

**Chapter 4: Studies Required to
Complete Identification of Use
Impairments and Describe Pollutant
Sources**

Chapter 4: Studies Required to Complete Identification of Use Impairments and Describe Pollutant Sources

Introduction

Each Remedial Action Plan shall include:

"A definition and detailed description of the environmental problem in the Area of Concern, including a definition of the beneficial uses that are impaired, the degree of impairment and the geographic extent of such impairment;"

"A definition of the causes of the use impairment, including a description of all known sources of pollutants involved and an evaluation of other possible sources..."

(Great Lakes Water Quality Agreement, as amended in 1987)

This Stage II chapter suggests studies to:

- Determine whether or not a use impairment exists.
- Learn more about the source of a pollutant.

The use impairments identified for the Rochester Embayment Area of Concern are summarized in the Stage I RAP on page 4-4, and they are reviewed in the Stage II RAP, Chapter 3. In a few cases it is unknown whether or not a use impairment exists. More documentation is needed and studies are proposed.

During the preparation of the Stage I RAP, questions also arose about some of the sources of pollutants. A summary of remaining questions is shown in the Stage I RAP, pages 6-6 and 6-7. Studies are proposed to help answer these questions. There are some exceptions:

- Baseline data assessing the abundance and condition of native species within the AOC: The baseline data will be collected as part of habitat monitoring. (See the Chapter 9 section on "Monitoring fish and wildlife habitat".)
- Impact of zebra mussels on zooplankton and phytoplankton populations: The Monroe County Water Quality Management Advisory Committee (WQMAC) and the Studies and Monitoring Task Group decided that it is inappropriate for a study to be conducted as part of the Rochester Embayment RAP process. Zebra mussels are a Great Lakes problem and research is already being conducted from that perspective. (See the Chapter 3 section on "Effect of zebra mussels on water quality and the food chain".)
- Whether toxins or boat traffic are responsible for decline of black tern populations in Braddock Bay: Experts consulted during the Stage II RAP process agreed that neither toxins nor boat wakes are a primary factor contributing to the decline of the black tern. The WQMAC and the Studies and Monitoring Task Group decided that further study would be inappropriate. (See the Chapter 3 section on "Contaminant impacts on black tern populations in the Rochester Embayment watershed".)

- Source of foaming in Sandy Creek: Any proposals regarding the Sandy Creek foaming will be incorporated in the Lake Ontario West Basin Plan. (For information about basin plans, see the Chapter 7 (Urban) section on “Complete basin water quality plans”.)
- An explanation for the discrepancy in atmospheric deposition among testing sites: There is no reason to expect close agreement in monitoring results at various sites, even within Monroe County. Within an order of magnitude is “agreement.”

Each study was designed by or with the assistance of professional scientists in the appropriate field of science. Each proposed study received three levels of review by:

- Review team composed of persons knowledgeable in the appropriate field of science.
- Monroe County Water Quality Coordinating Committee.
- Monroe County Water Quality Management Advisory Committee.

Because of the limited amount of resources that is available for studies and monitoring, a Studies and Monitoring Task Group evaluated the studies (and the monitoring) and ranked them in importance to the RAP process. See Chapter 10 for a description of the studies ranking process and the ranked list.

4.1. Verify whether fish in the Area of Concern have a chemical flavor or odor

4.1.1. Background:

Impairment that this study is planned to address:

Tainting of fish and wildlife flavor or odor

Data gaps that this study will fill: As noted in the Stage 1 RAP, the New York State Department of Environmental Conservation (NYSDEC) had, by that time, received approximately 6 to 8 complaints from anglers over the past five years who reported a chemical odor in salmonids caught in the lower Genesee River. The NYSDEC reports that some studies question the ability of anglers to accurately reflect this use impairment. A well-designed opinion survey is needed to document the perception that some fish caught in the lower Genesee River are impaired by chemical tainting.

4.1.2. Study: Survey anglers about chemical tainting of fish

Study description:

It is proposed that anglers who purchase fishing licenses in Monroe County be surveyed by mail to determine their perception of fish tainted by a "chemical" flavor and/or odor. The only Monroe County water for which tainting complaints have been registered with the Region 8 NYSDEC office is the Genesee River. If the perception suggests a statistically higher level of tainting in the Genesee River versus other Monroe County waters (controls), then tainting may be a reality. An angler sample can be drawn from Monroe County fishing license receipts. This will insure an adequate non-resident angler sample because many non-resident fishermen buy their licenses in Monroe County, mainly to fish the Genesee River or Lake Ontario. An initial draw of 1000 license holders may provide an adequate return. Maximum expected return is 65%.

