Macroinvertebrate Sampling Required by Ohio EPA Permit Number 3PA00002*FD

December 24, 2003

1. Name of the facility:

   Combined sewer overflows (CSOs) of the Northeast Ohio Regional Sewer District (NEORSD).

2. Receiving water of the discharge and subsequent stream network:

   NEORSD CSOs discharge to several water bodies. This report pertains to macroinvertebrate sampling required under Ohio EPA Permit No. 3PA00002*FD. Sampling was conducted on Big Creek, Doan Brook, Euclid Creek, and Mill Creek. Doan Brook and Euclid Creek are tributary to Lake Erie. Big Creek and Mill Creek are tributary to the Cuyahoga River and ultimately to Lake Erie.

3. Description of the facility:

   Several different types of CSO structures are present within the NEORSD system. The location of each NEORSD CSO is listed in Ohio EPA Permit No. 3PA00002*FD. Diagrams and any other descriptive information pertaining to each CSO are on file at the NEORSD Planning Department.

4. Characterization of the effluent from the facility:

   NEORSD CSO effluent data were reported to Ohio EPA in monthly Combined Sewer Overflow Reports from November 1988 through March 1997.

5. Descriptions of all sampling sites in the study area:

   Ohio EPA Permit No. 3PA00002*FD states that macroinvertebrate sampling shall be conducted at the mouths of Mill Creek, Big Creek, Doan Brook, and Euclid Creek. For practical purposes, however, sampling was not necessarily conducted at the mouths of these water bodies. This slight alteration of the sites specified in the permit was discussed with and approved by Ohio EPA in 1997. Documentation of this and other minor changes in sampling and reporting procedures are included in Appendix A.

   Big Creek

   Hester-Dendy artificial substrate samplers were installed downstream of all CSOs tributary to Big Creek, at NEORSD stream monitoring Site #25. This site is located approximately 150 meters downstream of Jennings Road. The creek at this location has riffles, a run, and a deep pool. The samplers were located approximately 30 meters downstream of the Treadway Creek outfall, downstream of the last riffle in the area and upstream of a sharp bend in the creek and a deep pool. The creek is approximately three meters wide at this location with riffle depths generally greater than ten centimeters. The Hester-Dendy samplers were placed in approximately 36 centimeters of water at this location. The stream gradient at Site #25 is estimated to be approximately eighteen feet per mile and the creek had a drainage area of approximately 38.6 square miles. The riparian zone in the area is very narrow, and land use is primarily urban/industrial.

Doan Brook

The Doan Brook NEORSD macroinvertebrate sampling site #16.1 is located approximately 50 meters downstream of the furthest downstream CSO discharging to Doan Brook. This site is located within Rockefeller Park, approximately 30 meters downstream of St. Clair Avenue in the channelized section of the brook. Stone walls 8 to 10 feet in height are present on both sides of the brook from the University Circle area to Interstate 90. Stream width at this location is approximately 3 meters and Hester-Dendy samplers were placed in approximately 36 centimeters of water. Land use in the area and throughout the Doan Brook watershed is predominantly residential and recreational. The stream gradient at this site was estimated at approximately 14 feet per mile and the stream has a drainage area of approximately 9.5 square miles.

Euclid Creek

The Euclid Creek macroinvertebrate sampling site is located downstream of NEORSD stream monitoring Site #0.5, within the Wildwood Park area of the Cleveland Lakefront State Park. The stream gradient at this site was estimated at approximately 6 feet per mile, creating a dry weather velocity that is lower than desired for the colonization of Hester-Dendy artificial substrate samplers. Despite this low flow, the Hester-Dendy artificial substrate samplers were set downstream of all the Euclid Creek CSOs, approximately 300 meters downstream of Lake Shore Boulevard, in a glide area, which was approximately 36 centimeters deep. The creek is approximately 20 meters wide at this location with a narrow riparian zone and a drainage area of approximately 24.2 square miles. Upstream of Lake Shore Boulevard, the creek has been channelized by the U.S. Army Corps of Engineers. Land use within the Euclid Creek watershed is primarily residential and recreational.

Mill Creek

Hester-Dendy artificial substrate samplers were installed downstream of all CSOs tributary to Mill Creek, at NEORSD stream monitoring Site #31. This site is located approximately 200 meters upstream of the confluence with the Cuyahoga River. Hester-Dendy artificial substrate samplers were installed downstream of a riffle approximately 50 feet upstream from the Canal Road Bridge. The samplers were installed in approximately 36 centimeters of water. This site is downstream from all CSO outfalls and tributaries to Mill Creek. At this location, the stream gradient is calculated to be approximately 12 feet per mile, and the creek has a drainage area of approximately 18.1 square miles. Land use within the Mill Creek watershed is primarily industrial and residential.

6. Listing of name and model number of all sampling equipment used:

Hester-Dendy artificial substrate samplers per Ohio EPA specifications; 12" x 8" x 4" cinder blocks; assorted lengths of ½-inch steel rebar; 3/8-inch eye bolts; plastic tie wraps; 1/8-inch 300-pound test nylon rope; U.S. number 35 standard sieve (500-micron openings); 1000-milliliter cylindrical plastic screw-top containers; 500-micron D-frame aquatic dip net, Turtox Design 73-440, Wildco Catalog number 425-A46; one square foot Surber sampler; serrated fine-point forceps; 50-milliliter snap-cap vials; Hedwin 4-Liter Cubitainers #10M4M3; Wildco Model #190-E20 wash bucket (583-micron mesh bottom); YSI Model 58 dissolved oxygen meter; YSI Model 95 oxygen, conductivity, salinity, and temperature

meter; YSI 610-D multi meter; Orion Model 260 pH meter; Orion Model 128 conductivity meter.

7. Descriptions of all electrofishing configurations used:

   Not Applicable.

8. Types of boats used:

   Not Applicable.

9. Description of exact methods for demarcation of the sampling zone:

   Hester-Dendy artificial substrate samplers were installed at midstream at all sample sites. Investigators identified sample locations by pacing off the distance between known landmarks and the sample location. The Big Creek site was located approximately 90 feet downstream of the Treadway Creek outfall, the Doan Brook site was located approximately 100 feet downstream of the St. Clair Avenue Bridge, the Euclid Creek site was located approximately 600 feet downstream of the Lake Shore Boulevard bridge, and the Mill Creek site was located approximately 50 feet upstream of Canal Road. All sample sites were marked with a length of rebar, the top end of which had been painted fluorescent orange.

10. Diagram of the course followed as each sampling zone was traversed:

    Not Applicable.

11. Description of sample preservation methods:

    The Hester-Dendy artificial substrate samplers were removed from the water and placed into the five-gallon Wildco wash bucket. The individual samplers were disassembled in this wash bucket. The Hester-Dendy plates were left in the wash bucket and all of the associated hardware was washed into the bucket with water from the stream being sampled and carefully examined before discarding. The contents of the wash bucket were then placed into a 1000-millileter cylindrical plastic screw-top container and enough ethanol to completely submerge the sample was added to the container. Qualitative samples were obtained and placed directly into a 50-milliliter snap-cap vial containing ethanol.

12. Listing of all taxonomic keys utilized for specimen identification:

    The following taxonomic literature sources were used by EA Engineering, Science and Technology to identify the benthos in the NEORSD's samples from Big Creek, Doan Brook, Mill Creek, and Euclid Creek.

Bednarik, A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus Stenonema (Ephemeroptera: Heptageniidae). Canadian Bulletins of Fisheries and Aquatic Sciences 201:1-73.

Bode, R.W. 1983. Larvae of North American Eukiefferiella and Tvetenia (Diptera: Chironomidae). New York State Museum Bulletin 452:1-40.

Bolton, M.J. 1998. Guide to the identification of larval Chironomidae (Diptera) in the temperate eastern Nearctic north of Florida. Ohio EPA, Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

Brown, H.P. 1976. Aquatic dryopoid beetles (Coleoptera) of the United States. Water Pollution Control Series 18050 ELDO4/72. 2nd edition. U.S. Environmental Protection Agency, Cincinnati, OH.

Burch, J.B. 1982. Freshwater snails (Mollusca: Gastropoda) of North America. EPA-600/3-82-026. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

Epler, J.H. 1987. Revision of the Nearctic Dicrotendipes Kieffer, 1913 (Diptera: Chironomidae). Evolutionary Monographs No. 9:1-102.

_____. 1995. Identification manual for the larval Chironomidae (Diptera) of Florida. Florida DEP, Division of Water Facilities, Tallahassee, FL.

_____. 2001. Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. North Carolina DENR, Division of Water Quality, Raleigh, NC.

Grodhaus, G. 1987. Endochironomus Kieffer, Tribelos Townes, Synendotendipes new genus, and Endotribelos new genus (Diptera: Chironomidae) of the Nearctic region. Journal of the Kansas Entomological Society 60(2):167-247.

