Biological and Physical Habitat Study of Fall Run (Wheeling Creek Watershed)

Belmont County
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TABLE OF CONTENTS

NOTICE TO USERS ii

FOREWORD iv

INTRODUCTION 1

SUMMARY 1

RECOMMENDATIONS 3

METHODS 5

RESULTS 7
Physical Habitat Assessment 7
Macroinvertebrate Community Assessment 7
Fish Community Assessment 8

REFERENCES 11
APPENDICES 14

NOTICE TO USERS

Ohio EPA incorporated biological criteria into the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish assemblage data, and the Invertebrate Community Index (ICI), which is based on macroinvertebrate assemblage data. Criteria for each index are specified for each of Ohio's five ecoregions (as described by Omernik 1987), and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the existing chemical and whole effluent toxicity evaluation methods and criteria, figure prominently in the monitoring and assessment of Ohio's surface water resources.

The following documents support the use of biological criteria by outlining the rationale for using biological information, the methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results:

Ohio Environmental Protection Agency. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989b. Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Plan. & Assess., Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989c. Biological criteria for the protection of aquatic life: Volume III.. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Since the publication of the preceding guidance documents, the following new publications by the Ohio EPA have become available. These publications should also be consulted as they represent the latest information and analyses used by the Ohio EPA to implement the biological criteria.

DeShon, J.D. 1995. Development and application of the invertebrate community index (ICI), pp. 217-243. in W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological criteria program development and implementation in Ohio, pp. 109-144. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. The role of biological criteria in water quality monitoring, assessment, and regulation. Environmental Regulation in Ohio: How to Cope With the Regulatory Jungle. Inst. of Business Law, Santa Monica, CA. 54 pp.

These documents and this report may be obtained by writing to:

Ohio EPA, Division of Surface Water
Ecological Assessment Section
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FOREWORD

What is a Biological and Water Quality Survey?

A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 6-10 different study areas with an aggregate total of 350-400 sampling sites.

Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. The data gathered by a biosurvey is processed, evaluated, and synthesized in a biological and water quality report. Each biological and water quality study contains a summary of major findings and recommendations for revisions to WQS, future monitoring needs, or other actions which may be needed to resolve existing impairment of designated uses. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, are also addressed.

The findings and conclusions of a biological and water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.*, NPDES permits, Director's Orders, the Ohio Water Quality Standards [OAC 3745-1]), and are eventually incorporated into Water Quality Permit Support Documents (WQPSDs), State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the Ohio Water Resource Inventory (305[b] report).

Hierarchy of Indicators

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach is outlined in Figure 1 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or

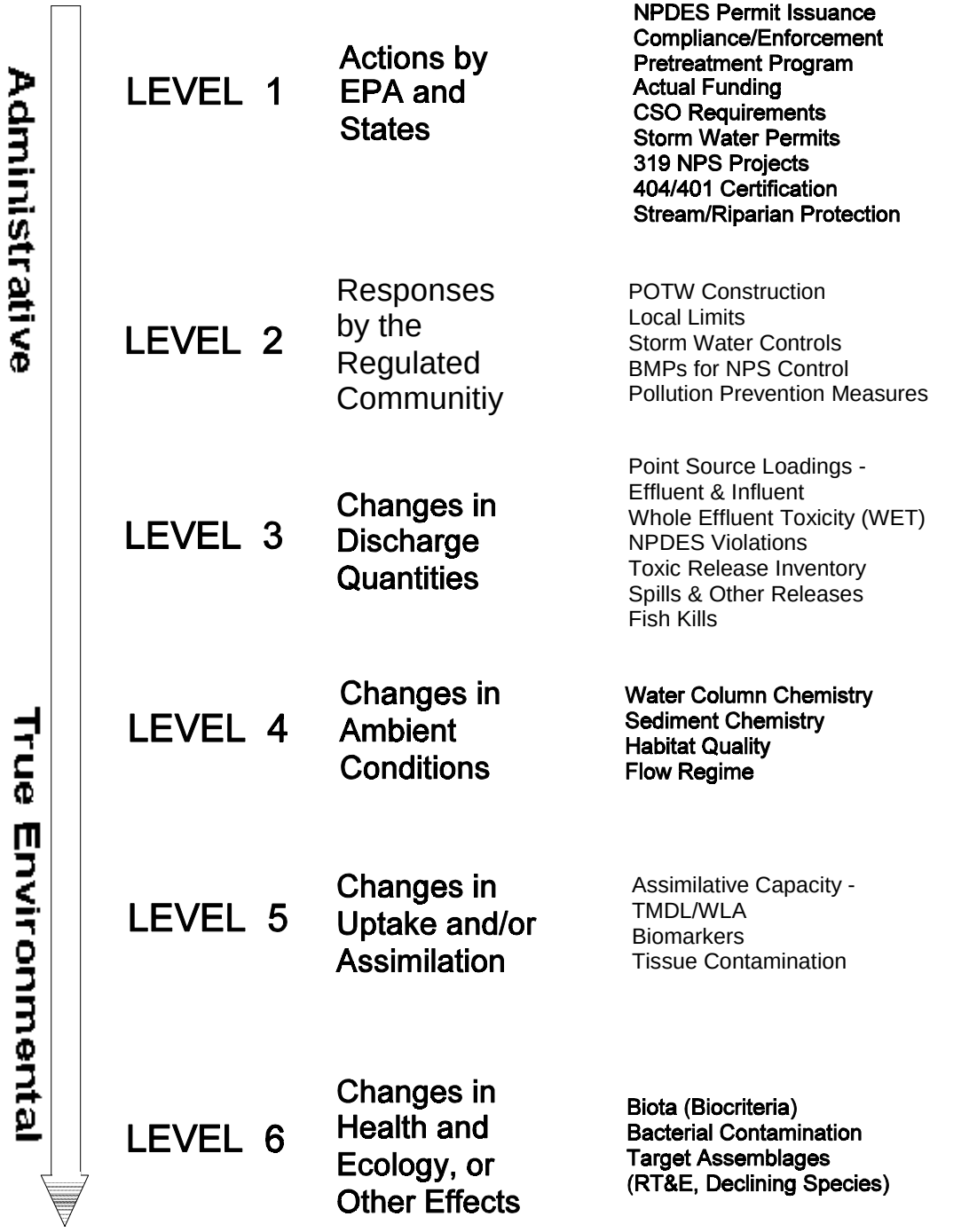

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health, ecology, or other effects (ecological condition, pathogens). In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages, *i.e.*, rare, threatened, endangered, special status, and declining species or bacterial levels which serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each.

