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Summary

To aid in the restoration and protection of water quality, habitat, wildlife, and recreational and commercial uses of natural resources in the Nimishillen Creek watershed, NEFCO developed, with input from local stakeholders, the Nimishillen Creek Watershed Action Plan. The Action Plan is the culmination of work previously conducted in the watershed, including Phases I and II of Nimishillen Creek Comprehensive Watershed Management Plan (CWMP). The Action Plan identifies a series of goals and objectives that, if achieved, should lead to higher environmental quality and the preservation of valuable and important resources. The Plan also includes a Cost Analysis for various watershed protection actions. The Cost Analysis can aid stakeholders in determining the feasibility of implementing many of the actions contained in the Action Plan.

In addition to the Watershed Action Plan, NEFCO also collected macroinvertebrate data at ten monitoring sites in the Nimishillen Creek watershed using methodology from the Ohio Scenic Rivers Stream Quality Monitoring Program. NEFCO initially selected four monitoring sites, but funding allowed for six additional sampling stations. The sampling sites were located throughout the watershed, but were primarily at the headwaters of the three main tributaries. Each site was visited once, and three samples were taken per site. According to the Scenic Rivers' protocol, two sites indicated "excellent" stream conditions, four sites received "good" score, two locations had "fair" conditions, and two registered "poor" scores.

Lastly, NEFCO hosted two planning meetings with the Nimishillen Creek Technical Advisory Committee (TAC) at the Stark Soil and Water Conservation District. The first TAC meeting was held on December 13, 2000, and the second on May 10, 2001. The meetings were held to discuss numerous watershed topics including findings and conclusions from previous Nimishillen Creek CWMP reports, development of the Watershed Action Plan, and the direction of future watershed improvement and protection efforts.

Introduction

The intent of this project is to develop a Watershed Action Plan which will describe possible responses to threats on water quality. The Plan, in combination with the Cost Analysis, will enable key stakeholders within the Nimishillen Creek watershed to locally identify the most appropriate mechanism(s) not only for preservation/protection efforts, but also for maintaining the integrity of the natural resources and their habitats necessary for a healthy watershed, while at the same time promoting economic growth.

Macroinvertebrate sampling and TAC meetings aided in the development of the Plan by examining current water quality conditions and targeting critical streams for protection and/or restoration. As funding becomes available, the Action Plan will act as a useful guide for implementing protection and restoration effort by identifying appropriate and cost-effective best management practices for the Nimishillen Creek watershed.

I. Macroinvertebrate Sampling

Summary

This section of the report presents the results of macroinvertebrate data taken from selected sites within the Nimishillen Creek Watershed using methodology from the Scenic Rivers Stream Quality Monitoring Program. The Ohio Department of Natural Resources (ODNR) developed this methodology as a screening tool for environmental education to examine the macroinvertebrate community and scoring stream segments accordingly.

Macroinvertebrate monitoring was conducted at ten sampling stations, with three samples per station, in the Nimishillen Creek Watershed. The sampling stations are located throughout the watershed, but are primarily at the headwaters of the three main tributaries. A copy of the Stream Quality Assessment Form for each of the three samples taken at each monitoring station (thirty samples in total) is included in Appendix A. This form includes the results of the monitoring and a description of the location for each site. The results of the macroinvertebrate monitoring implied that the waters of the Nimishillen Creek Watershed are of relatively good quality, but are most likely still not meeting the designated standards. It should be noted that all the sampling sites were chosen for their ideal habitat conditions; i.e. exposed rocks, riffles, and low sediment. Existing biological communities adjust their composition (diversity and number) to the quality of the water that flows over and around them. Poor water quality promotes poor communities of macroinvertebrates even in ideal habitat conditions. Excellent water quality encourages a diverse biological community of macroinvertebrates in an ideal habitat. By holding habitat as a constant (as much as possible) insight can be gained into chronic water conditions from the watershed. Conducting additional sampling (along with chemical and bacterial tests) within the watershed may provide more comprehensive baseline data that would better evaluate water quality conditions within the Nimishillen Creek Watershed.

Introduction

The purpose of the monitoring efforts is to study the water quality of the Nimishillen Creek by characterizing the status of the macroinvertebrate communities in the stream. According to ODNR, macroinvertebrates are organisms (such as insects, worms, clams) that “lack a backbone and are visible to the naked eye” (ODNR, 1993). The condition of the stream’s macroinvertebrate community can provide the baseline data needed to measure water quality progress, as well as identify areas for possible stream remediation. ODNR’s Scenic Rivers Stream Quality Monitoring Program is a screening tool that helps to identify these areas.

The examination of benthic macroinvertebrates has several advantages: their size makes them easy to identify, their limited mobility restricts them to specific environments or areas, and their life cycles span months or even years and, therefore, makes them indicators of past as well as present stream conditions. For example, if pollutants impact a stream, a considerable period of time may be required for the macroinvertebrate community to fully recover. Therefore, macroinvertebrate surveys can provide information regarding the long-term quality of a stream.

The benthic macroinvertebrate community is commonly used as an indicator of the environmental quality of a stream. Analysis of the community structure, especially species composition, diversity of taxa, number of taxa, a stream's physical characteristics, and surrounding land use, provides a more accurate representation of the condition of the aquatic ecosystem when determining water quality. However, according to the Ohio EPA, when determining the water quality of a stream, two or three groups of organisms (i.e. aquatic insects, fish, plants) should be examined in order to get more accurate results. Macroinvertebrate monitoring looks at one group of organisms, providing only part of the story about the health of a stream (Yoder and Davis, 1996).