Jezerinac, R.F., G.W. Stocker, and D.C. Tarter. 1995. The crayfishes (Decapoda: Cambaridae) of West Virginia. Bulletin of the Ohio Biological Survey 10(1):1-193.

Klemm, D.J. 1985. Guide to the freshwater Annelida (Polychaeta, naidid, and tubificid Oligochaeta, and Hirudinea) of North America. Kendall/Hunt Publishing Co., Dubuque, IA.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region: with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, Canada.

Maschwitz, D.E. 1976. Revision of the Nearctic species of the subgenus Polypedilum (Chironomidae: Diptera). Doctoral Dissertation, University of Minnesota.

McCafferty, W.P. and R.D. Waltz. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Transactions of the American Entomological Society 116(4):769-799.

Merritt, R.W. and K.W. Cummins, eds. 1996. An introduction to the aquatic insects of North America. 3rd edition. Kendall/Hunt Publishing Co., Dubuque, IA.

Morihara, D.K. and W.P. McCafferty. 1979. The Baetis larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105:139-221.

Needham, J.G. and M.J. Westfall, Jr. 1955. A manual of the dragonflies of North America (Anisoptera) including the Greater Antilles and the provinces of the Mexican border. University of California Press, Berkeley, California.

Pennak, R.W. 1989. Fresh-water invertebrates of the United States. 2nd edition. John Wiley & Sons, New York, NY.

Roback, S.S. 1985. The immature chironomids of the eastern United States VI. Pentaneurini-genus Ablabesmyia. Proceedings of The Academy of Natural Sciences of Philadelphia 137(2):153-212.

Saether, O.A. 1977. Taxonomic studies on Chironomidae: Nanocladius, Pseudochironomus, and the Harnischia complex. Bulletin of the Fisheries Research Board of Canada 196:1-143.

Simpson, K.W. and R.W. Bode. 1980. Common larvae of the Chironomidae (Diptera) from New York State streams and rivers with particular reference to the fauna of artificial substrates. New York State Museum Bulletin 439:1-105.

Wiederholm, T., ed. 1983. Chironomidae of the Holarctic region. Keys and diagnoses. Part 1. Larvae. Entomologica Scandinavica Supplement 19:1-457.

Wiggins, G.B. 1996. Larvae of the North American caddisfly genera (Trichoptera). 2nd edition. University of Toronto Press, Toronto, Canada.

13. Location of the reference collection and other sources used to verify identifications:

A reference collection was not necessary for identification of these specimens. However, if a reference collection had been needed to verify any specimens, EA maintains a sizable macroinvertebrate voucher collection with over 1800 specimens representing over 700 taxa. If this taxonomic library proved to be insufficient, every reasonable attempt would be made to have the specimen(s) identified or verified by a noted authority.

14. Exact methods used to construct Hester-Dendy samplers or source of purchase:

Hester-Dendy artificial substrate samplers were constructed by ARC Industries, Inc., using eight 3-inch squares of 1/8-inch thick hardboard, twelve one-inch diameter round, 1/8-inch thick plastic washers (spacers), a ¼-inch eyebolt, and ¼-inch nut. A ¼-inch diameter hole was drilled through the center of each hardboard square. The plates and spacers were arranged on the eyebolt to provide three single spaces, three double spaces and one triple space. ARC Industries, Inc. is located at 2879 Johnstown Road in Columbus, Ohio.

15. Methods used for anchoring Hester-Dendy samplers:

Five Hester-Dendy artificial substrate samplers were clustered together at each location with plastic tie-wraps. Another plastic tie-wrap was used to secure the cluster of samplers to the top of a 12" x 8" x 4" cinder block. In some cases the cluster of samplers was attached to a 3/8-inch eyebolt that was anchored to the top of a 12" x 8" x 4" cinder block. The cinder blocks were anchored in place by driving a length of steel rebar into the substrate through a hole in the cinder block or a second 3/8-inch eyebolt, which was attached to the end of the block. A diagram that shows how the Hester-Dendy samplers were anchored is included in Appendix B.

16. Descriptions of the methods used to identify dipterans of the family Chironomidae:

Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, 100 chironomids from any single sample are mounted for identification. Species-level identifications generally follow those suggested by Ohio EPA.

17. Copies of all raw data sheets:

Raw data sheets are located in the Appendices at the end of this report as follows:

Appendix C Chemical Sample Analysis Sheets

Appendix D Macroinvertebrate Data Sheets

18. Description of the methods used to calculate the QHEI, the IBI, the MIwb, and the ICI for each site:

The QHEI, IBI, and the MIwb were not required by Ohio EPA Permit Number 3PA00002*FD.

The methods used for calculation of the ICI are as follows (detailed methodology can be found in *Biological Criteria for the Protection of Aquatic Life*, OEPA. 1988):

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a

modification of the Index of Biotic Integrity for fish (Ohio EPA 1987). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa

Scoring criteria for all ten metrics are dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for each location.

Calculation of the ICI was conducted using a computer program written for the software SAS® by EA Engineering, Science, and Technology in 1994. This program is continuously tested to ensure its accuracy.

19. Description of qualitative macroinvertebrate sampling techniques:

Qualitative macroinvertebrate sampling was conducted using a 500-micron D-frame aquatic dip net and curved, serrated fine-point forceps. The net was placed in the water with the open end facing upstream. The substrate of all available habitat types (i.e., riffles, runs, deep pools, margins, undercut banks, etc.) was disturbed using kicks with the foot or by hand. Large objects, such as logs, boulders, and slabs, were first handpicked for large invertebrates using forceps and then were washed off into the dip net. Kick sampling and hand picking were conducted until all available habitat types were sampled. The contents of the net were placed into a white enamel pan and sorted for 35 to 45 minutes, until no new or different organisms were found. The organisms were preserved with ethanol in sealed containers for future identification.

A Surber sample was utilized when Hester-Dendy samplers were lost or buried. A quadrat (one square foot) is attached to the frame of the collecting net in such a way that it can be placed on the substrate. The substrate within the quadrat is disturbed and benthic organisms are washed by current into the net. The contents retained within the Surber sample were preserved with ethanol in sealed containers for future identification.

20. Complete description of any statistical analysis performed on the data:

The only statistical comparison used was the relative abundance (or percent composition) of individual taxa per site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Relative Abundance} = \frac{\text{\# Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

21. Dates and times of sampling:

Hester-Dendy artificial substrate samplers were installed at all four sites twice during the sampling season. Two macroinvertebrate samplings were conducted at each site in 2003 to evaluate seasonality as a variable. The following table lists the streams, date installed and date removed.

FIRST SAMPLING PERIOD		
Stream	Date	
	Installed	Removed
Euclid Creek	June 24, 2003	August 7, 2003 (Surber Sample)
Doan Brook		August 7, 2003 (Surber Sample)
Mill Creek		August 7, 2003
Big Creek	July 3, 2003	August 7, 2003 (Surber Sample)

SECOND SAMPLING PERIOD		
Stream	Date	
	Installed	Removed
Euclid Creek	August 11, 2003	September 26, 2003
Doan Brook		
Mill Creek		
Big Creek		

22. Results of the stream surveys, in terms of species presence, absence, and relative numbers for each study site:

A list of taxa collected at each site is included in Appendix D.

23. Discussion of historic data pertaining to the locality of the study sites or that stream segment:

The following table summarizes the historic results of macroinvertebrate sampling at all four sites:

Dates Sampled	**ICI Scores**			
	Big Creek	***Doan Brook***	***Euclid Creek***	***Mill Creek***
1995	22 (Fair)	-	-	18 (Fair)
1996	20 (Fair)	-	-	-
1997	8 (Poor)	4 (Poor)	8 (Poor)	
1998	-	16 (Fair)	4 (Poor)	-
1999	16 (Fair)	40 (Good)	22 (Fair)	32 (Marg. Good)
2000	12 (Poor)	30 (Marginally Good)	10 (Poor)	28 (Fair)
2001	22 (Fair)	8 (Poor)	4 (Poor)	12 (Fair)

Dates Sampled	ICI Scores			
	Big Creek	***Doan Brook***	***Euclid Creek***	***Mill Creek***
July 2002	34 (Good) (Surber sample)	30 (Marg. Good)	24 (Fair)	28 (Fair)
September 2002	26 (Fair)	22 (Fair)	26 (Fair)	32 (Marg. Good)

Big Creek

NEORSD has conducted quantitative macroinvertebrate sampling near the mouth of Big Creek since 1995. Although there were difficulties with the Hester-Dendy samplers being lost or buried in 1995 and high flows that prevented the timely removal in 1996, the site received an ICI score of 22 in 1995 and of 20 in 1996. In 1997, the site received a poor score of 8. It is important to note that, during the 1997 sampling period, a large construction project was taking place approximately ¼ of a mile upstream from the sample location. This construction site had extensive erosion and runoff, which entered Big Creek through nearby storm sewers. By 1999, the ICI score had improved to 16. In 2000, the ICI score decreased to 12, but it should be noted that the creek again experienced heavy sediment loadings attributable to a nearby construction project. By 2001, the score had improved to 22, which may reflect the benthic community's recovery from the previous high sediment load. In 2002, Hester-Dendy samplers were installed twice, once in July and once in September. During the July 2002 sampling period, the Hester-Dendy samplers were either lost or buried, so a Surber sample was obtained to calculate the ICI score of 34. In September 2002, the Hester-Dendy sampler was used to obtain an ICI score of 26.