An additional control for the survey is a similar survey of anglers who purchase fishing licenses in another county and who fish distant rivers or Lake Ontario. The surveys would be compared to see if there is a significant difference in reports of tainting between the two groups of anglers.

(The same questionnaire could be used to ask questions about the extent of lesions and tumors on the fish caught by anglers. See the Chapter 4 section on "Incidence of fish tumors or other deformities in the Rochester Embayment watershed".)

Time required to complete:

Design Study:	Month 1	Data Summary:	Month 7
Draw Sample:	Month 3	Draft Report	Month 9
First Mailing:	Month 4	Final Report	Month 11
Second Mailing:	Month 5		

Estimated costs:

Draw Sample	\$ 400
Printing:	150
Mailing	900
Final study design, implementation, summary, analysis, and report writing:	<u>\$3,500</u>
Total	\$5,000

To reduce costs, the implementor of this study could be assisted by a student intern.

Possible funding sources: NYSDEC

Possible implementors: NYSDEC, Great Lakes Research Consortium, New York Sea Grant Extension, Monroe County Fishery Advisory Board, Monroe County Water Quality Coordinating Committee (This project would be suitable for a student intern working under the supervision of the implementor.)

Author: Bill Abraham

4.2. Verify whether a fishless segment exists in the lower Genesee River

4.2.1. Background:

Impairment that this study is planned to address:

Degradation of fish and wildlife populations

Data gaps that this study will fill: In 1987, about a half-dozen charter boat captains using sonar alleged a "fishless" segment in the Genesee River downstream of the Lower Falls and upstream of the Riverside Cemetery (see Stage I RAP, p. 4-12). The alleged segment was observed during the fall chinook salmon run. A New York State Department of Environmental Conservation (NYSDEC) staff person, in a boat with a charter boat captain and sophisticated equipment, also observed it in late August 1987. The real extent of this segment, when and if it occurs, and its exact location are unknown. The NYSDEC in its research for the Lower Genesee River Study did not observe a fishless segment during the summer months of 1992 and 1993. However, a Study recommendation suggested that the Rochester Embayment RAP committee may wish to recommend further exploration of the possibility of a fishless segment using an intensive hydroacoustic fishery survey, or continuous monitoring with strategically placed caged fish. *(Recollection of a NYSDEC personnel involved in the field work: This fishless segment does not appear to be due to toxic effects. We had caged fish downstream of the Kodak discharge and did not see significant mortality.)*
(See also the Chapter 6 section on "Lower Genesee River Study".)

4.2.2. Study: Intensive hydroacoustic fishery survey

Study description:

Intensive hydroacoustic fishery surveys could define the frequency of any fishless events that may occur in the Genesee River.

Time required to complete: Select five random sample periods per week during the June through October period to complete a hydroacoustic transect from station 4 to station 6, as referenced in the Lower Genesee River Study:

- Downstream from the Eastman Kodak Company wastewater treatment plant discharge at King's Landing and upstream of Merrill Street storm sewer (site 4).
- Just upstream from cement dock and barge area, about one mile upstream from the Turning Basin (site 6).

The fishless segment has been reported to be between sites 4 and 6.

Estimated costs: Up to \$132,000 (for high quality equipment that will detect fish near the bottom, where lower quality equipment may fail to detect them)

Possible funding sources: NYSDEC, U.S. Fish and Wildlife Service

Possible implementors: Hydroacoustics consultant, SUNY College at Buffalo

Author: Bill Abraham, NYSDEC; BioSonics, Inc. (Consultant)

4.3. Incidence of Fish Tumors or Other Deformities in the Rochester Embayment Watershed

4.3.1. Background:

Impairment that this study is designed to address: Fish Tumors or Other Deformities

Data gaps that this study will fill:

Currently no agency monitors tumor incidence in fish in the Rochester Embayment. Rochester Gas & Electric (RG&E) may have some raw fish tumor data, as well as preserved samples. However, this data is not easily accessible and may be somewhat dated and therefore not reflective of the current situation. Because of this lack of data, the status of this Use Impairment was listed as "unknown" in the Stage I Rochester Embayment Remedial Action Plan. As described in Chapter 4 of the Stage I RAP, "sediment contaminant data can help determine whether carcinogenic substances are present that might cause fish tumors". For example, "extracts of Buffalo River sediments have been found to cause liver and skin neoplasia in brown bullheads, attributed at least in part to polynuclear aromatic hydrocarbons (PAHs) in the sediment". However, "total PAH levels in the Genesee River measured nearly one order of magnitude lower than those reported in the Buffalo River" (Monroe County Health Department, 1986). Therefore, it seems unlikely that fish tumors are a Use Impairment in the Rochester Embayment Area of Concern (AOC) (B. Abraham). In addition, it is recognized that many of the tumors that may be present are induced by bacteria and viruses (M. Ruszczyk).