Many waterways suffer from some degree of degradation ranging from mild nutrient enrichment from wastewater treatment plants, failing home sewage treatment systems and agricultural activities, to the dumping of toxic chemicals by manufacturers. Effective evaluation is necessary if water quality problems are to be identified and mitigated. A number of methods to assess stream quality may include the evaluation of the physical, chemical and biological characteristics of a stream. Although physical and chemical conditions are easy to measure, the use of these parameters as the sole criteria for water quality evaluation has limitations. Chemical measurements represent the condition of the stream only at the time of measurement. Contaminants, which may have affected the aquatic community, may be missed at a particular sample time as the contaminants are swept downstream. However, the biological communities within the aquatic system provide a more comprehensive picture of the actual, long-term conditions. One community commonly used to determine the water quality of a stream are the benthic macroinvertebrates.

Methodology

Assessment of the water quality of the Nimishillen Creek involved a biological and physical analysis of the ten selected sampling sites. The biological evaluation consisted of a survey of the benthic macroinvertebrate community. Evaluation of the physical characteristics of the sites included measurements of the stream's dimensions, habitat, riparian corridor, land uses, and possible adverse impacts. During mid-April and early May of 2001, a survey of the benthic macroinvertebrates community was conducted by NEFCO staff using the Ohio Department of Natural Resources' (ODNR) Scenic Rivers Stream Quality Monitoring Program (kick seining technique)(ODNR, 1993).

Several physical parameters were measured at each of the sampling stations. These parameters included stream width, depth, temperature, water condition, bed composition, habitat, stream shading, stream bank vegetation, stream channel alterations, possible point and nonpoint sources of pollution, and surrounding land use. Refer to the Stream Quality Assessment and Stream Inventory - Watershed Assessment Forms found in Appendix A.

The width and depth of the streams were measured using a steel tape measure. The stream width was measured at the widest point of the sampling area. The depth was measured at the actual sampling area. The temperature was measured using alcohol centigrade thermometers. Evaluation of the substrate was accomplished by visual inspection, classifying the substrate according to percent bedrock, boulder, gravel, sand, and silt.

In addition to the evaluation of the stream, the surrounding area was also surveyed by visual inspection as to land use, possible sources of point and nonpoint pollution, stream alterations, in-stream alterations, and the riparian corridor (i.e. flood plain type and width). Photos of each station were also taken and compiled into a photo album found in Appendix B.

Areas of the Nimishillen Creek were surveyed for macroinvertebrates using the Scenic Rivers Methodology, (ODNR, 1993). Figure 1 indicates the locations of the sampling stations and Table 1 lists the sampling date, location, river mile, and latitude/longitude of each site. Stations 4 (East Branch @ Louisville Sportsmen's Club on Maplegrove Ave.), and 5 (East Branch Tributary on Maplegrove Ave.) were sampled on April 13, 2001; stations 1 (West Branch on Brumbaugh St., just west of Stonebridge) and 8 (West Branch Tributary on Mt. Pleasant Rd., just west of Pittsburgh Rd.), were surveyed on April 19, 2001; stations 6 (Mainstem behind East Sparta Elementary School), 7 (Mainstem @ John Miller's Field on S.R. 800) and 10 (Mainstem Tributary on Howenstine Rd.) were sampled on April 26, 2001; stations 2 (Swartz Ditch on Tyro Rd., just east of Gans Rd.), and 9 (Mainstem on 6th St. and Riverside Dr.) were surveyed on April 27, 2001; and station 3 (Middle Branch @ Middle Branch Middle School on Middle Branch Rd.) was surveyed on May 1, 2001. For further details on the procedure for macroinvertebrate sampling, please refer to the *NEFCO Citizen Stream Monitoring Program Final Report, June 1994*.

Sites were chosen based on adequate riffle activity, riparian cover, accessibility and good in-stream habitat (boulders, cobbles, and gravel that provide a home for macroinvertebrates). The riffle areas represent the best habitat for macroinvertebrates and should produce the maximum number of species and individuals. However, it should be noted that riffle areas alone do not represent the entire biological community within a stream. Pool and margin areas are also micro-habitats that should be sampled in order to obtain the best picture of distribution and presence of taxa. A sample point in the riffle was selected based upon a variety of stream bed compositions and water depths. Ideally, the sample site should contain stones ranging from gravel size (1/4 inch to two inches) to greater than 10 inches, with water depth between two inches to one foot and a moderate stream velocity.

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Table 1
Locations of the Macroinvertebrate Stations in Nimishillen Creek

Site	Sampling Date	Site Location	River Mile	Latitude	Longitude
1	4/19/01	West Branch @ Brumbaugh St., just west of Stonebridge	23.42-23.43	40 54' 45"N	81 22' 45"W
2	4/27/01	Swartz Ditch @ Tyro Rd., just east of Gans Rd.	25.87-25.88	40 54' 30"N	81 18' 45"W
3	5/01/01	Middle Branch @ Middle Branch Middle School on Middle Branch Rd.	22.83-22.84	40 53' 30"N	81 19' 30"W
4	4/13/01	East Branch @ Louisville Sportsmen's Club on Maplegrove Ave.	25.75-25.76	40 51' 00"N	81 12' 30"W
5	4/13/01	Tributary to East Branch @ Maplegrove Ave.	24.51-24.52	40 48' 00"N	81 12' 30"W
6	4/26/01	Mainstem behind East Sparta Elementary School	3.30-3.31	40 40' 15"N	81 21' 15"W
7	4/26/01	Mainstem @ John Miller's Field on S.R. 800	6.54-6.55	40 42' 45"N	81 21' 16"W
8	4/19/01	Tributary to West Branch @ Mt. Pleasant Rd., just west of Pittsburgh Rd.	25.22-25.23	40 54' 30"N	81 25' 30"W
9	4/27/01	Mainstem @ 6th St. and Riverside Dr.	14.43-14.44	40 47' 45"N	81 21' 45"W
10	4/26/01	Tributary to Mainstem @ Howenstine Rd.	7.31-7.32	40 42' 30"N	81 21' 00"W

The seine was placed into the riffle, and an area the width of the outstretched seine (3.3 feet) and the length three feet upstream was disturbed. Initially, boulders and cobbles were moved and rubbed gently by hand to dislodge any organisms such as crayfish, snails, clams, and benthic macroinvertebrates. The remaining stream bed material was kicked vigorously side-to-side and toward the seine to dislodge any remaining organisms. The purpose was to trap as many macroinvertebrates in the net as possible. The seine was then carefully removed from the riffle to avoid losing any organisms. The seine was carried over to the stream bank and placed over a table. Leaves, rocks and debris were carefully examined for organisms and removed from the seine. The macroinvertebrates were sorted by family and placed into a divided plastic tray filled with water and were counted and grouped into three categories: Taxa 1 (pollution-intolerant), Taxa 2 (organisms that can live in both polluted or clean water), and Taxa 3 (pollution-tolerant) (see Appendix A).