Doan Brook

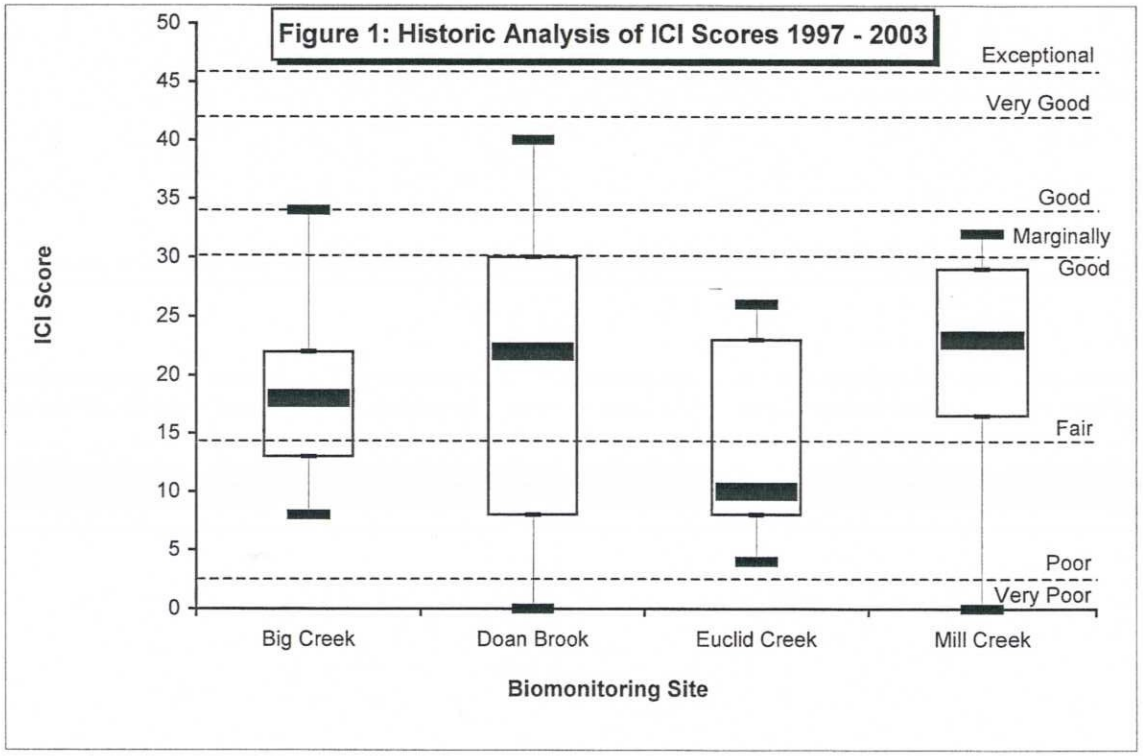
NEORSD has conducted quantitative sampling near the mouth of Doan Brook since 1997. The ICI score calculated was 4. The ICI score at this location improved to 16 by 1998. The 1999 ICI score of 40 demonstrated improvement from the previous years. Flow velocities had increased and some upstream discharges were remediated. In 2000, the ICI score near the mouth of Doan Brook was 30. In 2001, the score had decreased to 8 but, by 2002, the ICI score had improved. In 2002, Hester-Dendy samplers were installed twice, and they were removed in July and September. The scores had improved to 30 and 22, respectively.

Euclid Creek

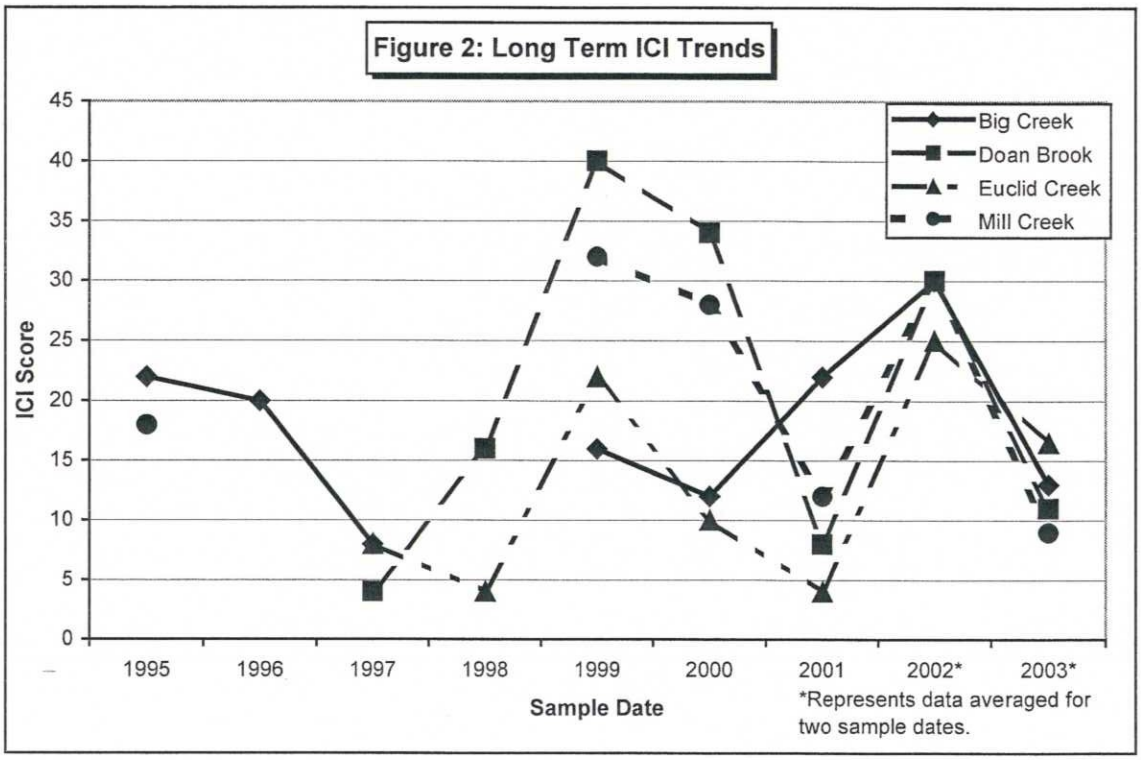
NEORSD conducted quantitative macroinvertebrate sampling near the mouth of Euclid Creek as early as 1991, when a score of 18 was obtained. In 1997, the site was relocated approximately 450 feet downstream of the previous location. At the new location (closer to the mouth), ICI scores of 8 and 4 were obtained in 1997 in 1998, respectively. Low flow seen at this site may have contributed to the poor habitat conditions and low ICI scores. By 1999, the ICI score near the mouth of Euclid Creek had improved to 22. However, in 2000 the score decreased to 10. In 2001, the score had further decreased to 4. By 2002, the Euclid Creek ICI scores had shown an improvement. The Hester Dendy samplers were installed twice in 2002, and they were removed in July and September with scores of 24 and 26, respectively.

Mill Creek

NEORSD conducted quantitative macroinvertebrate sampling on Mill Creek, upstream of Canal Road in 1995 and obtained an ICI score of 18. In 1999, ICI scores of 32 at Mill Creek showed a marked improvement since 1991. The ICI score decreased to 28 in 2000. It should be noted that a break in an interceptor sewer had occurred in the spring allowing untreated sewage to enter Mill Creek. In 2001, the ICI score had further decreased to 12. By 2002, the ICI scores near the mouth of Mill Creek had improved. The Hester-Dendy samplers were installed twice in 2002, and they were removed in July and September with scores of 28 and 32, respectively.



The box-and-whisker plot in figure 1 provides a comprehensive view for each body of water. This reveals that Doan Brook experienced the greatest amount of variability with fifty percent of the ICI scores (i.e., the interquartile range) falling between 8 and 30. Euclid Creek is next with fifty percent of the scores falling between 8 and 23. The interquartile range of scores for Mill Creek is from 16.5 to 29. Big Creek has the smallest interquartile range at 13 to 22. The interquartile ranges as well as the maximum and minimum scores indicate that there has been a great deal of variability at each site over the past six years.



Analyses of the long-term ICI scores reveal considerable fluctuation from year to year for each creek. This is clearly evident in Figure 2. This figure also suggests that the fluctuation in ICI scores may not be dependent on site-specific changes in water quality, as the scores for each site appear to increase and decrease in unison. The fluctuation of ICI scores may be at least partially dependent on some other factor that has a similar effect on each watershed.