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report), the Ohio Nonpoint Source Assessment, and other technical bulletins.

Ohio Water Quality Standards: Designated Aquatic Life Uses

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses.

The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*
2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*
3) *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.
4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned and permitted by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.
5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.^{2} drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Ohio Water Quality Standards: Non-Aquatic Life Uses

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliforms, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Department of Health and are detailed in other documents.

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    Fish community - Bob Miltner
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Report coordination - Jeff DeShon
Reviewer(s) - Marc Smith

INTRODUCTION

Monitoring of fish and macroinvertebrate communities along with an assessment of physical habitat quality was conducted in the Fall Run (Wheeling Creek) watershed during the summer of 2002. Three sampling sites were located on Fall Run, two were on an unnamed tributary to Fall Run (a.k.a. Hunkey Hollow Run), one on another unnamed tributary to Fall Run (a.k.a. Greys Ridge Run), and two were on Wheeling Creek (Table 1).

Specific objectives of this study were to:

1) determine the appropriate aquatic life use designations or verify the existing designations for streams sampled within the study area,

2) ascertain the status of fish and macroinvertebrate community conditions in the Fall Run watershed as affected by known acid mine drainage (AMD) seeps, and

3) recommend whether mitigation of AMD seeps within the Fall Run watershed will restore the aquatic life use attainment potential of the streams in the study area.

SUMMARY

A summary of monitoring results and the attainment status of current or recommended aquatic life uses in the Fall Run/Wheeling Creek study area can be found in Table 1. Index metrics and scores and raw species lists are tabulated in Appendix Table 1 (macroinvertebrates) and Appendix Table 2 (fish).

Monitoring of fish and macroinvertebrates in Fall Run reflected communities slightly but clearly affected by AMD impacts to the stream. The current Warmwater Habitat (WWH) aquatic life use was partially attained at the site upstream from the known AMD sources (RM 1.3). However, conditions declined at the site located below the AMD seeps where both fish and macroinvertebrates reflected a lowering of biological community quality (RM 1.2). Whereas macroinvertebrates were assessed as good at the upstream site and performing at ecoregional expectations, the community declined into the fair range at RM 1.2 and was considered in non-attainment of the WWH use. Fish were in the fair, not attaining category at both sites but the difference in IBI scores between the sites was considered significant and reflected a negative effect from the intervening mine seeps. Both fish and macroinvertebrate communities recovered modestly from the impacts as evidenced by full attainment of the WWH use at RM 0.1 near the confluence with Wheeling Creek. However, while communities were considered in full attainment, both the IBI score and the ICI score fell within the range of nonsignificant departure of the Western Allegheny Plateau biocriteria and indicated a marginal achievement of ecoregional expectations.

Table 1. Attainment status of the recommended stream aquatic life uses for Wheeling Creek and the Fall Run subwatershed based on biological sampling conducted during 2002.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status	Site Location
Wheeling Cr. (2002) *Western Allegheny Plateau (WAP) - LWH (existing)/WWH (recommended)*						
12.3 / 12.3	38*	6.3*	42	76.0	PARTIAL	Upst. Fall Run
12.2 / 12.2	41ns	6.4*	40	76.0	PARTIAL	Dst. Fall Run
Fall Run (2002) *Western Allegheny Plateau (WAP) - WWH (existing and recommended)*						
1.3 / 1.3	34*	NA	G	69.0	PARTIAL	Upst. all AMD sources
1.2 / 1.2	28*	NA	F*	63.5	**NON**	Dst. AMD sources
0.1 / 0.1	41ns	NA	34ns	58.0	FULL	Upst. Greys Ridge Run
Trib. to Fall Run (RM 1.12) (2002) *Western Allegheny Plateau (WAP) - Undesignated*[a] ***(a. k. a. Hunkey Hollow Run***)						
0.25/0.25	26 (P)	NA	G	58.0	-	Upst. known AMD sources
0.05/0.05	28 (F)	NA	MG	57.5	-	Dst. AMD sources
Trib. to Fall Run (RM 0.08) (2002) *Western Allegheny Plateau (WAP) - Undesignated*[a] ***(a.k.a. Greys Ridge Run)***						
- /0.05	-	-	MG	-	-	Near mouth

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

(from OAC 3745-1-07, Table 7-16)

INDEX	WWH	EWH	MWH[b]
IBI-Headwater	44	50	30
IBI-Wading	44	50	24
MIwb - Wading	8.4	9.4	5.5
ICI	36	46	30

a This small stream can be best characterized as a Class III Primary Headwater Habitat (PHWH) water body as defined by a recent Ohio EPA technical document (Ohio EPA 2002). As such, no attempt has been made to determine attainment status since this use has not yet been promulgated in the Ohio Water Quality Standards. When the PHWH use becomes codified, this stream will be assigned an appropriate aquatic life use utilizing the Ohio EPA rulemaking process established for designating aquatic life uses for Ohio streams.

b Modified Warmwater Habitat for mine affected areas.

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.

ns Nonsignificant departure from ecoregion biocriterion ($\leq$4 IBI and ICI units, $\leq$0.5 MIwb units).

NA MIwb not applicable at headwater stream sites.

As might be expected with the overall good, but marginal, biological condition of Fall Run at the mouth, there was no apparent impact on downstream biological communities in Wheeling Creek. Both fish and macroinvertebrates were very similar in structure and function at both RMs 12.3 and 12.2, upstream and downstream from Fall Run. Attainment status of the recommended WWH aquatic life use was partial at both sites. This was primarily due to subpar performances of the fish communities at the two sites especially with regards to the MIwb, lower scores of which, in this case, reflected depressed abundance of fish numbers. IBI scores were at (downstream site) or just below (upstream site) the minimum ecoregional reference condition. Conversely, macroinvertebrates were rated as good at both sites with ICI scores exceeding the WWH biocriterion. However, the near absence of mayfly populations at both sites was an indication of imbalanced macroinvertebrate communities. This response, as well as the reduced numerical abundance of fish, has been found to be very characteristic of impacts due to widespread mining land uses in southeastern Ohio watersheds.