Once all the macroinvertebrates were counted and grouped, the number of different types of organisms per taxa group were tallied. This number was then multiplied by an index value to get a total for each taxa group. Assigning index values was a way to weight each aquatic insect to emphasize the importance of the intolerant macroinvertebrates. The index value for group one taxa is 3 (heavily weighted for most pollutant-intolerant macroinvertebrates); the index value for group two taxa is 2 (moderately weighted for organisms who can live in both polluted or clean waters); and the index value for group three taxa is 1 (the lowest weight for the most pollutant tolerant organisms). The total from each of the three taxa categories was then combined to get the cumulative index value (CIV). CIVs less than 11 were given a poor rating; a fair rating was assigned if the CIV was between 11 and 16; CIVs between 17 and 22 were given a good rating; and an excellent rating was assigned if the CIV was 22 or higher. This procedure was repeated two more times (three total samples) in a different riffle area at the same stream segment. Therefore, there were three cumulative index values (A, B, and C) for each sampling site.

Results

The physical parameters for each monitoring site can be found in the Stream Quality Assessment and Stream Inventory - Watershed Assessment Forms in Appendix A.

Stream temperatures taken during the monitoring period of September and early October ranged from 42.8°F to 57.2°F. The temperatures for each sampling site can be found in the Stream Assessment forms in Appendix A.

The results of the macroinvetebrate surveys at each of the selected stations ranged from poor to excellent water quality. The sample stations were surveyed three times. The scores from each station were then averaged to give the following: poor water quality was recorded at two of the ten stations, fair water quality at two stations, good water quality at four stations, and excellent water quality at the remaining two sampling stations. Refer to Table 2 and Figure 2 for the location and water quality results for each site. Appendix C illustrates the type and abundance of macroinvertebrates recorded at each of the sixteen stations. They also include the taxa group that the macroinvertebrates belonged to. Group one taxa include macroinvertebrates that are the most pollution-sensitive organisms found in good quality water; group two taxa include organisms that are somewhat pollution tolerant, and can be found in good or fair quality water; and taxa found in group three include organisms that are pollution tolerant and can be found in a broad range of water quality conditions.

Table 2
Mean Cumulative Index Values (CIVs) and stream segment conditions based on macroinvertebrate surveys at selected sites

Station Number	Sample Date	Stream	Cumulative Index Values*			Mean	
			A	B	C	CIV	Segment Condition**
1	4/19/01	West Branch Nimishillen Creek (Brumbaugh St., just west of Stonebridge St.)	18	22	20	20	Good
2	4/27/01	Swartz Ditch (Tyro Rd., just east of Gans Rd.)	20	25	25	23	Excellent
3	5/1/01	Middle Branch Nimishillen Creek (Middle Branch Elementary @ Middle Branch Rd.)	20	16	22	19	Good
4	4/13/01	East Branch Nimishillen Creek (Louisville Sportsmen's Club @ Maplegrove Ave.)	20	20	25	22	Good
5	4/13/01	Tributary to East Branch Nimishillen Creek (Maplegrove Ave.)	31	24	27	27	Excellent
6	4/26/01	Nimishillen Creek Mainstem (Behind East Sparta Elementary School)	20	14	19	18	Good
7	4/26/01	Nimishillen Creek Mainstem (State Route 800 @ John Miller's Field)	16	12	13	14	Fair
8	4/19/01	Tributary to West Branch Nimishillen Creek (Mt. Pleasant Rd, just west of Pittsburgh Rd.)	7	7	10	8	Poor
9	4/27/01	Nimishillen Creek Mainstem (6th St. and Riverside Dr.)	15	12	19	15	Fair
10	4/26/01	Tributary to Nimishillen Creek Mainstem (Howenstine Rd.)	8	11	10	10	Poor

*Stream Quality Assessment (Source: ODNR, Stream Quality Monitoring Manual)
**Excellent: >22, Good: 17-22, Fair: 11-16; Poor: <11.

Table 2 presents the mean Cumulative Index Values (CIV) and stream segment conditions for each site surveyed. The results from stations 8 and 10 implied poor stream quality, (with mean CIVs of 8 and 10 respectively) based on the composition of organisms found in the sampling. Station 7 (with mean CIV of 14), and 9 (mean CIV of 15) suggested fair water quality. Those stations whose results suggested good water quality results were 6 (mean CIV of 18), 3 (mean CIV of 19), 1 (with mean CIV of 20), and 4 (mean CIV of 22). The results of the remaining stations (2 and 5) implied excellent stream quality, with mean cumulative index values of 23 and 27, respectively.

The results of the macroinvertebrate sampling conducted at the ten stream sites implies overall good water quality with an average macroinvertebrate cumulative index value of 17.6.