24. The calculated index scores used for comparison with the biological water quality criteria:

Sample Location	August 2003 Score	Narrative Rating	September 2003 Score	Narrative Rating	Avg. 2003 Scores	Narrative Rating
Big Creek	10*	Poor	16*	Fair	13	Fair
Doan Brook	0**	Very Poor	22	Fair	11	Poor
Euclid Creek	10*	Poor	23	Fair	16.5	Fair
Mill Creek	0	Very Poor	18	Fair	9	Poor

* ICI score obtained using Surber sampler.
** Hester-Dendy sampler missing, and Surber sampler found 0 organisms.

25. Raw data submitted in computer format:

The raw data are contained on the enclosed diskette.

26. The biological criteria used for comparison with the stream sampling data, and the rationale behind the selection of the criteria:

    The stream segments which are required to be sampled for macroinvertebrates per Ohio EPA Permit No. 3PA00002*FD have all been designated warmwater habitat for aquatic life use by the Ohio EPA. According to Table 7-15 (Biological Criteria for Warmwater, Exceptional Warmwater and Modified Warmwater Habitats) in OAC 3745-1-07, the ICI criterion for sites which have been designated warmwater habitat within the Erie/Ontario Lake Plain (EOLP) ecoregion is 34. The table, however, also indicates that the criteria do not apply to Lake Erie river mouths.

27. The calculated QHEI values:

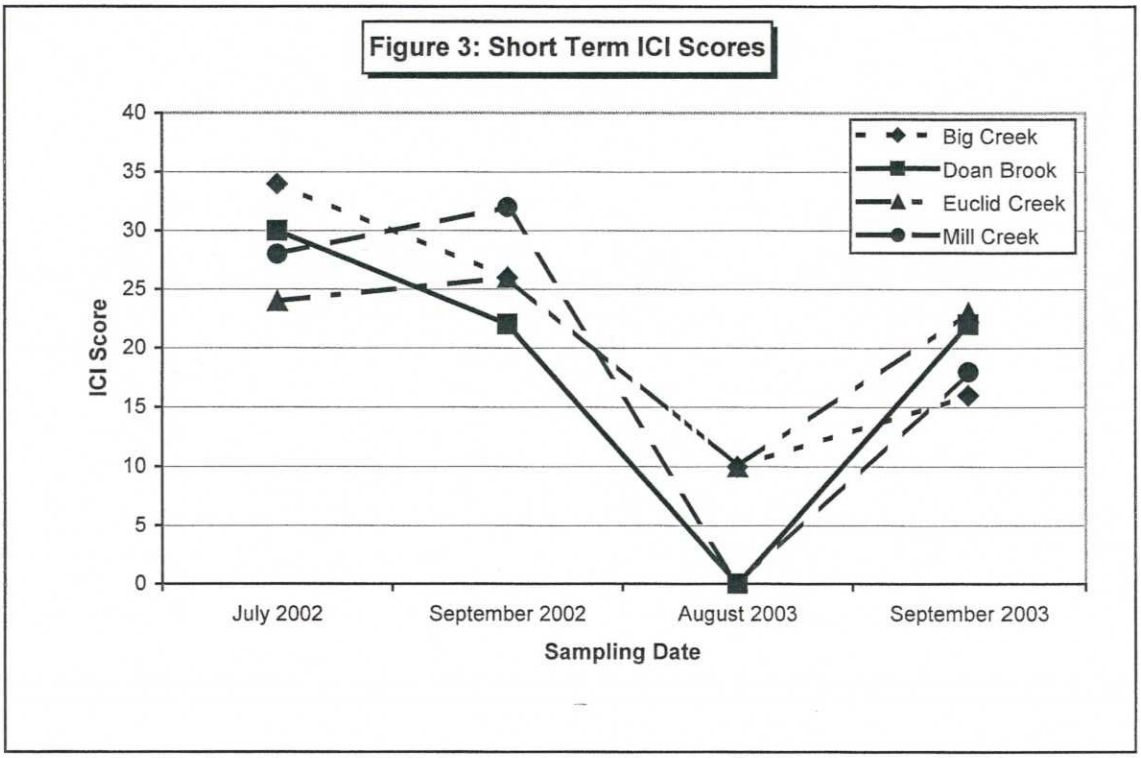
    Not required by OhioEPA Permit No. 3PA00002*FD.

28. Discussion of the study results in terms of impacts from the facility in question and other facilities that may have been studied:

    In 2003, as in 2002, NEORSD staff installed Hester-Dendy samplers for two six-week periods. The individual scores, as well as a calculated average for each site are provided in line item 24. As the table demonstrates, the ICI scores in 2003 were especially low during the first sampling period, from the end of June through August 7. All of the scores during this time were in the poor range. By the second sampling period, the scores had all improved to the fair range.

    There were seven documented dry weather overflows to Mill Creek during the time the Hester-Dendy samplers were in place. Five of these events occurred during the first sampling period. There were two documented dry weather overflows to Big Creek. These both occurred on the same day during the second sampling period as a result of a pump station malfunction. There were eight dry weather overflows to Doan Brook while the Hester-Dendy samplers were in place. Five of these occurred during the second sampling period. There were no documented dry weather overflows to Euclid Creek while the Hester-Dendy samplers were in place.

    It is also important to note that, during the first sampling period, the ICI scores for Big Creek, Doan Brook, and Euclid Creek were all obtained using a Surber sample. During the second sampling period, the ICI score for Big Creek was calculated using a Surber sample. A Surber sample was used when the Hester-Dendy sampler was missing or buried in sediment. It is hypothesized that heavy rains during the first sampling period led to the samplers being washed away or buried. Cuyahoga County averaged 4.7 inches of rain during the first sampling period and 2.8 inches of rain during the second sampling period. (Rainfall data were averaged from the Automated Flood Warning System at www.afws.net on December 12, 2003).



As with the long-term ICI scores, analyses of the short-term ICI scores, shown in Figure 3, reveals significant fluctuation from sampling period to sampling period. This is further support for a hypothesis that the fluctuation of ICI scores is not dependent on site-specific changes in water quality, as the scores for each site appear to increase and decrease in unison.

Results from chemical and bacteriological analyses of water samples collected at these macroinvertebrate sampling sites are presented in Appendix C. None of the chemical concentrations measured in the grab samples collected from these sites during the two six-week periods exceeded applicable Ohio EPA water quality criteria for protection of warmwater habitat aquatic life, agricultural water supply, or industrial water supply. With the sole exception of mercury, no chemicals analyzed had concentrations exceeding their applicable water quality criteria for protection of wildlife and human health. However, most of the *E. coli* concentrations exceeded the water quality criteria for protection of primary contact recreational use. Many of these elevated bacteria levels were associated with rain events occurring at or soon before the time of sample collection, although some remain unexplained. In most cases, elevated *E. coli* levels exceeding the primary contact criteria were also measured in samples collected concurrently upstream of the respective CSO-impacted stream reaches.

29. Other relevant information:

All information believed to be relevant has been included above.

Appendix A
Correspondence Concerning Minor Changes in Sampling and Reporting Procedures

Northeast Ohio Regional Sewer District

Environmental & Maintenance Services Center • 4747 E. 49th St. • Cuyahoga Heights, OH 44125-1011
(216) 641-6000 • FAX: (216) 641-8118

May 8, 1997

Ms. Sandy Cappotto
Ohio Environmental Protection Agency
Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087

Dear Ms. Cappotto:

I am writing to confirm our telephone conversation of April 28, 1997 concerning the Northeast Ohio Regional Sewer District's (NEORSD) CSO NPDES Permit No. 3PA00002*FD, effective April 1, 1997.

Part II, Item I of the permit states in part, "The macroinvertebrate sampling required at F.1(d) and G.2 shall be established and conducted in accordance with procedures outlined in 'Reporting and Testing Guidance for Biomonitoring Required by the Ohio Environmental Protection Agency'(October 1991, or latest revision; Division of Surface Water)...." The October 1991 version of "Reporting and Testing Guidance..." is the latest revision.

Section 1, Part B of "Reporting and Testing Guidance..." requires the submission of a Standard Operating Procedure (SOP) which details the techniques used to conduct tests required by NPDES permits. NEORSD will not be required, for the purposes of macroinvertebrate sampling required by NPDES Permit No. 3PA00002*FD, to submit an SOP.

Section 4, Part F of "Reporting and Testing Guidance..." requires the submission of a study plan prior to the initiation of an instream biomonitoring program. NEORSD will not be required, for the purposes of macroinvertebrate sampling required by NPDES Permit No. 3PA00002*FD, to submit a study plan.

Section 4, Part G of "Reporting and Testing Guidance..." requires chemical analysis of ambient waters in conjunction with an instream biological survey. Part G states,

"Parameters analyzed at each site should be relevant to the NPDES permit monitoring requirements and any interactive impacts, including nonpoint sources, that occur in the study area." Ohio EPA will not specify which chemical parameters must be analyzed. NEORSD staff may exercise its discretion in the selection of appropriate chemical parameters.