Macroinvertebrate communities in the two small Fall Run tributaries were assessed as marginally good to good and reflected conditions near what would be expected in small Class 3 Primary Headwater Habitat (PHWH) streams. Extensive deposits of iron precipitates at the mouth of Hunkey Hollow Run was evidence of AMD impacts although the effect on the macroinvertebrate community was limited to a decline in mayfly diversity. Likewise, fish were sparsely represented both in diversity of species and in numerical abundance at the two sites in Hunkey Hollow Run. This was an expected condition given the extremely small size of the subwatershed although an impact on the fish community from AMD sources was readily apparent.

RECOMMENDATIONS

Status of Aquatic Life Uses

Fall Run and Wheeling Creek were designated for aquatic life uses in the 1978 Ohio WQS. This study represents the first use of a standardized approach to the collection of instream biological and habitat data to evaluate and establish the aquatic life use designation for these two streams. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use.

Wheeling Creek is currently designated as Limited Warmwater Habitat (LWH) due to AMD conditions with an exemption of the WWH total dissolved solids criterion. All LWH streams and stream segments in Ohio are to undergo use attainability analyses and be reassigned to the appropriate, verified aquatic life use. While only very limited sampling was conducted in Wheeling

Creek during 2002, both in the number of sites and spatial coverage, results of fish, macroinvertebrate, and habitat sampling indicated that the WWH aquatic life use is the most appropriate designation for the stream in this area. Qualitative Habitat Evaluation Index (QHEI) scores for the two sampled sites were both 76, a value reflecting exceptional physical habitat quality and well in excess of the minimum threshold score of 60 associated with WWH potential. While fish index scores at both sites were in the fair to marginally good range and not meeting the WWH biocriteria, macroinvertebrate scores did exceed the WAP biocriterion and reflected good quality communities, albeit somewhat imbalanced due to the paucity of mayflies. Future monitoring of more of the mainstem of Wheeling Creek will be needed to verify that the WWH use is the most appropriate aquatic life use for the entirety of the creek.

Fall Run is currently designated as WWH in the Ohio WQS. Monitoring at sites within the stream during 2002 demonstrated that this is the appropriate aquatic life use. QHEI scores at the three monitoring locations ranged from 58.0 at RM 0.1 to 69.0 at RM 1.3; all scores were near or above the WWH minimum threshold score of 60 and reflected physical habitat conditions conducive to the support of WWH communities. More importantly, Western Allegheny Plateau (WAP) biocriteria established for fish and macroinvertebrates were met or exceeded and full attainment of the WWH use was achieved near the Fall Run confluence with Wheeling Creek (RM 0.1).

Both unnamed tributaries to Fall Run (a.k.a. Hunkey Hollow Run and Greys Ridge Run) are recommended to remain undesignated for aquatic life use. These small streams can be best characterized as Class III Primary Headwater Habitat (PHWH) water bodies as defined by a recent Ohio EPA technical document (Ohio EPA 2002). When the PHWH use becomes codified in the Ohio WQS, these streams will be assigned an appropriate aquatic life use utilizing the Ohio EPA rulemaking process established for designating aquatic life uses for Ohio streams.

Status of Non-Aquatic Life Uses

Physical habitat characteristics observed in Fall Run and Wheeling Creek during this study verified that the currently designated Primary Contact Recreation (PCR) use is appropriate and should be retained for both streams. Waters in each stream were of sufficient depth and extent and/or conducive to body contact recreational activities to support the PCR use.

Other Recommendations

Based on the assessment of fish and macroinvertebrate communities in Fall Run, ample evidence exists to document an aquatic life use impairment due to impacts from AMD seeps. While the degree of impairment when compared to upstream background biological condition is fairly slight, the stream is clearly in non-attainment of its WWH aquatic life use. Efforts to remediate the effects of AMD parameters, if successful, should bring about positive changes in fish and macroinvertebrate structure and function and lead to communities performing at a level meeting or

exceeding the ecoregional expectation. However, it is important that the remediation efforts do not compromise the existing good physical habitat quality of Fall Run. Overall, though, the lessening of AMD parameter loadings to the Wheeling Creek watershed can only prove beneficial in the long run as more widespread abatement projects are initiated at other locations within the watershed.

METHODS

All physical habitat and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995).

Determining Use Attainment Status

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-16). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - Full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.*, full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description.

Physical Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the habitat characteristics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided

water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

Macroinvertebrate Community Assessment

Macroinvertebrates were collected from artificial substrates and/or from the natural habitats at all sites in the Fall Run/Wheeling Creek study area. The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. Natural substrates were sampled using a qualitative multihabitat composite protocol. This sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (e.g., riffle, run, pool, margin). Artificial substrates with qualitative multihabitat composite samples were collected from the two Wheeling Creek sites and the site at the mouth of Fall Run. Qualitative multihabitat composite samples were taken at all the remaining sites. Detailed discussion of macroinvertebrate field and laboratory procedures is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

Fish Community Assessment

Fish were sampled twice at each site using pulsed DC electrofishing methods, with sampling distances at each site varying between 150 and 220 meters in length. Fish were processed in the field, and included identifying each individual to species, counting, weighing, and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, within a weight of evidence framework, has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, land use data, and biological results (Yoder and Rankin 1995). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or

statistically linked together. The ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

RESULTS

Physical Habitat Assessment

Physical habitat was evaluated in the Fall Run/Wheeling Creek study area at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are listed in Table 1 and detailed in Table 2.

Fall Run

The QHEI scores for the three sites sampled on Fall Run averaged 63.5, suggesting sufficient habitat quality to support WWH aquatic communities. Especially noteworthy is that the ratio of positive habitat attributes (or WWH attributes) equaled or exceeded negative (or Modified) attributes. Negative attributes present at the two locations sampled downstream from Acid Mine Drainage (AMD) sources were riffle and substrate embeddedness from fines that appeared to have originated from mine discharges.

Tributary to Fall Run (RM 1.12) "Hunkey Hollow Run"

The habitat evaluated at the two sites sampled in Hunkey Hollow Run had more positive than negative habitat attributes, a mix of substrate types (gravel, cobble, bedrock), and a natural sinuous channel, but a very shallow depth, suggesting that the stream should be capable of supporting Class III PHWH biotas. As with Fall Run, the site on Hunkey Hollow Run located downstream from the AMD source had substrates embedded with fines.

Wheeling Creek

The habitat in Wheeling Creek was assessed immediately upstream and downstream from Fall Run. Both sites had excellent habitat quality characterized by a natural stream channel, a diversity of substrate kinds and sizes, and deep pools. The only negative habitat attributes were moderately embedded substrates and riffles; again, an indication of the pervasiveness of AMD in the drainage basin.

