construction of impervious surfaces concomitant with development increases storm water runoff to nearby bodies of water. Recent population growth trends in the seven-county metropolitan area of Minneapolis/St. Paul indicate the fastest population growth and resulting development is largely in the Rice Creek Watershed District (RCWD). The RCWD holds numerous lakes, chains of lakes, rivers, and streams across three counties and twenty-seven cities. This concern over local water resources has increased in the face of current and future development.

In response to this concern, the Friends of the Mississippi River (FMR) in partnership with the RCWD, the Anoka Conservation District, a number of local cities, Minnesota Waters and the Minnesota Pollution Control Agency (MPCA), began a pilot project in 2006 to monitor water quality in Rice Creek Watershed using adult volunteers. The project, called Stream Health Evaluation Program (SHEP) used 28 adult volunteers organized in three teams to monitor a total of six sites in the fall of 2006, two sites each at Hardwood Creek, Rice Creek, and the inlet of Locke Lake. Locations were chosen to study the effects of recent restorations on these streams, with one site being upstream of the restoration site and ones below the restoration site at each location.

The SHEP monitoring protocol was adapted from similar methods used by the Volunteer Stream Monitoring Partnership and the MPCA. The protocol was divided into two sections: a physical habitat assessment and a biological assessment of aquatic macroinvertebrates. Volunteers participated in 1.5 days of training, covering the in-stream physical assessment and macroinvertebrate collection methods, and laboratory macroinvertebrate identification procedure. Each volunteer group collected data at one site and cross-checked a separate site. After macroinvertebrate collection was completed, volunteers spent one day in the lab identifying samples. The samples were later cross-checked by professionals.

SHEP held three main goals for the first year of the program: accurate and useful data collection, cultivation of a volunteer base to perpetuate the program in the future, and motivating citizen engagement in the quality of the water in the area. SHEP organizers partnered with the Higher Education Consortium for Urban Affairs (HECUA) Environmental Sustainability program to evaluate SHEP's first year in relation to these goals.

Guided by Dr. Julia Frost Nerbonne and Robby Schreiber, one graduate student and thirteen undergraduate students in the HECUA Environmental Sustainability program completed an evaluation of SHEP's first season. The class split into three groups to evaluate each of SHEP's goals: the *technical group* researched the efficacy of the data that SHEP groups collected, the *volunteer group* evaluated the experience of the SHEP

volunteers to better understand volunteer interests and motivations, and the *broader context group* studied the value of the SHEP program as it relates to public policy.

Methods

The technical evaluation assessed both the accuracy and utility of data collected by SHEP volunteers. Was the data collected in 2006 able to help SHEP meet the goals of accurate and useful data? This group performed a literature review of both professional and volunteer macroinvertebrate monitoring techniques and examined three case studies of successful macroinvertebrate monitoring programs in California, Michigan, and Washington State. Semi-structured in person, phone, and email interviews of seven Twin Cities water resources professionals were conducted. Interviews were transcribed and coded for emerging themes. Students observed four of the six in-stream monitoring days, examining volunteer field monitoring for replicability and accuracy.

The volunteer evaluation assessed what motivated SHEP volunteers to participate in the program, what might motivate them to continue, and examined the program for successes and potential areas of improvement. This group conducted a mail survey sent to all 28 volunteers who participated in the SHEP program. The survey consisted of 17 multi-part questions, both scaled and open-ended. Questions focused on the broad categories of motivation and program success/improvement. All 28 surveys were returned.

To understand the context of survey results, semi-structured phone and in-person interviews were conducted of three volunteer group leaders and seven volunteers. Interviews were recorded, transcribed and coded for emerging themes.

The broader context evaluation focused on how the SHEP program could influence public policy in a way that contributes to an overall increase in the quality of watershed stewardship. This group conducted a focus group of the volunteer group leaders, interviewed eight decision-makers related to the RCWD, and reviewed the decision-making structures that existed within the local area.