If I have misinterpreted or misstated our telephone conversation of April 28, 1997, please contact me at the letterhead address or by telephone at (216) 641-6000.

Sincerely,

Frank Foley

Frank Foley, Supervisor
Water Quality and Industrial Surveillance

cc J. Weber
R. Connelly
F. Greenland
K. Linn
W. Mack

OhioEPA
State of Ohio Environmental Protection Agency
Northeast District Office
2110 E. Aurora Road
Twinsburg, Ohio 44087-1969
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George V. Voinovich
Governor

June 9, 1997

NEORSD
CSO Permit
3PA00002 (OH0043991)

Mr. Frank Greenland
NEO Regional Sewer District
3826 Euclid Ave.
Cleveland, OH 44115

Dear Mr. Greenland:

This letter is to document conversations between Frank Foley, NEORSD and Steve Tuckerman of this office concerning the macroinvertebrate sampling requirement per Part II., I., of the NEORSD CSO permit. The permit as written has conflicting information concerning the dates of deployment of the Hester Dendy artificial substrates (HDs). The dates specified in the permit are in error and all macroinvertebrate sampling should be performed in accordance with "Biological Criteria for the Protection of Aquatic Life: Volume III" which lists June 15 through September 30 as the proper sampling times.

Concern was also expressed about the possible loss of HDs due to natural stream conditions or vandalism. The Ohio EPA recognizes that such situations may occur. All reasonable efforts must be made to collect samples from HDs. If loss of substrates should occur, the District would send a written explanation of why the HDs could not be collected. In any case, qualitative kick net sampling should be performed and the results reported.

The site locations mentioned in the permit are intended as a general location of the sampling area. Final selection of the HD location may be made at the discretion of the NEORSD field staff.

If you have any questions please contact this office at (216) 963-1124 or Steve Tuckerman (216) 963-1105.