Macroinvertebrate Community Assessment

Fall Run

Macroinvertebrate collections from the three Fall Run sampling locations reflected an impact and a subsequent modest, but incomplete, recovery from AMD seeps to the stream. A good quality community was collected at the upstream site (RM 1.3). Thirty-six unique taxa were collected including 4 taxa of mayflies, 2 taxa of stoneflies, and 6 taxa of caddisflies; these three groups (referred to as the EPT taxa) are generally considered pollution intolerant and their good diversity at the upstream site indicated a good quality resource. Community quality declined at the middle

site (RM 1.2) which was located downstream from the principal AMD seep. Total and EPT diversity were nearly halved at this site with only 20 taxa collected including 1 mayfly taxon, 2 stonefly taxa, and 3 caddisfly taxa. Observations of heavy iron precipitates and reduced abundance of macroinvertebrates compared to upstream were additional indications of the impact. Macroinvertebrates were assessed as fair and not meeting WAP ecoregional expectations. Some recovery occurred at the most downstream site near the Fall Run confluence with Wheeling Creek. At this location, data collected from artificial substrates scored an ICI value of 34 which was a nonsignificant departure from the WAP ecoregion biocriterion and indicated a marginally good macroinvertebrate assemblage. Natural substrate sampling at this location also corraborated some recovery with 33 total taxa collected including 1 mayfly taxon, 2 stonefly taxa, and 6 caddisfly taxa. However, the continued presence of heavy iron precipitates and the near absence of mayflies were evidence of a continued AMD influence at this sampling site.

Wheeling Creek

The two Wheeling Creek sampling locations which bracketed Fall Run supported very similar macroinvertebrate assemblages and indicated no apparent effect by Fall Run on the water quality of Wheeling Creek. ICI scores of 42 and 40 were achieved at RMs 12.3 and 12.2, respectively. These scores exceeded the WAP ecoregion biocriterion and would have normally reflected good macroinvertebrate communities. However, as at the mouth of Fall Run, the mayfly component of the community was conspicuously depauperate and, while other expected components of the fauna were present, this absence of mayflies resulted in an unbalanced community structure and function. This type of macroinvertebrate response has been observed as very characteristic of southeastern Ohio watersheds receiving significant amounts of AMD loadings.

Tribs. to Fall Run ("Hunkey Hollow Run" and "Greys Ridge Run")

Macroinvertebrate communities in the two small Fall Run tributaries (a k a Hunkey Hollow Run and Greys Ridge Run) were assessed as marginally good to good and reflected conditions near what would be expected in small Class 3 PHWH streams. Total taxa diversity at the three sampling locations ranged between 25 (Greys Ridge Run) and 36 (Hunkey Hollow Run near its mouth). EPT taxa ranged between 6 and 10 with the upstream Hunkey Hollow Run site being the most diverse and assessed as good quality. The mouth sites at each tributary were assessed as marginally good and, while instream channel modifications likely limited biological performance in Greys Ridge Run, significant iron precipitates were present in Hunkey Hollow Run. At both sites, EPT diversity was essentially made up of caddisfly taxa with mayflies and stoneflies not present or represented by a single taxon.

Fish Community Assessment

Fall Run

The fish communities in Fall Run showed a pattern of impact and recovery from AMD (Figure 2). Although the fish community in Fall Run upstream (RM 1.3) from known AMD sources did not meet the regional expectation for a small headwater stream, the fish community performed better there than immediately downstream (RM 1.2) from the AMD source. Both communities were dominated by tolerant fishes; however, the percentage of pioneering fish met expectations for the stream size suggesting that the source of stress was chronic rather than acute. The site upstream

from the AMD had two darter and simple lithophilic species and compared to none and one, respectively, downstream, an indication that sedimentation is one of the stressors.

Tributary to Fall Run (RM 1.12) "Hunkey Hollow Run"

The fish communities in Hunkey Hollow Run were very sparse at the two sites sampled (RMs 0.05 and 0.25). At both sites, tolerant fishes, primarily creek chubs and blacknose dace composed the entire catch. No darters or sensitive species were collected. This combination suggested natural limitations to fish community diversity due to the very small stream size further influenced by chronic toxicity from AMD at both sites.

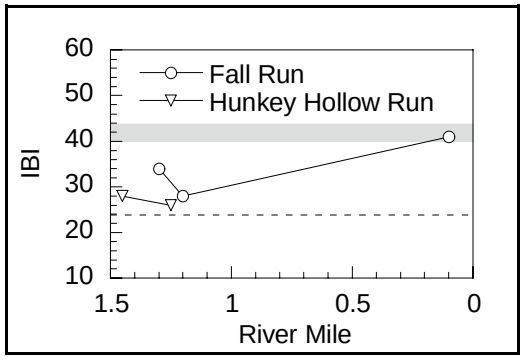

Figure 2. Plot of Index of Biotic Integrity (IBI) scores by river mile for Fall Run and Hunkey Hollow Run, 2002.

Wheeling Creek

Electrofishing samples were collected upstream and downstream from the confluence of Fall Run in Wheeling Creek. The Modified Index of well-being (MIwb) failed to meet the ecoregional expectation for medium sized WWH streams at both sites (6.2 upstream, 6.4 downstream, both assessed as fair). The Index of Biotic Integrity (IBI) score (41, mean of two passes) downstream from Fall Run was in the range of nonsignificant departure from the WWH criterion, and failed to meet the criterion upstream (IBI = 38). However, both IBI scores were within three points, suggesting that the difference was due to differences in habitat as the upstream site was primarily deep pool habitat, compared to the downstream site, which was primarily a series of riffles and runs. The habitat, however, was good to excellent in both cases, suggesting that the fair to marginal performance of both biotic indexes was related to AMD influences pervasive throughout the watershed as opposed to a localized impact from Fall Run.

Table 2. Qualitative Habitat Evaluation Index (QHEI) scores for sites in the Fall Run/Wheeling Creek study area, 2002.