The headwaters of the West Branch (and tributaries) of the Nimishillen Creek had two sites sampled for macroinvertebrates: 1 and 8. Station 1 had three good cumulative index values (CIVs) of 18, 22 and 20, giving the site a good mean CIV of 20. The three samples taken at this site were very similar. All three samples had an abundance of caddisfly larvae (group one taxa). The next highest number of organisms found in all three samples were aquatic worms and midge larvae (group three taxa). The macroinvertebrate survey results for site 8 were quite different from site 1. The variety of organisms found for each sample was minimal. Caddisfly larvae (group one taxa), beetle larvae (group two taxa), aquatic worms and midge larvae (group three taxa) were found at all three sample sites. The only difference between the three sample sites were that sample C had riffle beetle adults (group on taxa). No other type of organism was found at this site. Site 8 had a poor CIV at each sample station, giving it the lowest mean CIV (of all ten sites) of 8.

Site 2 was the only station sampled for macroinvertebrates at Swartz Ditch (in the headwaters). This was a good site that had a variety of organisms in each sample and had a mean CIV of 23. Sample A had a good CIV of 20 and samples B and C both scored excellent CIVs of 25. The samples at this site revealed an abundance of caddisfly larvae, riffle beetle adult (group one taxa), clams (group two taxa), and midge larvae (group three taxa). Most of the organisms found at the three sample sites represented group two taxa, such as crane fly larvae, beetle larvae, crayfish, scuds and clams. Damselfly nymphs were also found at sample site B.

The Middle Branch of the Nimishillen Creek had one sample site: 3. The CIV scores at this site varied, having one fair CIV (16), one good CIV (20), and one excellent CIV (22) to give the site a good mean CIV of 19. There was an abundance of caddisfly larvae (group one taxa), and midge larvae (group three taxa) at this site. Minimal numbers of various other macroinvertebrates representing all three taxa groups were also found at this site.

Two sites were sampled in the headwaters of the East Branch (and tributaries) of the Nimishillen Creek: sites 4 and 5. Both sites were favorable with high CIVs and a good variety of organisms. Site 4 had two good CIV scores of 20 and an excellent CIV score of 25, giving the site a good mean CIV of 22. Caddisfly larvae (group one taxa) were highest in number in all samples at this station. Mayfly nymphs, riffle beetle adult (group on taxa), crane fly larvae, beetle larvae, clams, sowbugs (group two taxa), blackfly larvae and midge larvae (group three taxa) were also found at all three sites. A salamander was caught at the sample B site, and six salamanders were caught at the sample C site. This is a very good indicator of excellent water quality as salamanders are pollution intolerant organisms. Site 5 had the largest variety of macroinvertebrates than any other site. The most abundant organism from all three samples were caddisfly larvae (group on taxa). Other macroinvertebrates found at all three sample sites were stonefly nymphs, riffle beetle adult (group one taxa), crane fly larvae, beetle larvae, crayfish, scuds, clams, sowbugs (group two taxa), aquatic worms and midge larvae (group three taxa). Mayfly nymphs (group one taxa) were found at sample site A. Of all the thirty sites sampled, sample site A had the highest CIV of 31. Samples B and C also had excellent CIVs of 24 and 27 respectively, giving site 5 a mean CIV of 27.

The four remaining sampling sites were located on the Mainstem (and tributaries) of the Nimishillen Creek: 9, 10, 7 and 6. Site 9 had two fair CIVs (15 and 12) and a good CIV of 19, giving the site a fair mean CIV of 15. This site had a limited variety of macroinvertebrates. The highest number of organisms found at all three samples were caddisfly larvae (group one taxa), and midge larvae (group three taxa). Other organisms found at all three sampling sites were mayfly nymphs, beetle larvae and aquatic worms. Crayfish, scuds and clams (group two taxa) were also found. Site 10 had even less of a variety of organisms than site 9. All three samples had caddisfly larvae (group one taxa), crane fly larvae, and crayfish (group two taxa). Riffle beetle adults (group one taxa), scuds (group two taxa), midge larvae and aquatic worms (group three taxa) were also found. The mean CIV at site 10 was poor (10), with two poor CIVs (8 and 10) and one fair (11). The three CIV scores at site 7 were all fair, giving a mean CIV of 14. Caddisfly larvae (group one taxa) were the highest in number for all three sample sites. Blackfly larvae and aquatic worms (group three taxa) were also abundant at sample sites A and B. Other organisms found at this site were stonefly nymphs, other snails (group one taxa), crane fly larvae, beetle larvae, clams, sowbugs (group two taxa), and midge larvae (group three taxa). The sampling sites at site 6 experienced mostly caddisfly larvae (group one taxa) and midge larvae (group three taxa). Other macroinvertebrates found at all three sites were beetle larvae, crayfish, sowbugs (group two taxa), and aquatic worms (group three taxa). Other snails (group one taxa), scuds and clams (group two taxa) were found at sampling sites A and C. Crane fly larvae were found at sampling sites A and B; and leeches were found at sampling sites B and C. Site 6 had a mean CIV of 18 (good), with two good CIVs (19 and 20) and a fair CIV of 14.

Discussion

Physical Characteristics

An ideal stream sampling site has a good riparian habitat consisting of a variety of vegetation (trees, plants, shrubs, etc.), good in-stream habitat, and a good riffle area. (refer to Table 3). Many of the ten sites sampled had these characteristics, and reflected well in the CIV scores during the macroinvertebrate monitoring. For example, sample site 4 had an ideal habitat with good in-stream habitat, good riparian habitat and a good riffle area and received a good mean CIV. On the other hand, site 9 had virtually no riparian and had been channelized and received a fair mean CIV. With this in mind, it may be suggested that riparian habitat, riffle activity and in-stream habitat were limiting factors on the macroinvertebrate communities during this monitoring period. The majority of high scoring sampling sites were located in the headwaters. Site 8 was an exception, as it is also located in the headwaters, but received the lowest CIVs out of all ten sites. This may be due to the absence of a riparian corridor and poor in-stream habitat, as well as, the urban/light industrial area in which site 8 is located . Site 6 is located downstream of the headwaters in East Sparta. This site may attribute its high CIV scores to its excellent riparian habitat, good in-stream habitat and good riffle areas. It may be suggested that factors, such as industrial and urban land uses surrounding the sampling areas are affecting the water quality and macroinvertebrate communities in the streams closer to the confluence.