4.3.2. Study: Incidence of Fish Tumors or Other Deformities in the Rochester Embayment Watershed Study

Background:

Fish samples would be collected from sites in the Rochester Embayment Watershed and examined externally for evidence of skin tumors or lesions using information available from researchers at Cornell University. Livers would be preserved for later analysis if funding can be secured. The logical study organisms are bullhead catfishes (*Ameiurus* spp.). These fish species live and feed in close association with benthic sediments, are semi-resident in local streams and ponds, and are known to have elevated skin and liver cancers/tumors in highly contaminated AOCs such as the Buffalo River.¹

In addition, RG&E data sheets would be reviewed and tabulated and a report prepared. If preserved samples still exist, microscopic examination would be conducted.

¹ Reviewer comment - White or redhorse suckers would serve as viable alternatives because they are more common in the Genesee River, exhibit appropriate life histories for this investigation, and have frequently been used in this type of study, with results reported in the literature.

A study of fish tumors could be coordinated with monitoring of bioaccumulative chemicals in resident biota and benthic macroinvertebrate communities. Sampling for each of these three Use Impairments could be performed simultaneously at each site. For additional information, see the Chapter 9 section entitled "Monitoring for Toxics".

Strategies:

Sampling should be conducted at upstream (south of densely populated areas), midstream (in densely populated areas), and downstream (north of densely populated areas) locations within the 3 major watersheds in the Rochester AOC. Sites might include those in the Irondequoit Creek/Bay and Salmon Creek/Braddock Bay watersheds.

Also, two sites in the lower Genesee River, upstream and downstream from the Kodak discharge, should also be identified and sampled.² However, it may be difficult to distinguish between the effects of the Merrill Street sewer and the Kodak discharge (B. Abraham). Based on previous sampling in the lower river, these sites can be considered as "contaminated controls".³

An attempt should also be made to identify and sample a "pristine control" in the AOC, although this may be difficult because it is thought that there are not any pristine controls. While an ideal comparison requires proper controls, presence/absence determination and/or comparisons from the literature may be sufficient.

Methods:

Fish would be collected by electrofishing or trap nets and examined and prepared according to protocols obtained from Cornell researchers. Mid summer is the best time to collect fish samples.⁴

Possible Study implications:

If the study determines that fish tumors are a Use Impairment in the Rochester Embayment AOC, then the Stage I RAP would have to be revised accordingly. In addition, remedial measures that address this Use Impairment, would also have to be developed.

² Reviewer comment - The area at the base of the Lower Falls should be of greatest concern because it contains toxic leachates.

³ Reviewer comment - The use of the word "contaminated" implies a use impairment that has not been shown. The presence of chemicals or metals does not mean they are bioavailable or causing harm.

⁴ Reviewer comment - Spring is the best time to collect brown bullheads with trap nets.

Estimated costs:

A student intern could be employed to review the RG&E data sheets and compile the short report. It is anticipated that two weeks of time would be required to conduct this task. Therefore the cost would be approximately \$560.

If the study of fish tumors was conducted along with monitoring of bioaccumulative chemicals in resident biota and monitoring of macroinvertebrate communities, the costs would be minimal. The cost of collecting bullheads at eight sample sites and examining them externally for evidence of skin tumors or cancerous lesions would cost approximately \$2,000. Liver analysis would cost approximately \$3,000.

Possible funding sources: Monroe County or NYSDEC

Authors: Jim Haynes, Todd Stevenson

4.4. Genesee River erosion study

4.4.1. Background:

Impairment that this study is planned to address:

Degradation of benthos

Data gaps that this study will fill: During the past 20 to 30 years the portion of the Genesee River floodplain near its confluence with Canaseraga Creek, between the Letchworth Park flood control dam and Geneseo, may have undergone accelerated bank erosion changes in an area that was historically more stable (see Figure 4-1). The sediment produced by the high rate of erosion upstream, between Mt. Morris and Geneseo, is exacerbating some downstream issues, such as water quality and the need for ongoing dredging at the mouth of the River and harbor in Rochester. (See Stage I RAP, pages 5-17 and 5-18, Table 5-13, and Figure 5-10.)