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	MWH Attributes (High Influence): Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	MWH Attributes (Moderate Influence): Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total M.I. MWH Attributes	(MWH H.I.+1)/(WWH+1) Ratio	(MWH M.I.+1)/(WWH+1) Ratio
(06-800) Wheeling Creek																																		
Year: 2002																																		
12.3	**76.0**	16.13	■	■		■	■	■	■	■	■		8						0									■	■		2	0.11	0.33
12.2	**76.0**	16.13	■	■		■	■	■	■	■	■		8						0									■	■		2	0.11	0.33
(06-807) Fall Run																																		
Year: 2002																																		
1.3	**69.0**	95.24	■	■		■	■	■		■	■	■	8						0									■			1	0.11	0.22
1.2	**63.5**	95.24	■	■		■	■	■		■	■		8						0									■	■	■	3	0.11	0.44
0.1	**58.0**	21.28	■	■			■	■			■		5				◆		1				■					■	■	■	4	0.33	1.00
(06-821) Trib. to Fall Run (RM 1.12)																																		
Year: 2002																																		
0.2	**58.0**	100.0	■	■		■	■	■		■	■		7						0				■					■		■	3	0.13	0.50
0.0	**57.5**	125.0	■	■		■	■	■		■			6				◆		1				■					■	■	■	4	0.29	0.86

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APPENDICES

Appendix Table 1. Invertebrate Community Index (ICI) metrics and scores and species lists for sampling locations in the Wheeling Creek/Fall Run study area, 2002.

River Mile	Drainage Area (sq mi)	Number of				Percent:							
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms	Qual. EPT	Eco-region	ICI
Wheeling Creek (06-800)													
Year: 2002													
12.30	78.0	33(4)	1(0)	9(6)	18(4)	0.1(2)	17.1(6)	48.3(6)	34.3(4)	3.6(6)	10(4)	4	42
12.20	82.0	27(4)	0(0)	6(6)	16(4)	0.0(0)	17.8(6)	59.6(6)	22.6(6)	1.9(6)	7(2)	4	40
Fall Run (06-807)													
Year: 2002													
0.10	3.4	37(4)	0(0)	5(6)	20(6)	0.0(0)	11.1(6)	7.2(2)	75.6(0)	5.0(6)	9(4)	4	34

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/2002 River Code: 06-800 RM: 12.30 Site: Wheeling Creek upst. Fall Run

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
01900	*Nemertea*	24
03600	*Oligochaeta*	+
06830	*Gammarus minus*	+
08200	*Orconectes sp*	+
08601	*Hydracarina*	88 +
13400	*Stenacron sp*	+
17200	*Caenis sp*	2 +
21200	*Calopteryx sp*	+
23909	*Boyeria vinosa*	+
50301	*Chimarra aterrima*	1 +
50315	*Chimarra obscura*	12 +
51600	*Polycentropus sp*	1
52200	*Cheumatopsyche sp*	108 +
52430	*Ceratopsyche morosa group*	237 +
52540	*Hydropsyche dicantha*	1 +
53800	*Hydroptila sp*	54 +
54100	*Neotrichia sp*	13
57900	*Pycnopsyche sp*	1 +
59555	*Oecetis inconspicua complex sp F (sensu Floyd, 1995)*	+
60900	*Peltodytes sp*	+
68075	*Psephenus herricki*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	1 +
69400	*Stenelmis sp*	5 +
77120	*Ablabesmyia mallochi*	26 +
77500	*Conchapelopia sp*	105
77750	*Hayesomyia senata or Thienemannimyia norena*	132
80410	*Cricotopus (C.) sp*	53
80420	*Cricotopus (C.) bicinctus*	53 +
80430	*Cricotopus (C.) tremulus group*	53 +
80440	*Cricotopus (C.) trifascia*	+
81650	*Parametriocnemus sp*	105
81825	*Rheocricotopus (Psilocricotopus) robacki*	53
82141	*Thienemanniella xena*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	53 +
84300	*Phaenopsectra obediens group*	26
84450	*Polypedilum (Uresipedilum) flavum*	26
84460	*Polypedilum (P.) fallax group*	26
84470	*Polypedilum (P.) illinoense*	+
84700	*Stenochironomus sp*	+
85230	*Cladotanytarsus mancus group*	26 +
85500	*Paratanytarsus sp*	26
85625	*Rheotanytarsus sp*	763 +
85800	*Tanytarsus sp*	+
85821	*Tanytarsus glabrescens group sp 7*	368 +
85840	*Tanytarsus guerlus group*	26 +
87540	*Hemerodromia sp*	24 +
95100	*Physella sp*	10 +

No. Quantitative Taxa: 33 Total Taxa: 50
No. Qualitative Taxa: 38 ICI: **42**
Number of Organisms: 2502 Qual EPT: 10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/2002 River Code: 06-800 RM: 12.20 Site: Wheeling Creek dst. Fall Run

Taxa Code	Taxa	Quant/Qual
01900	*Nemertea*	4 +
03360	*Plumatella sp*	1
06201	*Hyalella azteca*	+
06830	*Gammarus minus*	1 +
08200	*Orconectes sp*	+
08601	*Hydracarina*	8 +
13400	*Stenacron sp*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
50315	*Chimarra obscura*	31 +
52200	*Cheumatopsyche sp*	79 +
52430	*Ceratopsyche morosa group*	188 +
52540	*Hydropsyche dicantha*	8 +
53800	*Hydroptila sp*	4 +
54100	*Neotrichia sp*	12
59550	*Oecetis inconspicua complex sp A (sensu Floyd, 1995)*	+
60900	*Peltodytes sp*	+
65800	*Berosus sp*	+
68708	*Dubiraphia vittata group*	+
69400	*Stenelmis sp*	+
70600	*Antocha sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	13 +
77500	*Conchapelopia sp*	53 +
77750	*Hayesomyia senata or Thienemannimyia norena*	40
77800	*Helopelopia sp*	27
78450	*Nilotanypus fimbriatus*	40
78655	*Procladius (Holotanypus) sp*	+
80410	*Cricotopus (C.) sp*	67 +
80420	*Cricotopus (C.) bicinctus*	+
80430	*Cricotopus (C.) tremulus group*	+
80440	*Cricotopus (C.) trifascia*	+
81650	*Parametriocnemus sp*	27 +
81825	*Rheocricotopus (Psilocricotopus) robacki*	40
82710	*Chironomus (C.) sp*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84300	*Phaenopsectra obediens group*	27 +
84450	*Polypedilum (Uresipedilum) flavum*	13
84460	*Polypedilum (P.) fallax group*	27
84470	*Polypedilum (P.) illinoense*	+
85625	*Rheotanytarsus sp*	959 +
85800	*Tanytarsus sp*	13 +
85821	*Tanytarsus glabrescens group sp 7*	93 +
85840	*Tanytarsus guerlus group*	13 +
87540	*Hemerodromia sp*	12
95100	*Physella sp*	8 +