Sincerely,

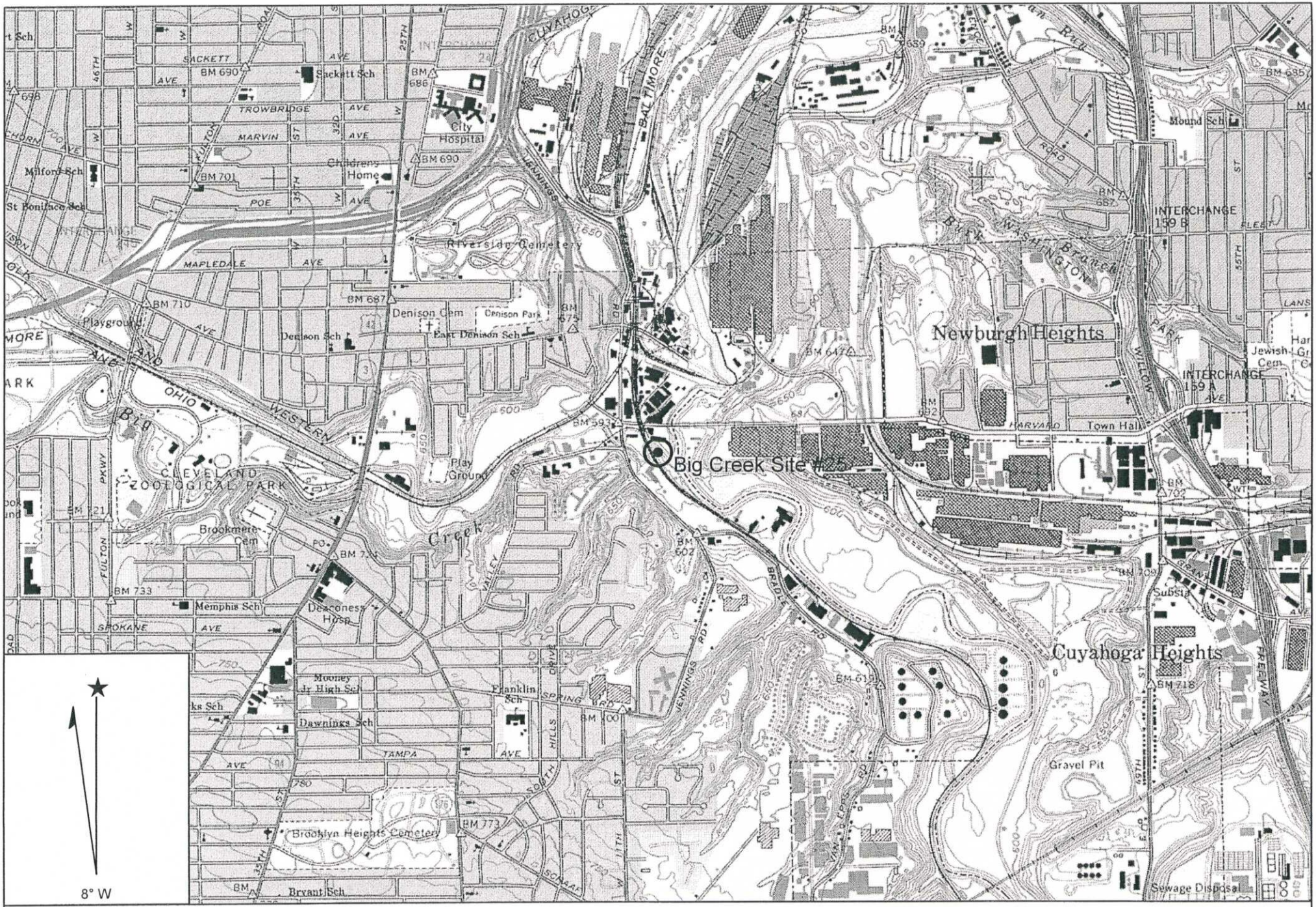
Sandra M. Cappotto

Sandra M. Cappotto
Environmental Scientist
Division of Surface Water

SMC:bp

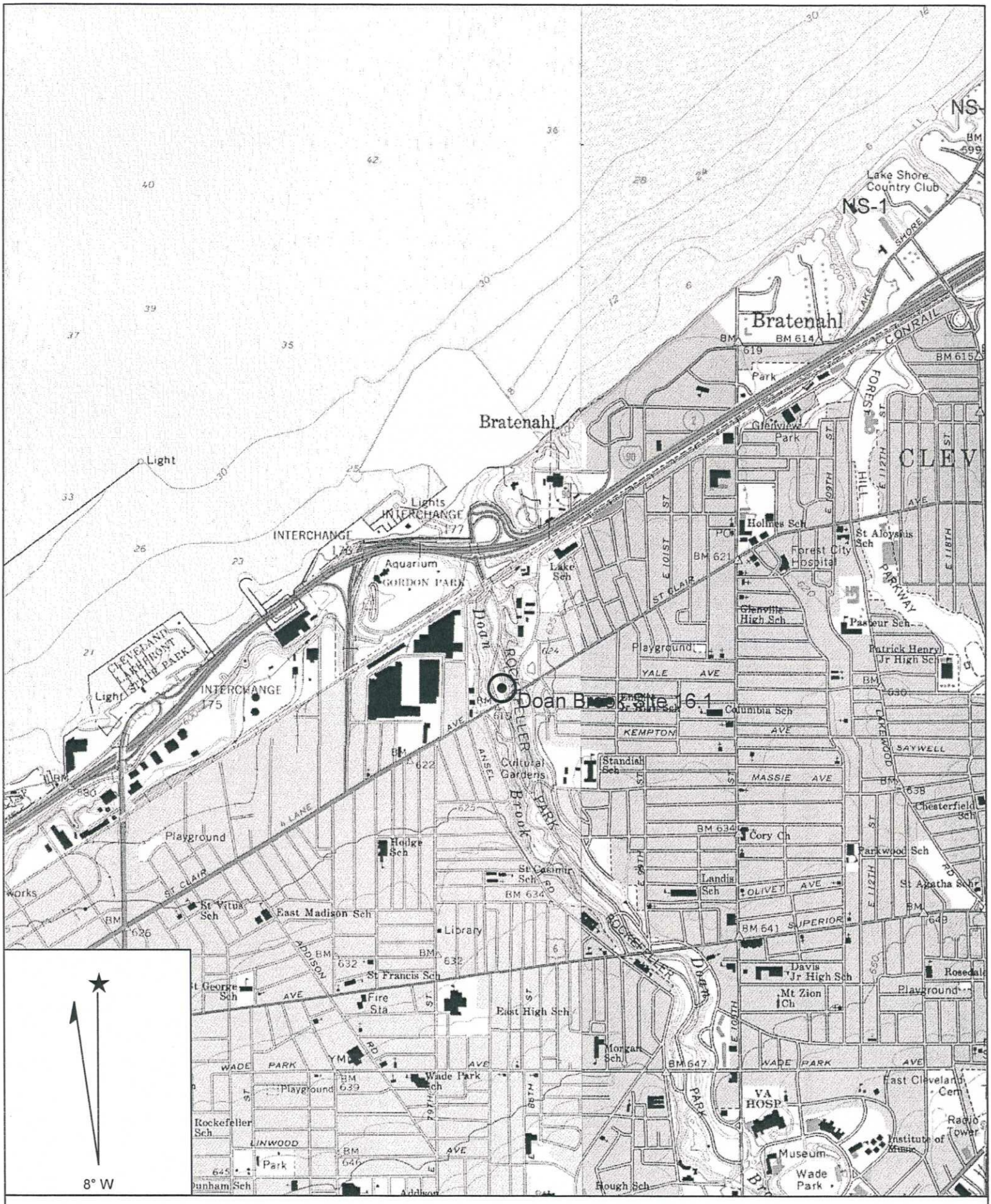
cc: Frank Foley, NEORSD

file:misc:neorsd:mac



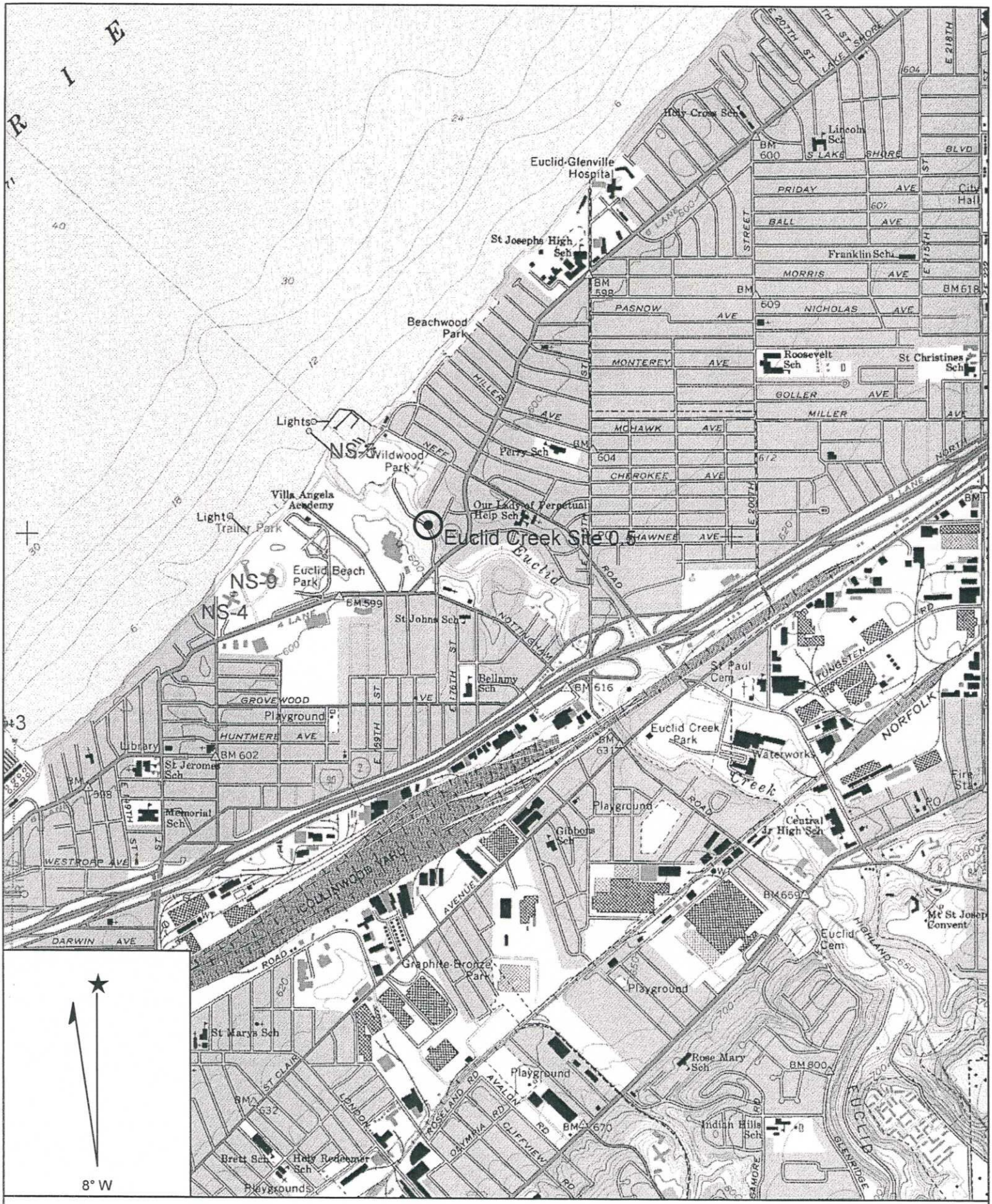
Name: CLEVELAND SOUTH
Date: 12/24/2003
Scale: 1 inch equals 2000 feet

Location: 041° 26' 45.8" N 081° 41' 08.8" W
Caption: NEORSD CSO Permit-Required Macroinvertebrate Sampling Site, Big Creek



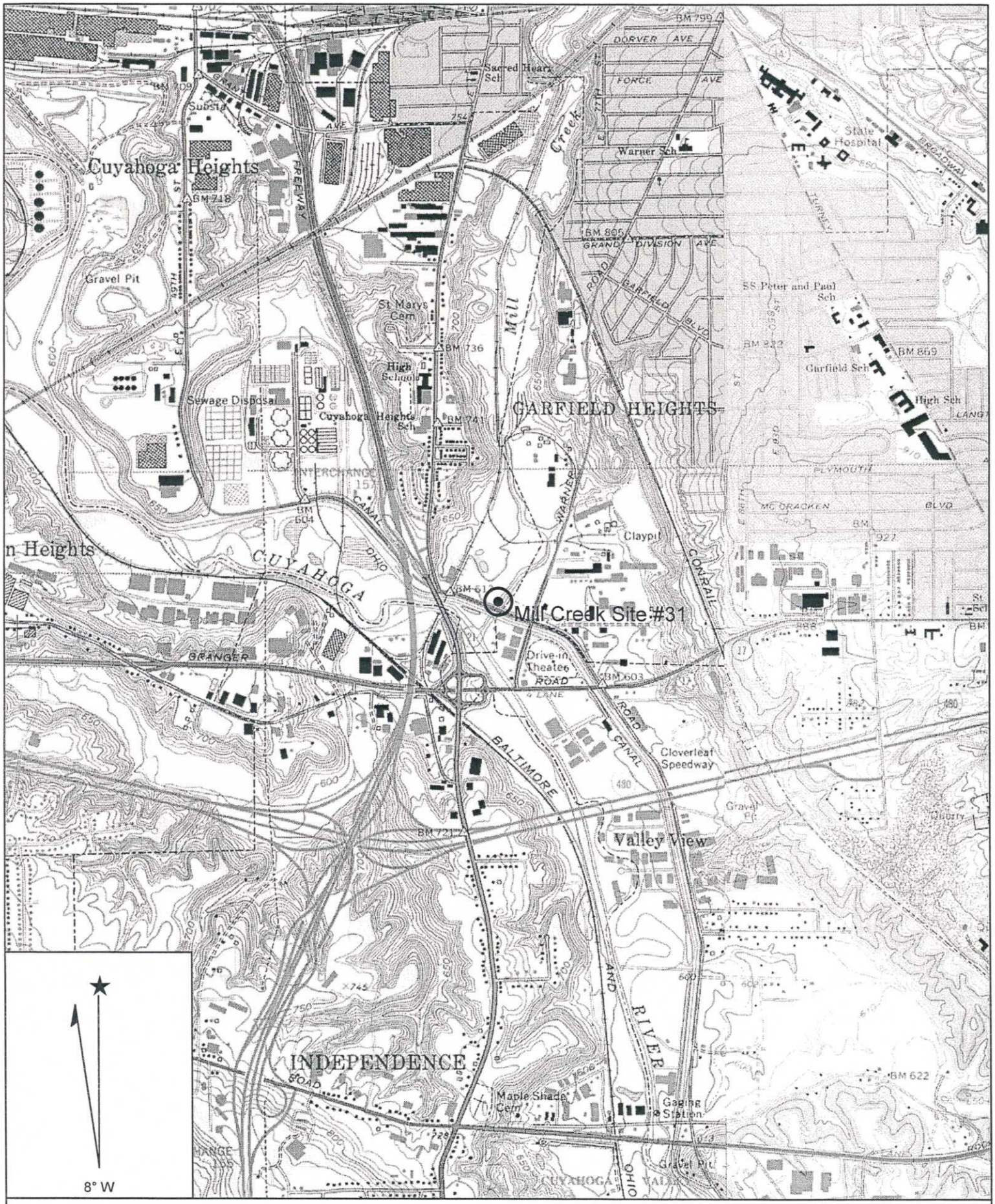
Name: CLEVELAND NORTH
Date: 12/24/2003
Scale: 1 inch equals 2000 feet