Part of the difficulty in initiating remedial action is inadequate documentation of the apparent abnormal behavior of the river system and the lack of geologic data that show what the normal rates of change were over the long term. The issue is complicated by the location and effect of the major flood control dam upstream, that was constructed in the 1950s. The issue may become further complicated in the near future due to the dewatering of the alluvial/glacial aquifer in the Genesee Valley as a result of the 1994 Akzo-Nobel mine collapse. (See the Chapter 9 section on "Monitoring of events at the AKZO Nobel Salt Mine".)

Pre- and post-dam data from the 1930s to 1990s can be reasonably evaluated from existing photography, U.S. Geological Survey studies and Army Corps of Engineers studies. However, pre-dam photography is limited and, therefore, 1930-1950 data based on photos may not be representative of pre-dam conditions.

Radiocarbon data, going back as far as approximately 8,000 years, can give a broader overview of meander and channel change rates that can be compared with historic photos. Data from this longer "geologic" period is necessary as a baseline from which to judge the more recent post-dam behavior. Without radiocarbon dates, it is not possible to decide whether recent behavior is reflecting changes possibly caused by dam construction.

It should also be possible to more accurately evaluate the rate of floodplain buildup (sediment storage) caused by historic settlement of the region from the 1700s to the 1900s. This is caused by clearing of upstream forests and farming practices, as well as possible slow uplift of the Lake Ontario basin to the north (glacial rebound).

The desired result of the study is a better understanding of what constitutes normal (historical) and abnormal (man-caused) streambank erosion in this part of the Genesee River, in order to plan measures that prevent erosion and stabilize streambanks.

4.4.2. Study: Compare historic and modern channel erosion rates within the Mt. Morris to Geneseo reach of the Genesee River floodplain and their relationship to downstream sediment loadings

Study description:

Geologic studies of existing floodplain deposits, and dating of the organic materials that they contain can place realistic limits on the behavior of the meander system over the past 4,000-8,000 years. Wood buried along the floodplain and in the channel during former channel migration and flooding events can be used to date the events that document past river behavior. Geologic interpretation of the sediments enclosing the buried organic materials can be used to characterize the river's rate of lateral migration and other aspects of its sedimentation and erosion history.

The proposed studies would utilize several methods to determine past river behavior:

- Radiocarbon age determinations on organic remains in floodplain sediment samples.
- Geologic mapping and interpretation of a critical 5-10 mile reach of the river in conjunction with the collection of organic samples.
- Compilation and updating of a reconnaissance geologic map of local streambank geology and documentation of key sample collection sites for radiocarbon dating.
- Aerial photography compilation, updating and documentation of changes in streambank position from 1938 to the present.
- Sediment cores from selected depths (down to 30 feet).

Expected benefits of the study are:

1. Description and documentation of past river behavior over the short term (decades) that would allow determination of whether the recent post-dam behavior of the channel represents an increase in erosion over the more natural condition of the river prior to dam construction.
2. Documentation of past river behavior over the long term (thousands of years) by radiocarbon dating.
3. Recommendations for a long-term action plan to stabilize streambanks, and minimize erosion, loss of prime agricultural land, and destruction of natural stream corridor habitat, including suggestions for potential participating outside agencies.

Time required to complete: The time required is approximately one year.

Estimated costs: \$8300

Possible funding sources: Dr. Richard A. Young (donation of services), Monroe County, Livingston County, New York State Department of Environmental Conservation, U.S. Geologic Survey