No. Quantitative Taxa: 27 Total Taxa: 47

No. Qualitative Taxa: 38 ICI: **40**

Number of Organisms: 1808 Qual EPT: 7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/2002 River Code: 06-807 RM: 1.30 Site: Fall Run upst. AMD tributary

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
06830	*Gammarus minus*	+
08230	*Orconectes (Crokerinus) obscurus*	+
08601	*Hydracarina*	+
11430	*Diphetor hageni*	+
13400	*Stenacron sp*	+
15000	*Paraleptophlebia sp*	+
17200	*Caenis sp*	+
25510	*Stylogomphus albistylus*	+
33100	*Leuctra sp*	+
34130	*Acroneuria frisoni*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
50301	*Chimarra aterrima*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52440	*Ceratopsyche slossonae*	+
53800	*Hydroptila sp*	+
63300	*Hydroporus sp*	+
68075	*Psephenus herricki*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
70600	*Antocha sp*	+
71100	*Hexatoma sp*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
78350	*Meropelopia sp*	+
82820	*Cryptochironomus sp*	+
85625	*Rheotanytarsus sp*	+
85800	*Tanytarsus sp*	+
85821	*Tanytarsus glabrescens group sp 7*	+
85840	*Tanytarsus guerlus group*	+
87540	*Hemerodromia sp*	+
94400	*Fossaria sp*	+

No. Quantitative Taxa:	0	Total Taxa:	36
No. Qualitative Taxa:	36	ICI:	
Number of Organisms:	0	Qual EPT:	12

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/2002 River Code: 06-807 RM: 1.20 Site: Fall Run dst. AMD tributary

Taxa Code	Taxa	Quant/Qual
06830	*Gammarus minus*	+
07810	*Cambarus (Cambarus) carinirostris*	+
08230	*Orconectes (Crokerinus) obscurus*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
25510	*Stylogomphus albistylus*	+
33100	*Leuctra sp*	+
34130	*Acroneuria frisoni*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
63300	*Hydroporus sp*	+
68075	*Psephenus herricki*	+
69400	*Stenelmis sp*	+
81650	*Parametriocnemus sp*	+
84469	*Polypedilum (P.) illinoense group*	+
87540	*Hemerodromia sp*	+
94400	*Fossaria sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 20
No. Qualitative Taxa: 20 ICI:
Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/2002 River Code: 06-807 RM: 0.10 Site: Fall Run upst. Grays Ridge Run, near

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	2 +
01900	*Nemertea*	4
03600	*Oligochaeta*	4
06830	*Gammarus minus*	1
08230	*Orconectes (Crokerinus) obscurus*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	25 +
25510	*Stylogomphus albistylus*	+
33100	*Leuctra sp*	2 +
34130	*Acroneuria frisoni*	2 +
45300	*Sigara sp*	+
50301	*Chimarra aterrima*	4 +
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	19 +
52430	*Ceratopsyche morosa group*	21 +
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
53800	*Hydroptila sp*	14
54100	*Neotrichia sp*	2
67700	*Paracymus sp*	+
68025	*Ectopria sp*	1
68201	*Scirtidae*	2
68707	*Dubiraphia quadrinotata*	+
69400	*Stenelmis sp*	1 +
71100	*Hexatoma sp*	+
71300	*Limonia sp*	+
71900	*Tipula sp*	+
74501	*Ceratopogonidae*	16 +
77500	*Conchapelopia sp*	35
77800	*Helopelopia sp*	6
78450	*Nilotanypus fimbriatus*	9 +
80420	*Cricotopus (C.) bicinctus*	3 +
80440	*Cricotopus (C.) trifascia*	3 +
81650	*Parametriocnemus sp*	163
81825	*Rheocricotopus (Psilocricotopus) robacki*	29 +
82141	*Thienemanniella xena*	2
82820	*Cryptochironomus sp*	9 +
84300	*Phaenopsectra obediens group*	9
84460	*Polypedilum (P.) fallax group*	15
84601	*Saetheria species 1 (sensu Jackson, 1977)*	3
85400	*Micropsectra sp*	6
85625	*Rheotanytarsus sp*	12 +
85800	*Tanytarsus sp*	3 +
85821	*Tanytarsus glabrescens group sp 7*	15 +
85840	*Tanytarsus guerlus group*	3 +
87510	*Chelifera sp*	2
87540	*Hemerodromia sp*	88 +
94400	*Fossaria sp*	2 +
95100	*Physella sp*	5 +

No. Quantitative Taxa: 37 Total Taxa: 49
No. Qualitative Taxa: 33 ICI: **34**
Number of Organisms: 542 Qual EPT: 9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/2002 River Code: 06-820 RM: 0.05 Site: Trib. to Fall Run (RM 0.08)

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
06830	*Gammarus minus*	+
07810	*Cambarus (Cambarus) carinirostris*	+
21001	*Calopterygidae*	+
44501	*Corixidae*	+
48610	*Nigronia fasciatus*	+
50301	*Chimarra aterrima*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52315	*Diplectrona modesta*	+
52530	*Hydropsyche depravata group*	+
53501	*Hydroptilidae*	+
68025	*Ectopria sp*	+
69400	*Stenelmis sp*	+
71800	*Pseudolimnophila sp*	+
71900	*Tipula sp*	+
72700	*Anopheles sp*	+
77500	*Conchapelopia sp*	+
80420	*Cricotopus (C.) bicinctus*	+
81650	*Parametriocnemus sp*	+
81690	*Paratrichocladius sp*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84470	*Polypedilum (P.) illinoense*	+
87540	*Hemerodromia sp*	+
95100	*Physella sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 25
No. Qualitative Taxa: 25 ICI:
Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/12/2002 River Code: 06-821 RM: 0.25 Site: Trib. to Fall Run (RM 1.12) upst. AMD