Location: 041° 32' 12.6" N 081° 37' 48.4" W
Caption: NEORSD CSO Permit-Required Macroinvertebrate Sampling Site, Doan Brook



Name: EAST CLEVELAND
Date: 12/24/2003
Scale: 1 inch equals 2000 feet

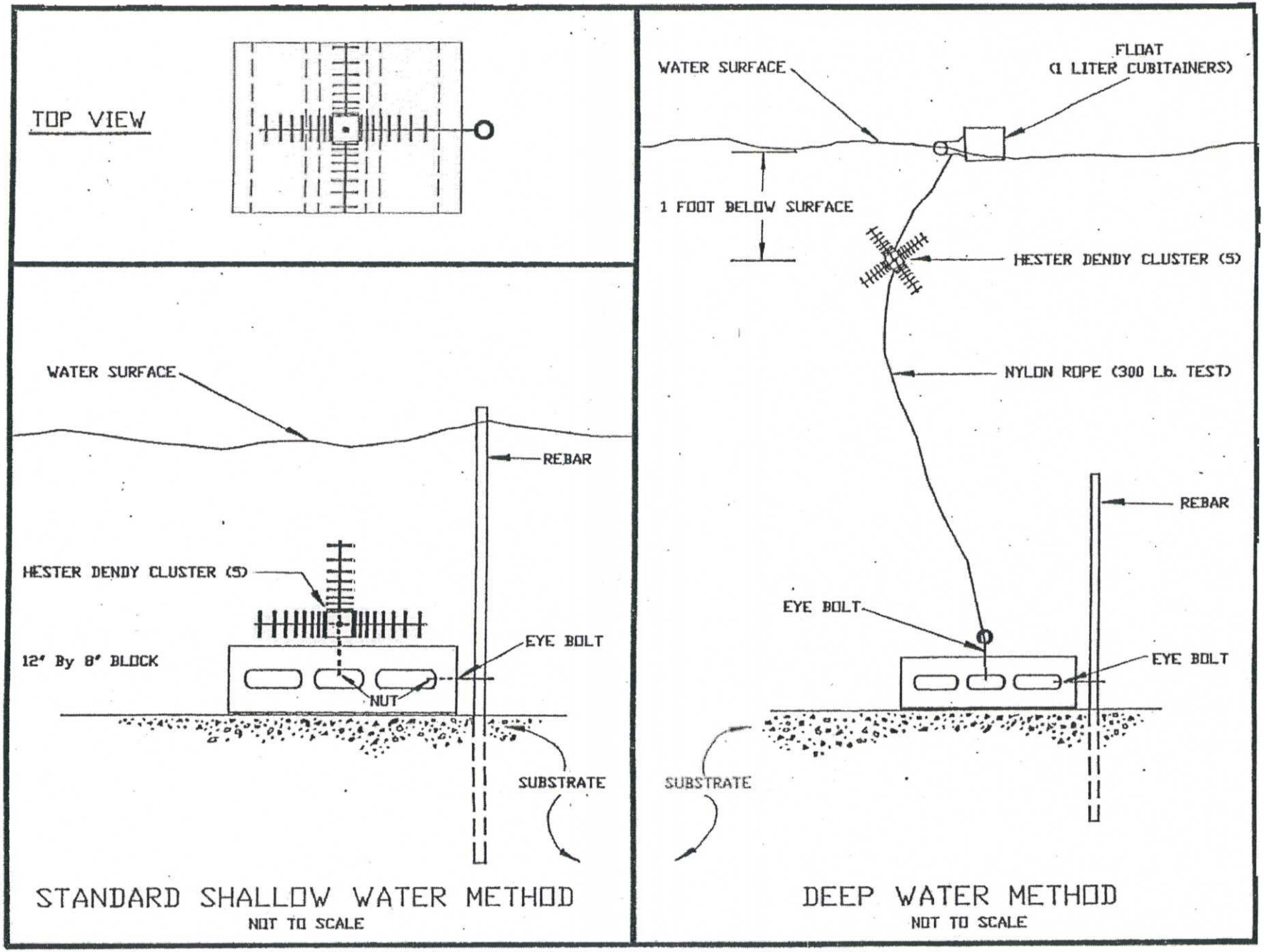
Location: 041° 34' 48.9" N 081° 33' 20.3" W
Caption: NEORSD CSO Permit-Required Macroinvertebrate Sampling Site, Euclid Creek



Name: CLEVELAND SOUTH
Date: 12/24/2003
Scale: 1 inch equals 2000 feet

Location: 041° 25' 03.9" N 081° 38' 18.2" W
Caption: NEORSD CSO Permit-Required Macroinvertebrate Sampling Site, Mill Creek

Appendix B
Diagram of Hester-Dendy Anchoring Methods


TOP VIEW
WATER SURFACE
REBAR
HESTER DENDY CLUSTER (5)
12" By 8" BLOCK
EYE BOLT
NUT
SUBSTRATE
STANDARD SHALLOW WATER METHOD
NOT TO SCALE
WATER SURFACE
FLOAT
(1 LITER CUBITAINERS)
1 FOOT BELOW SURFACE
HESTER DENDY CLUSTER (5)
NYLON ROPE (300 Lb. TEST)
REBAR
EYE BOLT
EYE BOLT
SUBSTRATE
DEEP WATER METHOD
NOT TO SCALE

Appendix D
Macroinvertebrate Data

NEORSD - 2003 MACROINVERTEBRATE STUDY
ICI METRICS AND SCORES

LOCATION	DATE	DRAINAREA	ICI TOTAL	TOTNUM	NUMTAX	TAXSCORE	NUMMAY	MAYSCORE	NUMCAD	CADSCORE	NUMDIPT	DIPSCORE	PERMAY	PMAYSCR	PERCAD	PCADSCR	PERTAN	PTANSCR	PERTHER	PTHSCR	PERTOL	PTOLSCR	QUALEPT	EPTSCORE
BC25	07AUG03	38.0	10(a)	51	11	0	1	0	1	2	6	0	2.0	2	23.5	6	0.0	0	74.5	0	49.0	0	1	0
BC25	26SEP03	38.0	16(a)	15	7	0	1	0	1	2	1	0	33.3	6	6.7	4	0.0	0	60.0	2	20.0	2	3	0
DB16.1	07AUG03	10.0	--(b)	--	--	-	--	-	--	-	--	-	--	-	--	-	--	-	--	-	--	-	1	0
DB16.1	26SEP03	10.0	22	336	24	2	1	0	1	4	19	4	0.6	2	14.9	6	11.9	4	72.6	0	41.4	0	2	0
EC0.5	07AUG03	23.0	10(a)	60	14	2	0	0	1	2	12	2	0.0	0	3.3	2	6.7	2	90.0	0	68.3	0	1	0
EC0.5	26SEP03	23.0	26	159	21	2	0	0	4	6	12	2	0.0	0	36.5	6	3.1	2	49.1	2	5.7	6	2	0
MC31	07AUG03	18.1	0	30	6	0	0	0	0	0	4	0	0.0	0	0.0	0	0.0	0	100.0	0	73.3	0	0	0
MC31	26SEP03	18.1	18	173	17	2	1	0	1	2	7	2	1.2	2	1.7	2	1.2	2	94.2	0	9.8	4	4	2

(a) ICI calculated with surber sample.
(b) Quantitative sample not collected.

TAXA COMPOSITION, NUMBER, AND PERCENT OF ORGANISMS COLLECTED IN EACH SURBER AND QUALITATIVE SAMPLE AT LOCATION BIG CREEK (BC25), AUGUST AND SEPTEMBER 2003.

TAXA	07AUG03				26SEP03			
	SURBER		QUAL		SURBER		QUAL	
	#	%	#	%	#	%	#	%
Turbellaria	--	--	--	--	1	6.67	3	10.00
Oligochaeta	7	13.73	1	5.26	3	20.00	--	--
Mooreobdella microstoma	2	3.92	1	5.26	1	6.67	--	--
Caecidotea	3	5.88	1	5.26	2	13.33	6	20.00
Baetis flavistriga	1	1.96	--	--	5	33.33	7	23.33
Calopteryx	--	--	--	--	--	--	3	10.00
Enallagma	--	--	--	--	--	--	1	3.33
Cheumatopsyche	--	--	--	--	--	--	5	16.67
Hydropsyche depravata grp.	--	--	--	--	1	6.67	--	--
Ceratopsyche morosa	--	--	--	--	--	--	1	3.33
Hydroptila	12	23.53	1	5.26	--	--	--	--
Thienemannimyia grp.	--	--	--	--	--	--	2	6.67
Cricotopus bicinctus grp.	2	3.92	--	--	--	--	--	--
Cricotopus sylvestris grp.	2	3.92	--	--	--	--	--	--
Chironomus	5	9.80	9	47.37	--	--	--	--
Dicrotendipes neomodestus	--	--	--	--	2	13.33	--	--
Dicrotendipes simpsoni	--	--	--	--	--	--	1	3.33
Polypedilum flavum	1	1.96	--	--	--	--	--	--
Polypedilum illinoense	9	17.65	4	21.05	--	--	--	--
Polypedilum scalaenum grp.	--	--	1	5.26	--	--	--	--
Tribelos jucundum	7	13.73	--	--	--	--	--	--
Paratanytarsus	--	--	--	--	--	--	1	3.33
Muscidae	--	--	1	5.26	--	--	--	--
TOTAL	51	100.00	19	100.00	15	100.00	30	100.00
TOTAL TAXA	11		8		7		10	

TAXA COMPOSITION, NUMBER, AND PERCENT OF ORGANISMS COLLECTED IN EACH HESTER-DENDY AND QUALITATIVE SAMPLE AT LOCATION DOAN BROOK (DB18.1), AUGUST AND SEPTEMBER 2003.