Stream Temperature

Stream temperatures measured during the surveys in mid-April and early May are shown in Appendix A on the Stream Quality Assessment forms. The stream temperatures measured at each sampling station were lower than the criteria established for the Ohio River basin. The stream temperatures that were recorded during that time period ranged from 42.8°F to 57.2°F.

Underground water sources, snow melt and shade can lower water temperature as well (Campbell and Wildberger, 1992, p. 30). Water temperature may also be increased as a result of discharges of water used for cooling by industrial or utility plants, runoff from impervious surfaces, and loss of riparian cover. Increased stream temperature enhances oxygen retention in the water and facilitates the stream assimilative capacity. Variation of stream temperature could affect feeding, reproduction and the metabolism of aquatic animals. Temperature preferences among species vary, but all species can tolerate slow, seasonal changes better than rapid changes.

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Table 3
Comparison of Selected Physical Characteristics of the Nimishillen Creek Macroinvertebrate Sampling Sites

Stream	Site # / River Mile (RM)	Habitat	Stream Shading (%)	Streambank Vegetation* (%)	Surrounding Land Uses	Outfalls** (type/ location)	Stream Channel Alterations	In-Stream Structures/ Barriers
West Branch	1 RM:23.42	pools, undercut banks, large boulders, riffles, tree roots, woody debris, man-made objects	50 - 74	T:30, P:15, G:10, S:40, RM:5 (L:25',R:10')	residential (with new construction)	SWR- right bank by bridge	channelization	bridge
West Branch Tributary	8 RM:25.22	pools, riffles, tree roots, man-made objects	25 - 49	T:15, P:15, G:35, S:25, RO:5, O:5 (L:60', R:32')	residential and retail/comm., light manufacturing, parking lots	SWR-4 total, upstream and downstream of bridge on both banks	channelization	bridge, sediment/ sandbars
Swartz Ditch	2 RM:25.87	pools, weed beds, undercut banks, riffles, tree roots, man-made objects	0 - 24	T:20, P:10, G:35, S:30, RM:5 (L:10-15', R:10-15')	pasture/grazing land	none	none	bridge, sediment/ sandbars
Middle Branch	3 RM:22.83	pools, undercut banks, wetlands	25 - 49	T:35, P:40, G:10, S:10, RM:5 (L:100+', R:100+')	school recreational fields	none	none	none
East Branch	4 RM:25.75	pools, log piles, large boulders, riffles, tree roots, woody debris, man-made objects	50 - 74	T:35, P:10, G:5, S:45, RM:5 (L:50', R:100+')	cropland, woods, railroad~100' from stream on left bank	none	channelization	bridge, log jams, sediment/ sand-bars
East Branch Tributary	5 RM:24.51	pools, undercut banks, large boulders, riffles, tree roots, woody debris, man-made objects	50 - 74	T:20, P:5, BS:5, G:40, S:30 (L:10', R:30')	pasture/grazing land, cropland, residential, abandoned field, oil wells south (rt bank)	O: pond outlet - upstream on other side of road	channelization and fill	bridge

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Table 3
Comparison of Selected Physical Characteristics of the Nimishillen Creek Macroinvertebrate Sampling Sites

Stream	Site # / River Mile (RM)	Habitat	Stream Shading (%)	Streambank Vegetation* (%)	Surrounding Land Uses	Outfalls** (type/ location)	Stream Channel Alterations	In-Stream Structures/ Barriers
Mainstem	9 RM:14.43	pools, riffles, man-made objects (bridges and concrete wall)	0 - 24	T:25, G:25, O:50 (L:10', R:30')	residential, urban park and baseball field (on right bank)	SWR-at north bridge (rt side) and drain holes in concrete wall	channelization	bridge
Mainstem Tributary	10 RM:7.31	pools, log piles, undercut banks, riffles, tree roots, woody debris, man-made objects	50 - 74	T:50, P:30, BS:10, G:10, (L:200+', R:60')	large lot residential, woods	none	none	bridge, sediment/ sand-bars
Mainstem	7 RM:6.54	pools, undercut banks, large boulders, riffles, tree roots	50 - 74	T:35, P:15, BS:10, G:50, (L:14', R:200+')	baseball field, railroad tracks	U- upstream at riffle site (left side of stream)	none	bridge (~150 yards upstream)
Mainstem	6 RM:3.30	pools, undercut banks, large boulders, riffles, tree roots, woody debris	50 - 74	T:25, P:30, BS:5, G:5, S:30, RO:5 (L:200+', R:200+')	woods	none	none	bridge

*Symbols for streambank vegetation: T=trees, P=other plants, BS=bare soil, G=grass, S=shrubs, RO=root mats, O=other, L=approximate width of left bank vegetation, R=approximate width of right bank vegetation.

**Type of discharge pipe: ST=sewage treatment, SWR=storm water runoff, I=industrial, DTO=drainage tile outlets, U=unknown, O=other.

Benthic Macroinvertebrate Monitoring

Even though this type of stream assessment takes into consideration all of the factors which can pose threats to aquatic life, such as stream modification, climatic change and land use within the riparian buffer zone, one should understand that even sampling of the macroinvertebrate community has its limitations. For example, it cannot specifically identify any pollutant that is impacting the macroinvertebrate community, and the presence of any particular species may only indicate that the minimum requirements for its existence have been met. In addition, its absence or presence may be due to factors other than water quality problems. These may include the natural change of dynamics of the macroinvertebrate community (seasonal cycles), unsuitable natural conditions, substrate composition, and the lack of introduction into a stream.