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
06830	*Gammarus minus*	+			
07810	*Cambarus (Cambarus) carinirostris*	+			
11120	*Baetis flavistriga*	+			
11250	*Centroptilum sp (w/o hindwing pads)*	+			
15000	*Paraleptophlebia sp*	+			
17200	*Caenis sp*	+			
45300	*Sigara sp*	+			
47600	*Sialis sp*	+			
48610	*Nigronia fasciatus*	+			
52200	*Cheumatopsyche sp*	+			
52315	*Diplectrona modesta*	+			
52430	*Ceratopsyche morosa group*	+			
52440	*Ceratopsyche slossonae*	+			
52530	*Hydropsyche depravata group*	+			
57900	*Pycnopsyche sp*	+			
68025	*Ectopria sp*	+			
69400	*Stenelmis sp*	+			
71900	*Tipula sp*	+			
74100	*Simulium sp*	+			
78350	*Meropelopia sp*	+			
82200	*Tvetenia bavarica group*	+			
82710	*Chironomus (C.) sp*	+			
82820	*Cryptochironomus sp*	+			
84450	*Polypedilum (Uresipedilum) flavum*	+			
84470	*Polypedilum (P.) illinoense*	+			
85625	*Rheotanytarsus sp*	+			
85800	*Tanytarsus sp*	+			
94400	*Fossaria sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 29

No. Qualitative Taxa: 29 ICI:

Number of Organisms: 0 Qual EPT: 10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/13/2002 River Code: 06-821 RM: 0.05 Site: Trib. to Fall Run (RM 1.12) at mouth,

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
08230	*Orconectes (Crokerinus) obscurus*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
23909	*Boyeria vinosa*	+
25510	*Stylogomphus albistylus*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
53800	*Hydroptila sp*	+
61400	*Agabus sp*	+
67100	*Hydrobius sp*	+
67500	*Laccobius sp*	+
68708	*Dubiraphia vittata group*	+
69400	*Stenelmis sp*	+
71800	*Pseudolimnophila sp*	+
71900	*Tipula sp*	+
77500	*Conchapelopia sp*	+
81650	*Parametriocnemus sp*	+
82141	*Thienemanniella xena*	+
82710	*Chironomus (C.) sp*	+
82820	*Cryptochironomus sp*	+
84450	*Polypedilum (Uresipedilum) flavum*	+
84750	*Stictochironomus sp*	+
85500	*Paratanytarsus sp*	+
85625	*Rheotanytarsus sp*	+
85800	*Tanytarsus sp*	+
85821	*Tanytarsus glabrescens group sp 7*	+
87540	*Hemerodromia sp*	+
94400	*Fossaria sp*	+
95100	*Physella sp*	+
98200	*Pisidium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 36
No. Qualitative Taxa: 36 ICI:
Number of Organisms: 0 Qual EPT: 6

Appendix Table 2. Index of Biotic Integrity (IBI) metrics and scores and species lists for sampling locations in the Wheeling Creek/Fall Run study area, 2002.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
Wheeling Creek - (06800)																		
Year: 2002																		
12.30	D	08/07/2002	78	8(1)	1(1)	2(3)	2(1)	2(1)	81(5)	14(5)	3(5)	4.8(3)	92(5)	0.0(5)	81(1)	*	36	5.9
12.30	D	09/04/2002	78	9(1)	2(3)	3(3)	0(1)	2(1)	67(5)	19(5)	8(5)	7.1(5)	81(5)	0.0(5)	102(1)	*	40	6.6
12.20	D	08/07/2002	82	13(3)	2(3)	2(3)	2(1)	3(3)	46(5)	12(5)	0(5)	0.0(1)	46(3)	0.0(5)	305(3)		40	6.8
12.20	D	09/04/2002	82	11(3)	2(3)	2(3)	0(1)	3(3)	86(5)	9(5)	3(5)	3.0(3)	90(5)	0.0(5)	137(1)	*	42	5.9

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2. Index of Biotic Integrity (IBI) metrics and scores and species lists for sampling locations in the Wheeling Creek/Fall Run study area, 2002.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Percent of Individuals: Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Fall Run - (06-807)																
Year: 2002																
1.30	E	08/07/2002	2.3	7(3)	4(3)	1(1)	1(1)	2(3)	2(3)	89(1)	6(5)	17(5)	2(1)	0.0(5)	96(3)	34
1.20	E	08/07/2002	2.9	5(3)	4(3)	1(1)	0(1)	0(1)	1(1)	99(1)	2(5)	23(5)	1(1)	0.0(5)	15(1)	28
0.10	E	08/07/2002	3.4	12(5)	4(3)	2(3)	3(3)	3(5)	4(3)	71(1)	10(5)	37(3)	26(3)	0.0(5)	108(3)	42
0.10	E	09/04/2002	3.4	10(3)	4(3)	1(1)	2(3)	2(3)	3(3)	57(1)	3(5)	28(5)	35(5)	0.0(5)	125(3)	40
Fall Run trib 1.12 - (06-821)																
Year: 2002																
0.25	E	08/07/2002	0.5	2(1)	2(3)	1(1)	0(1)	0(1)	1(3)	100(1)	0(5)	31(3)	0(1)	0.0(5)	0(1)	26
0.05	E	08/07/2002	0.6	4(3)	3(3)	1(1)	0(1)	0(1)	1(3)	100(1)	6(5)	36(3)	6(1)	0.0(5)	0(1)	28

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

River Code: **06-800**	Stream: **Wheeling Creek**	Sample Date: **2002**
River Mile: **12.30**	Location: upst. Fall Run	Date Range: 08/07/2002
Time Fished: 2100 sec	Drainage: 78.0 sq mi	Thru: 09/04/2002
Dist Fished: 0.40 km	Basin: Central Ohio River Tribs No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Black Redhorse	R	I	S	I	4	3.00	2.72	1.28	12.80	425.00
Golden Redhorse	R	I	S	M	1	0.75	0.68	0.34	3.39	450.00
Northern Hog Sucker	R	I	S	M	23	17.25	15.65	1.69	16.94	97.83
White Sucker	W	O	S	T	7	5.25	4.76	0.31	3.13	59.29
Common Carp	G	O	M	T	2	1.50	1.36	3.94	39.52	2,625.00
Creek Chub	N	G	N	T	1	0.75	0.68	0.06	0.57	76.00
Silver Shiner	N	I	S	I	2	1.50	1.36	0.01	0.13	8.50
Smallmouth Bass	F	C	C	M	8	6.00	5.44	1.71	17.17	285.13
Largemouth Bass	F	C	C		1	0.75	0.68	0.02	0.15	20.00
Green Sunfish	S	I	C	T	15	11.25	10.20	0.31	3.13	27.67
Bluegill Sunfish	S	I	C	P	11	8.25	7.48	0.11	1.10	13.27
Hybrid X Sunfish					2	1.50	1.36	0.10	0.96	63.50
Greenside Darter	D	I	S	M	29	21.75	19.73	0.07	0.69	3.14
Rainbow Darter	D	I	S	M	41	30.75	27.89	0.03	0.35	1.11
	Mile Total				147	110.25		9.96		
	Number of Species				13					
	Number of Hybrids				1					