TAXA	07AUG03		26SEP03			
	QUAL		HESTER		QUAL	
	#	%	#	%	#	%
Turbellaria	3	5.00	--	--	3	10.71
Oligochaeta	1	1.67	24	7.14	1	3.57
Helobdella stagnalis	25	41.67	1	0.30	--	--
Helobdella triserialis	1	1.67	--	--	--	--
Erpobdella punctata punctata	1	1.67	--	--	--	--
Mooreobdella microstoma	--	--	1	0.30	1	3.57
Baetis flavistriga	21	35.00	2	0.60	8	28.57
Cheumatopsyche	--	--	50	14.88	5	17.86
Stenelmis	1	1.67	--	--	1	3.57
Ablabesmyia janta	--	--	3	0.89	--	--
Thienemannimyia grp.	--	--	49	14.58	--	--
Cricotopus bicinctus grp.	--	--	--	--	1	3.57
Cricotopus sylvestris grp.	1	1.67	3	0.89	--	--
Mesosmittia	--	--	3	0.89	--	--
Nanocladius distinctus	--	--	3	0.89	--	--
Nanocladius crassicornus/rectinervis	--	--	11	3.27	--	--
Synorthocladius	--	--	--	--	1	3.57
Chironomus	1	1.67	3	0.89	--	--
Dicrotendipes fumidus	--	--	3	0.89	--	--
Dicrotendipes simpsoni	--	--	5	1.49	--	--
Phaenopsectra punctipes	1	1.67	5	1.49	--	--
Polypedilum flavum	--	--	11	3.27	--	--
Polypedilum illinoense	1	1.67	101	30.06	--	--
Tribelos jucundum	--	--	5	1.49	--	--
Paratanytarsus	--	--	21	6.25	1	3.57
Rheotanytarsus	1	1.67	3	0.89	--	--
Tanytarsus glabrescens grp.	--	--	8	2.38	--	--
Tanytarsus guerlus grp.	--	--	8	2.38	--	--
Pericoma	--	--	8	2.38	--	--
Simulium	--	--	5	1.49	4	14.29
Bithynia tentaculata	--	--	--	--	2	7.14
Physella	2	3.33	--	--	--	--
TOTAL	60	100.00	336	100.00	28	100.00
TOTAL TAXA	13		24		11	

TAXA COMPOSITION, NUMBER, AND PERCENT OF ORGANISMS COLLECTED IN EACH SURBER, HESTER-DENDY, AND QUALITATIVE SAMPLE AT LOCATION EUCLID CREEK (ECO.5), AUGUST AND SEPTEMBER 2003.

TAXA	07AUG03				26SEP03			
	SURBER		QUAL		HESTER		QUAL	
	#	%	#	%	#	%	#	%
Turbellaria	--	--	--	--	--	--	3	8.33
Oligochaeta	21	35.00	11	40.74	8	5.03	3	8.33
Mooreobdella microstoma	--	--	1	3.70	3	1.89	--	--
Caecidotea	--	--	2	7.41	1	0.63	1	2.78
Crangonyx	--	--	2	7.41	1	0.63	4	11.11
Hydracarina	--	--	1	3.70	--	--	--	--
Baetis flavistriga	--	--	1	3.70	--	--	4	11.11
Calopteryx	--	--	--	--	--	--	4	11.11
Cheumatopsyche	--	--	--	--	52	32.70	5	13.89
Hydropsyche depravata grp.	--	--	--	--	1	0.63	--	--
Hydropsyche dicantha	--	--	--	--	3	1.89	--	--
Hydroptila	2	3.33	--	--	2	1.26	--	--
Stenelmis	--	--	--	--	18	11.32	5	13.89
Thienemannimyia grp.	--	--	--	--	20	12.58	--	--
Thienemanniella xena	--	--	--	--	2	1.26	2	5.56
Cricotopus tremulus grp.	4	6.67	--	--	--	--	--	--
Cricotopus bicinctus grp.	4	6.67	--	--	1	0.63	4	11.11
Cricotopus sylvestris grp.	2	3.33	--	--	--	--	--	--
Parametriocnemus	--	--	--	--	1	0.63	--	--
Chironomus	3	5.00	1	3.70	--	--	--	--
Dicrotendipes neomodestus	4	6.67	2	7.41	24	15.09	--	--
Dicrotendipes fumidus	1	1.67	--	--	5	3.14	--	--
Dicrotendipes simpsoni	1	1.67	--	--	--	--	--	--
Paratendipes	--	--	3	11.11	--	--	--	--
Polypedilum flavum	2	3.33	--	--	4	2.52	--	--
Polypedilum illinoense	10	16.67	3	11.11	--	--	--	--
Polypedilum scalaenum grp.	1	1.67	--	--	2	1.26	--	--
Tribelos jucundum	1	1.67	--	--	3	1.89	--	--
Paratanytarsus	4	6.67	--	--	2	1.26	--	--
Tanytarsus glabrescens grp.	--	--	--	--	3	1.89	--	--
Hemerodromia	--	--	--	--	3	1.89	1	2.78
TOTAL	60	100.00	27	100.00	159	100.00	36	100.00
TOTAL TAXA	14		10		21		11	

TAXA COMPOSITION, NUMBER, AND PERCENT OF ORGANISMS COLLECTED IN EACH HESTER-DENDY AND QUALITATIVE SAMPLE AT LOCATION MILL CREEK (MC31), AUGUST AND SEPTEMBER 2003.

TAXA	07AUG03				26SEP03			
	HESTER		QUAL		HESTER		QUAL	
	#	%	#	%	#	%	#	%
Turbellaria	--	--	1	2.27	3	1.73	--	--
Oligochaeta	12	40.00	2	4.55	13	7.51	--	--
Haemopis	--	--	1	2.27	--	--	--	--
Erpobdella punctata punctata	--	--	--	--	1	0.58	--	--
Mooreobdella microstoma	3	10.00	2	4.55	2	1.16	1	7.69
Caecidotea	--	--	1	2.27	2	1.16	--	--
Crangonyx	--	--	2	4.55	--	--	--	--
Collembola	--	--	1	2.27	--	--	--	--
Baetis flavistriga	--	--	--	--	2	1.16	4	30.77
Calopteryx	--	--	1	2.27	--	--	--	--
Hetaerina	--	--	9	20.45	2	1.16	--	--
Enallagma	--	--	4	9.09	--	--	--	--
Cheumatopsyche	--	--	--	--	3	1.73	1	7.69
Hydropsyche depravata grp.	--	--	--	--	--	--	2	15.38
Hydropsyche dicantha	--	--	--	--	--	--	1	7.69
Copelatus	--	--	1	2.27	--	--	--	--
Berosus	--	--	--	--	1	0.58	--	--
Ablabesmyia mallochi	--	--	3	6.82	--	--	--	--
Thienemannimyia grp.	--	--	5	11.36	121	69.94	--	--
Brillia	1	3.33	--	--	--	--	--	--
Cricotopus bicinctus grp.	1	3.33	1	2.27	--	--	--	--
Chironomus	--	--	1	2.27	--	--	--	--
Cryptochironomus	--	--	1	2.27	--	--	1	7.69
Polypedilum fallax grp.	--	--	--	--	2	1.16	--	--
Polypedilum flavum	4	13.33	--	--	3	1.73	--	--
Polypedilum illinoense	9	30.00	8	18.18	--	--	1	7.69
Polypedilum scalaenum grp.	--	--	--	--	12	6.94	--	--
Rheotanytarsus	--	--	--	--	2	1.16	--	--
Simulium	--	--	--	--	1	0.58	2	15.38
Hemerodromia	--	--	--	--	1	0.58	--	--
Physella	--	--	--	--	2	1.16	--	--
TOTAL	30	100.00	44	100.00	173	100.00	13	100.00
TOTAL TAXA	6		17		17		8	