The monitoring results suggest that two of the sampling sites had poor water quality, two had fair water quality, four had good quality, and two had excellent water quality (Table 2). NEFCO staff took the mean of all scores from the ten sites, giving the streams in the watershed an overall evaluation of good water quality. Most of the sites had a good riparian cover, good in-stream habitat and riffle activity. For the most part these sites were found in the headwaters. The sites closer to the confluences (9, 10, 7) tended to have lower CIVs. For sites 7 and 10, these lower CIV scores may be attributed to the heavily urban and industrial areas upstream of these sites. The predominance of storm water runoff (from major industries in the area), urban runoff and sedimentation within the watershed may have influenced these scores. Site 9 is located directly in an urbanized area, where there is virtually no riparian. Both sides of the stream consist of concrete walls, making this site less than ideal. Similar to sites 7 and 10, site 6 is also located downstream of the urban and industrial areas, however, it had higher CIVs. This may be due to its location, being further downstream of the confluence than the other sites may allow for some degree of recovery. Site 8 experienced the lowest CIV scores, however, this site is located in the headwaters of a West Branch Tributary. Unlike the other sites located in the headwaters, site 8 is located in an urban, light industrial area and may experience storm water runoff, urban runoff and sedimentation similar to sites 7 and 10.

When looking at the macroinvertebrate monitoring results for each stream (starting from upstream locations and moving downstream) the following was observed: the West Branch of the Nimishillen Creek began with a good mean CIV at site 1 (in the headwaters), and dropped quite a bit at site 8 to a poor mean CIV at a West Branch Tributary (in the headwaters). This is understandable since site 8 is located in an urban/light industrial area where storm water runoff may be affecting the water quality of the stream. Site 2 in the headwaters of Swartz Ditch received an excellent mean CIV. This site is located in an agricultural area with a satisfactory riparian, but still managed to have high macroinvertebrate numbers. The next site downstream from site 2, is site 3 on the Middle Branch that had a good mean CIV. This site was located behind an elementary school and had a good riparian on both sides of the stream, which may explain its high macroinvertebrate numbers. Sites 4 and 5 in the headwaters of the East Branch and East Branch Tributary received a good (site 4) and excellent (site 5) mean CIV. These two sites had some of the highest macroinvertebrate counts out of all ten sites. This may be due to the fact that both sites are located in rural areas where minimal threats are apparent. The sites closer to the confluence and downstream of the confluence were all on the Mainstem. Site 9, located on the Mainstem south of the confluence of the Middle Branch, East Branch and Mainstem received a mean CIV of fair. A fair score at this site is understandable since there was virtually no riparian habitat and that section of the stream had been channelized. Further south on a Mainstem Tributary at site 10 the mean CIV was poor. Site 7, located even further south on the Mainstem had a fair mean CIV. Both of these sites received low macroinvertebrate counts which are probably due to the fact that they are receiving runoff from heavily industrial and urban areas in Canton. Site 6 is located furthest south downstream on the Mainstem in East Sparta. This site received a good mean CIV. The rise in macroinvertebrate numbers could be attributed to the recovery period that site 6 experiences, compared to the sites upstream of it (sites 7 and 10).

The macroinvertebrate sampling was useful in helping to determine the environmental quality of the streams in the Nimishillen Creek Watershed. However, determining the water quality of a stream entails more extensive sampling (i.e. Ohio EPA's biological assessments), that would include looking at more components within the community such as fish or vegetation.

Conclusion

Understanding the interrelationship of water quality, land use, aquatic habitats and their relationship with natural environments and human activities is an important element for the protection and/or enhancement of a stream's health. The analysis of existing physical characteristics, water quality and aquatic organisms will provide base level information that will enable key stakeholders to make more effective decisions regarding both positive and/or negative impacts of hydrologic modifications, such as stream dredging, burial, channelization, or construction of a sewage treatment plant, or changes of land use activities, such as mining, farming or development.

Aquatic insects and other bottom-dwelling organisms can be monitored to measure both subtle and profound effects that changes in water quality have on aquatic life. Changes in the composition of bottom-dwelling communities will reflect water quality shifts that may be caused by the addition or deletion of pollutants to the water. These pollutants may be continual, intermittent, or accidental, and they may originate from point or nonpoint sources.

The results of the macroinvertebrate sampling, based on the methodology from the Scenic Rivers Monitoring Program, revealed poor water quality at two sites, fair water quality at two sites, good water quality at four sites, and excellent at the remaining two sites, resulting in a cumulative index value of 17.6 or good water quality.

The results also suggest that the riparian habitat, riffle activity, and in-stream habitat were limiting factors in stream monitoring for macroinvertebrate community quality. During this monitoring period, the streams that possessed a good riparian habitat, good in-stream habitat, and a good riffle area received high CIV scores. Most of these sampling sites were located in the headwaters. Therefore, it could be said that the conditions in and around the stream seemed to influence the macroinvertebrate communities. It may be suggested that factors, such as industrial and other urban land uses surrounding the sampling areas are affecting the water quality and macroinvertebrate communities in the streams closer to the confluence.

The results for each stream also revealed a pattern in which the quality of the macroinvertebrate communities within most of the streams monitored seemed to drop from the headwater sites to the downstream sites. This observation may be attributed to higher levels of industrial activity occurring closer to the confluences of the streams. It also depends on other sources of impairment such as sedimentation, storm water runoff and urban runoff.

As previously mentioned, all the benthic macroinvertebrate sampling stations were observed to be under ideal habitat, which may or may not accurately imply the water quality conditions throughout the watershed. Sampling additional macroinvertebrate sites and conducting chemical and bacterial tests within the watershed would result in more comprehensive baseline data that would better characterize water quality conditions within the Nimishillen Creek Watershed, and help explain the variations in macroinvertebrate community composition found in this study.

II. Watershed Action Plan and Cost Analysis

Introduction

The Nimishillen Creek Watershed Action Plan (Table 4) is a strategic plan that aims to restore and protect water quality, habitat, wildlife, and recreational and commercial uses of natural resources in the Watershed. The Plan outlines a series of seven goals and numerous objectives that, if achieved, should lead to a higher level of environmental quality and a preservation of important resources. The actions in the Plan provide the methods by which to achieve the objectives.