River Code: **06-800**	Stream: **Wheeling Creek**	Sample Date: **2002**
River Mile: **12.20**	Location: dst. Fall Run	Date Range: 08/07/2002
Time Fished:	Drainage: 82.0 sq mi	Thru: 09/04/2002
Dist Fished: 0.40 km	Basin: Central Ohio River Tribs No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Northern Hog Sucker	R	I	S	M	34	25.50	10.27	1.97	39.64	77.29
White Sucker	W	O	S	T	3	2.25	0.91	0.09	1.85	40.67
Common Carp	G	O	M	T	1	0.75	0.30	0.94	18.86	1,250.00
Blacknose Dace	N	G	S	T	9	6.75	2.72	0.02	0.38	2.78
Creek Chub	N	G	N	T	18	13.50	5.44	0.42	8.48	31.22
Silver Shiner	N	I	S	I	2	1.50	0.60	0.01	0.15	5.00
Rosyface Shiner	N	I	S	I	1	0.75	0.30	0.00	0.05	3.00
Sand Shiner	N	I	M	M	3	2.25	0.91	0.00	0.06	1.33
Central Stoneroller	N	H	N		101	75.75	30.51	0.96	19.32	12.68
Smallmouth Bass	F	C	C	M	3	2.25	0.91	0.14	2.79	61.33
Green Sunfish	S	I	C	T	6	4.50	1.81	0.07	1.32	14.50
Bluegill Sunfish	S	I	C	P	4	3.00	1.21	0.10	1.91	31.50
Johnny Darter	D	I	C		1	0.75	0.30	0.00	0.03	2.00
Greenside Darter	D	I	S	M	80	60.00	24.17	0.19	3.85	3.19
Rainbow Darter	D	I	S	M	63	47.25	19.03	0.07	1.32	1.38
Fantail Darter	D	I	C		2	1.50	0.60	0.00	0.06	2.00
	Mile Total				331	248.25		4.97		
	Number of Species				16					
	Number of Hybrids				0					

River Code: **06-807**	Stream: **Fall Run**	Sample Date: **2002**
River Mile: **1.30**	Location: upst. AMD tributary	Date Range: 08/07/2002
Time Fished:	Drainage: 2.3 sq mi	
Dist Fished: 0.10 km	Basin: Central Ohio River Tribs No of Passes: 1	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	220	660.00	73.09			
Creek Chub	N	G	N	T	29	87.00	9.63			
Fathead Minnow	N	O	C	T	19	57.00	6.31			
Central Stoneroller	N	H	N		28	84.00	9.30			
Green Sunfish	S	I	C	T	1	3.00	0.33			
Johnny Darter	D	I	C		3	9.00	1.00			
Rainbow Darter	D	I	S	M	1	3.00	0.33			
Mile Total					301	903.00				
Number of Species					7					
Number of Hybrids					0					

River Code: **06-807**	Stream: **Fall Run**	Sample Date: **2002**
River Mile: **1.20**	Location: dst. AMD tributary	Date Range: 08/07/2002
Time Fished:	Drainage: 2.9 sq mi	
Dist Fished: 0.10 km	Basin: Central Ohio River Tribs No of Passes: 1	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	253	759.00	75.30			
Creek Chub	N	G	N	T	68	204.00	20.24			
Fathead Minnow	N	O	C	T	7	21.00	2.08			
Central Stoneroller	N	H	N		4	12.00	1.19			
Green Sunfish	S	I	C	T	3	9.00	0.89			
Green Sf X Hybrid					1	3.00	0.30			
Mile Total					336	1,008.00				
Number of Species					5					
Number of Hybrids					1					

River Code: **06-807**	Stream: **Fall Run**	Sample Date: **2002**
River Mile: **0.10**	Location: upst. Grays Ridge Run, near mouth	Date Range: 08/07/2002
Time Fished: 1800 sec	Drainage: 3.4 sq mi	Thru: 09/04/2002
Dist Fished: 0.26 km	Basin: Central Ohio River Tribs No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Northern Hog Sucker	R	I	S	M	1	1.15	0.34			
White Sucker	W	O	S	T	12	13.85	4.14			
Blacknose Dace	N	G	S	T	85	98.08	29.31			
Creek Chub	N	G	N	T	78	90.00	26.90			
Fathead Minnow	N	O	C	T	9	10.38	3.10			
Central Stoneroller	N	H	N		6	6.92	2.07			
Smallmouth Bass	F	C	C	M	14	16.15	4.83			
Green Sunfish	S	I	C	T	5	5.77	1.72			
Bluegill Sunfish	S	I	C	P	8	9.23	2.76			
Johnny Darter	D	I	C		5	5.77	1.72			
Rainbow Darter	D	I	S	M	66	76.15	22.76			
Fantail Darter	D	I	C		1	1.15	0.34			
Mile Total					290	334.62				
Number of Species					12					
Number of Hybrids					0					

River Code: **06-821**	Stream: **Trib. to Fall Run (RM 1.12)**	Sample Date: **2002**
River Mile: **0.25**	Location: upst. AMD outfall	Date Range: 08/07/2002
Time Fished:	Drainage: 0.5 sq mi	
Dist Fished: 0.10 km	Basin: Central Ohio River Tributaries	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	46	138.00	68.66			
Creek Chub	N	G	N	T	21	63.00	31.34			
Mile Total					67	201.00				
Number of Species					2					
Number of Hybrids					0					

River Code: **06-821**	Stream: **Trib. to Fall Run (RM 1.12)**	Sample Date: **2002**
River Mile: **0.05**	Location: at mouth, dst. AMD outfall	Date Range: 08/07/2002
Time Fished:	Drainage: 0.6 sq mi	
Dist Fished: 0.05 km	Basin: Central Ohio River Tributaries	No of Passes: 1 Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	35	210.00	63.64			
Creek Chub	N	G	N	T	14	84.00	25.45			
Fathead Minnow	N	O	C	T	3	18.00	5.45			
Green Sunfish	S	I	C	T	3	18.00	5.45			
Mile Total					55	330.00				
Number of Species					4					
Number of Hybrids					0					