Findings

Technical Efficacy

From literature and case study review, macroinvertebrate monitoring programs across the country commonly include three components: macroinvertebrate assessment, habitat assessment (including substrate classification, describing surrounding vegetation, and taking a picture or drawing the site), and water chemistry testing (including temperature, pH, turbidity, conductivity, and nutrient tests.) The case studies were shown to be successful in providing baseline stream quality data, as well as identifying potential restoration sites, mapping floodplains, and tracking the effects of development.

Observations of SHEP's in-stream monitoring protocol showed consistent and confident macroinvertebrate collection methods. During collection, volunteers paid close attention to detail, randomness, and replicability, a great success and positive indicator for the

SHEP protocol. However, methodological consistency of the physical habitat assessment varied widely from group to group. While some volunteers were more systematic and technical, others demonstrated broader estimation and guesswork, indicating that this portion of the monitoring would benefit from greater focus.

The accuracy of the macroinvertebrate identification by the volunteers was extremely high: quality control by professionals showed greater than 95% of 1,477 samples were correctly identified to family by the volunteers. This is a remarkable accuracy rate for a pilot program and a great success.

The Family Biotic Index (FBI) for each site is summarized in the Table 1:

	Above Restoration	*Below Restoration*
Rice Creek	8.8	8.3
Locke Lake	5.0	5.3
Hardwood Creek	7.6	5.1

Table 1*: FBIs for each location above and below restoration sites.*

As illustrated, Rice Creek and Locke Lake show little difference this season, while Hardwood Creek demonstrates some positive change. Water resources professionals indicated that differences between above and below restoration sites may take several seasons to demonstrate change in the biotic community, and it is likely that SHEP methods will track those changes.

Interviews with water resource professionals indicated that we can expect SHEP to provide baseline data on stream quality. Whether the program will be able to expand from this data use remains to be seen. Water resource professionals expressed that the higher the accuracy, replicability, and variety of the data, the more useful, and likely to be used, it will be. As stated, the accuracy of the macroinvertebrate identification was extremely high. Water resource professionals expressed some doubt over the replicability of the habitat assessment, echoed by the volunteers themselves in interviews and the survey, and observed by the technical evaluation group. The professionals also commented that adding water chemistry information to a more standardized habitat assessment would make the macroinvertebrate data more robust, echoed by comments from decision-makers in the broader context interviews. A greater variety of analysis methods allows for a more specific explanation of biotic index results, as well as providing opportunities for more immediate data.

The Volunteer Experience

From the survey, the volunteer group found the following demographic results: 11 of the SHEP volunteers live in the RCWD, while 16 live in other areas of the metro; and 9 of the volunteers are retirees while 16 are not. In a scaled, multi-part question on volunteer motivation, the most popular motivation for volunteers to participate in SHEP was educational (26/28), followed closely by a desire to help protect water quality (25/28), building naturalist skills (23/28), getting outdoors (23/28), and having fun (22/28). 14/27 volunteers chose educational experience as the most important reason for getting involved in SHEP, 9/27 chose collecting data, and 4/27 chose fighting pollution.

In interviews and open-ended survey comments, volunteers expressed comfort with the macroinvertebrate collection training, but felt they could use more training on habitat assessment and macroinvertebrate identification. Group leaders also felt that they could benefit from a separate training.

Volunteers expressed confidence in the in-stream macroinvertebrate collection, but would like to see the habitat assessment more systematized. Interestingly, volunteers also expressed uncertainty on their identification process, though the quality control proved their skills to be more than adequate.

In interviews and open-ended survey comments, volunteers made several comments on the organization of the program. Two people dropped out of the program due to scheduling conflicts, and nine other volunteers mentioned they would like to see the groups matched by schedule. The volunteers also suggested improving the organization of equipment, as well as double-checking to ensure that all private landowners receive prior notice of monitoring on their property. Group leaders mentioned a desire for more organization around their roles, as well.