The identification of goals stems from a pair of meetings of the Nimishillen Creek Watershed Local Stakeholder Group held in 2000 and 2002, which brought together a variety of backgrounds, interests and expertise. Such combined efforts help ensure that all aspects of water quality improvement and protection are considered and will ultimately help toward implementing comprehensive and holistic solutions. The seven identified goals, generally in order of priority, are:

1. Decrease levels of toxic substances (heavy metals, oil and petroleum products, etc.) entering surface and/or ground water.

2. Reduce nutrient and bacteria loads, from fecal contamination, in lakes and streams.

3. Reduce impacts from sedimentation/siltation in lakes and streams.

4. Reduce fertilizer, herbicide and pesticide runoff into the watershed

5. Protect and/or restore shorelines and riparian corridors in selected wetlands, lakes, and streams.

6. Reduce levels of salinity impacting surface and/or ground water quality, which will decrease levels of dissolved solids.

7. Acquire stronger understanding, cooperation and participation regarding water quality issues.

In addition to informing officials and residents about water quality issues in the Nimishillen Creek Watershed, the Action Plan can also serve as a tool to help focus and organize efforts to improve, preserve and protect water quality. To further the potential efficacy of the Plan, NEFCO included a cost analysis (Table 5), assigning cost estimates to the actions contained in the Plan. This information was based upon a cost analysis performed for the Upper Tuscarawas River in Summit, Stark and Portage Counties in 2000. The estimates for that analysis were gathered through personal communications with professionals in our region, from both the public and private sectors, who are familiar with implementing actions like those called for in the Plan. Because these estimates were based upon regional examples and are relatively recent, NEFCO believes that they can also be applied to the Nimishillen Creek watershed. Further, like the Nimishillen, the Upper Tuscarawas River watershed is a developing, urbanized watershed with many of the same land use and potential pollution source issues.

The cost estimates in the Action Plan are meant to provide basic, general examples of what implementation costs may be incurred. Similar projects may produce greatly differing costs, as many situation-specific factors determine what the cost of a given project will be.

The amendment of the Action Plan by the addition of the Cost Analysis can aid in determining the level of feasibility of implementing the many actions that the Plan contains. It is hoped that reasonable cost estimates will allow various entities, who can provide guidance and assistance in carrying out the actions in the Plan, to better judge their own capabilities and available resources. Establishing how much support exists for carrying out particular actions is necessary for a prioritization of specific tasks as well as insight into their feasibility.

Tables 4 and 5 comprises two complimentary documents--the amended Nimishillen Creek Watershed Action Plan and a Cost Analysis, respectively. The latter explains how costs were derived, and in many cases gives further information about the actions themselves. Each Table may be used to reference the other. The individual actions in the Plan are coded, leading the reader to the accompanying explanation, while the Cost Analysis examples refer the reader to those actions in the Plan that they exemplify.

Table 6 is an explanation of abbreviations and acronyms used in the Plan. Some actions and cost explanations use specific business or product names for illustrative purposes only. The use of such names does not necessarily represent endorsement.

Table 6
ABBREVIATIONS/ACRONYMS

BMP	Best Management Practice
CRP	Conservation Reserve Program
EQIP	Environmental Quality Incentives Program
HBA	Home Builders Association
HSDS	Home Sewage Disposal System
IPM	Integrated Pesticide Management
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Loads
NEFCO	Northeast Ohio Four County Regional Planning and Development Organization
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source Pollution
ODA	Ohio Department of Agriculture
ODNR	Ohio Department of Natural Resources DSWC - Division of Soil and Water Conservation
ODOT	Ohio Department of Transportation
OEEF	Ohio Environmental Education Fund
Ohio EPA	Ohio Environmental Protection Agency DDAGW - Division of Drinking and Groundwater DERR - Division of Environmental and Remedial Response DSW - Division of Surface Water DWPC - Division of Water Pollution Control
OSU	Ohio State University
PL-566	Refers to the Small Watershed Program through the NRCS
PS	Point Source Pollution
RAP	Remedial Action Plans
RUST	Registered Underground Storage Tank
SFM	State Fire Marshal (Ohio Department of Commerce) BUSTR - Bureau for Underground Storage Tank Regulations
SIP	Stewardship Incentives Program
SPSDS	Semi-Public Sewage Disposal System
S.R.	State Route
SWCD	Soil and Water Conservation District
SWPPP	Storm Water Pollution Prevention Plan
USDA	United States Department of Agriculture NRCS - Natural Resources Conservation Service
UST	Underground Storage Tank
VLMP	Volunteer Lake Monitoring Program
WPCLF	Water Pollution Control Loan Fund
WWTP	Wastewater Treatment Plant

III. Technical Advisory Committee Meeting Summaries

This section of the report provides a summary of the results from two planning meetings held during Phase III of the Nimishillen Creek CWMP. The purpose of the first meeting on December 13, 2000 was to discuss the findings and conclusions of the Nimishillen Creek CWMP Phase II report; continue efforts towards developing an Action Plan for the Nimishillen Creek Watershed; discuss upcoming macroinvertebrate monitoring; discuss the macroinvertebrate monitoring that NEFCO conducted for the City of Canton; and discuss future steps of the Nimishillen Creek CWMP. NEFCO hosted a second meeting on May 10, 2001, which discussed the status of the macroinvertebrate monitoring; explained the cost feasibility analysis table that was completed by NEFCO; Andy Bayham from the Stark Natural Resources Conservation Service (NRCS) discussed the Environmental Quality Incentives Program (EQIP) grant that was awarded to the Stark SWCD; Susan Dicken from Mill Creek Metroparks and AWARE (Alliance for Watershed Action and Riparian Easements) provided some insight into forming a watershed group based on her experiences with Mill Creek, Yellow Creek, and Meander Creek Watersheds. Finally, this meeting discussed future steps of the Nimishillen Creek CWMP.

The Nimishillen Creek CWMP - Phase III meetings were held on December 13, 2000 and May 10, 2001 at the Stark Soil and Water Conservation District. Appendix D contains copies of the meeting agendas, notices, news releases, and attendance sheets.

<u>December 13, 2000 Stakeholder Meeting Summary</u>:

This meeting began by going through the findings of Phase II of the Nimishillen Creek CWMP, and to inform the stakeholders that NEFCO's General Policy Board approved the final reports for both Phases I and II of the Nimishillen Creek CWMP.

Phase III of the Nimishillen Creek CWMP was the next item discussed. It was at this time that NEFCO staff provided an explanation of the Action Plan and its importance to the whole CWMP process. NEFCO staff explained that the input that they had provided toward completing the Land Use Characterization Table in Phase II helped to prioritize goals and objectives that are necessary to form an Action Plan. The stakeholders had reviewed the Action Plan prior to this meeting and were asked if there were any questions, concerns or changes that should be made to the Action Plan. There were no changes to be made regarding the Action Plan, however, a few comments were made regarding Home Sewage Treatment Systems (HSTSs) and their position in the Action Plan. A meeting attendee offered information on inspection programs that are in place to regulate HSTSs. Mr. Dean England of Drainage Service and Supply commented that old tile fields are being destroyed by new construction, which is another potential problem in the watershed. Mr. England went on to discuss watershed district and taxes and the importance of recognizing funding to keep watershed districts operable.

The upcoming macroinvertebrate monitoring in Spring 2001 was the next item that was covered at this meeting. NEFCO staff let stakeholders know that potential monitoring have already been considered and that monitoring would begin as soon as the weather warmed up. The macroinvertebrate monitoring report that NEFCO conducted for the City of Canton was the next item on the agenda. Since the report was not completed at that time, NEFCO staff showed the stakeholders a map of the monitoring sites and gave them an approximate time in which the report would be available to the public.

NEFCO staff concluded the meeting by outlining future activities for Phase III of the Nimishillen Creek CWMP. NEFCO mentioned when the next technical review meeting would take place, as well as, the status of the cost feasibility analysis that would be done during this phase. Some interests arose when NEFCO introduced the possibility of forming a watershed group. Mr. Tracy Mills from the City of Canton Water Pollution Control Center suggested that a mass mailout may be advantageous to our efforts. That it would be a way gage interest for a watershed group. Mr. Jan Lukens of Marlboro Township added that a good source to increase our mailing list would be the townships, as they have lists of businesses used for fire protection. Mr. Dean England also suggested that we talk to someone at the Farm Bureau, as they would be a valuable representative for such a group.

The last item discussed at this meeting was NEFCO explaining that we were applying for the Ohio Department of Natural Resources (ODNR) watershed coordinator grant again this year.

<u>May 10, 2001 Stakeholder Meeting Summary</u>:

This meeting began by introducing the watershed profile that NEFCO staff created (Appendix E). Staff explained that the watershed profile was not part of the Phase III scope but the budget allowed for such a document. NEFCO also explained that the budget allowed for the creation of the profile, but not for mass distribution and perhaps a grant could cover additional copies.

The next item on the agenda was the status of the macroinvertebrate monitoring that was conducted at the end of April and early May. NEFCO staff explained that the budget had also allowed for more monitoring sites. The original scope called for four sites to be monitored, however, the budget allowed for six more sites to be monitored. Staff also explained that due to the response from stakeholders during the last monitoring period, more sites were monitored in the headwaters. The monitoring results and maps of the monitoring sites were shown to the meeting participants. Mr. Michael Miller of the City of Canton expressed concern regarding the monitoring results, as he did not agree with comparing urban streams to non-modified streams. Mr. Miller did not agree with putting stream standards on something that is technically a drainage ditch, and that different standards should apply.

The cost feasibility analysis table and how it relates with the Action Plan was explained to the stakeholders. NEFCO staff also discussed how the cost feasibility analysis table would be used in the next phase. How it will help decipher which action is feasible with the grant money that may become available.

Mr. Andy Bayham from the Stark NRCS provided the meeting attendees with an explanation of the Environmental Quality Incentives Program (EQIP) grant that was awarded to his agency for the East and Middle Branches of the Nimishillen Creek.

Ms. Susan Dicken from Mill Creek Metroparks and AWARE discussed what is involved in forming a watershed group. Ms. Dicken provided the stakeholders an idea of what is needed in order to form such a group. She began by explaining how her organization got started and how it grew into what it is now. Ms. Dicken stressed the importance of partnerships and how they are the secret to grant money; how a variety of partners (ie. Chamber of Commerce, Universities, Building Association etc.) is also vital to the foundation of a strong watershed group.

The next item on the agenda involved the Ohio Department of Natural Resources (ODNR) watershed coordinator grant application in which NEFCO staff explained that they were in the process of applying for and what the grant could possibly mean for the Nimishillen Creek watershed.

This meeting ended with an informal discussion on what future activities the stakeholders expected from this process:

Mr. Dean England of Drainage Service and Supply discussed BMP follow-up and the importance of a maintenance program to keep them operational and maintained.

Another stakeholder expressed the importance of ditch clean-up by removing flow impediments from drainage ditches.

Mr. Michael Miller from the City of Canton inquired about construction advice and funding options in conducting urban stream restoration.

Mr. Bob Somrak from the Stark County Health Department suggested an inventory of Home Sewage Treatment Systems in Stark County be done.

Ms. Lin Wu from Mount Union College offered to help with our efforts by using students to do some of the research involved.

Judging by the reaction from the stakeholders at this meeting, NEFCO staff felt that there was some genuine interest in forming a watershed group to work on improving the water quality of the Nimishillen Creek Watershed.

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