28/28 volunteers expressed that they enjoyed their SHEP experience. The majority of volunteers agreed that they had fun, learned a lot of interesting information, and met new people whose company they enjoyed. The majority of volunteers would like to participate in SHEP next year, a great success for the program. The main reason cited for this enthusiasm was fun, stemming from the educational and social opportunity the program presented.

The majority of volunteers also reported that their SHEP experience made them more aware of and engaged in local watershed politics, that they would be more likely to participate in those politics, and that they would be willing to help present their data to local decision-makers. Interviews and open-ended answers indicated an overwhelming amount of enthusiasm and support for SHEP from the volunteers, with a broad interest in learning about ways they could support and present SHEP in watershed decision-making.

Utility of SHEP Data in the Broader Public Policy Arena

The broader context group found that decision-makers were most influenced by watershed data when data demonstrates impacts on health, recreation, valued wildlife, or finances. Hard, visual evidence such as changes in water clarity and visible pollution are also seriously considered. Decision-makers also consider citizen concern about water quality. This concern tends to be two-fold in relation to development: during construction, soil displacement, compaction and erosion can affect water clarity, impacting wildlife and recreational enjoyment; after development is completed, new impervious surfaces increase storm water runoff, disrupting stream flow and adding contaminants from roads and stressed sewer drainage. Though decision-makers value both data and citizen concern, they expressed that an engaged, educated citizenry has a much greater influence than data alone, and that they believed a program such as SHEP would produce such a group of educated citizen advocates.

Recommendations

From these findings, we identified several areas of potential growth for SHEP, as well as several areas of success.

First, we recommend **increasing targeted portions of the training**. From both volunteer and technical results, deeper understanding and stricter methodology on the physical habitat assessment would be useful for all volunteers, giving better data for professionals and decision-makers. Though volunteers were outstanding at macroinvertebrate collection, their survey and interview responses showed that they were less confident about collecting quality physical habitat data. In addition, adding an optional identification training would allow those less confident to feel more comfortable in this area, giving volunteers a better experience. Finally, providing an extra training specifically for group leaders would give those leaders more confidence and information to enforce the scientific method and answer questions when needed.

Second, we recommend an **expansion of the monitoring focus** to include simple water quality and physical habitat parameters that would keep volunteers active year round and give the SHEP program data that can be more immediately related to the expansion of development in the watershed. Both the technical and broader context results support broadening SHEP protocols to include the collection of more data that can be used to assess the immediate impact of development on in-stream water quality and public health. Volunteer leaders also expressed an interest in expanding monitoring activities so that they can keep their group active throughout the year. Adding a component to the SHEP program that is simple, inexpensive, and enhances the immediacy of the biotic data would be valuable across all areas of interest. For example, turbidity tubes are an inexpensive and simple way to measure water clarity, and taking a photo of the physical habitat in addition to the assessment ensures more consistent results.

Finally, we recommend **greater communication and organization between all audiences**: SHEP organizers, volunteers, water resources professionals, decision-makers, and the broader community. Greater communication and organization can avoid equipment confusion, landowner conflicts, and scheduling difficulties. Greater communication between SHEP organizers, water resource professionals, and local decision-makers can help SHEP choose whether and how to grow their data collection. Finally, facilitating communication between SHEP volunteers and the broader community can keep the enthusiastic momentum of the program going strong even outside of the field season, and can harness the deeper feelings of engagement that volunteers feel because of SHEP.

Overall, we feel that this first year of SHEP was a great success. We find the outstanding macroinvertebrate identification accuracy to be a reflection of the commitment and interest of the 28 volunteers participating. The enormous volunteer enthusiasm and support this program fostered is outstanding. Volunteers made it very clear that they had lots of fun and a very enjoyable experience, and indicated a strong desire for future participation. Not only did this program provide baseline data on streams, but it also developed a great group of volunteers, who came back with a deeper appreciation for the watershed and a willingness to let others know about it.

This first year is a valuable and fortuitous foundation on which SHEP can build an even better season than the first. Something great happened, and it can also be used to effect change in and engage the broader community.