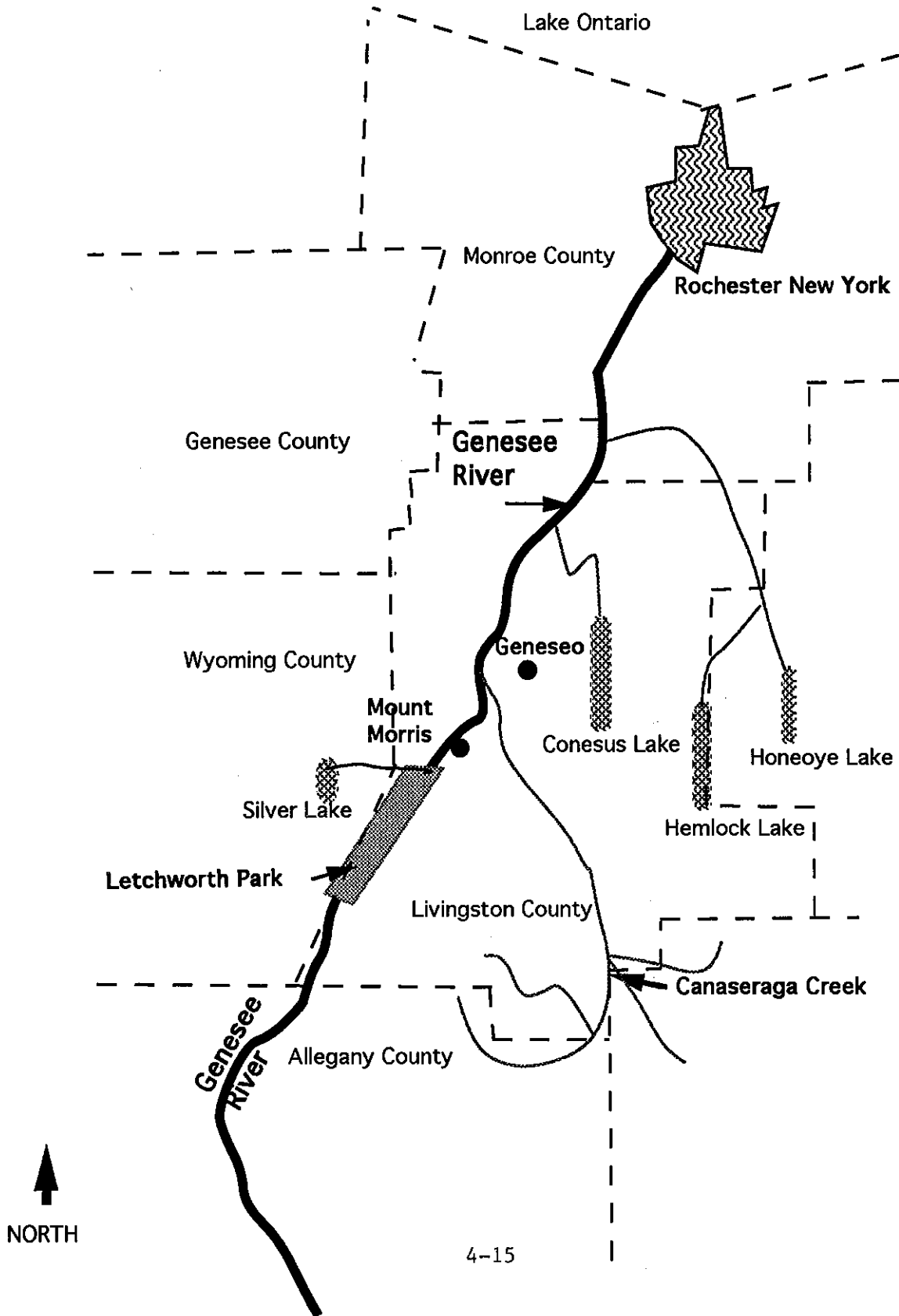
Possible implementors: Dr. Richard A. Young, (Department of Geological Sciences, SUNY,

Geneseo), Monroe County, Livingston County

Author: Carole Beal

Figure 4 - 1

Genesee River



4.5. Does the Lake Ontario portion of the Rochester Embayment suffer from degradation of benthos?

4.5.1. Background:

Impairment that this study is planned to address:

Degradation of benthos

Data gaps that this study will fill:

The status of the benthic macroinvertebrate community structure in the *Lake Ontario* portion of the Rochester Embayment is unknown. (The status of the benthic macroinvertebrate community structure in the *lower Genesee River* is impaired.) See Stage I RAP, Chapter 4, page 4-14.

4.5.2. Study: Benthos in the Lake Ontario portion of the Rochester Embayment

Study description:

The goal of this study is to determine whether the Lake Ontario portion of the Rochester Embayment suffers from degradation of benthos. A two-phase study is suggested focusing on community structure and deformities in mouth parts of Chironomidae. (*NYSDEC reviewer comment: The measurement of deformities in chironomid mouthparts is a compelling tool, but one that is subject to availability of mature specimens of a given genus. The genus Chironomus is the midge shown to be most susceptible to deformities, and sufficient numbers often cannot be obtained, such as in the lower Genesee River. Many genera apparently do not display deformities, and it would be misleading to measure deformity rates in these.*)

Phase 1

By considering community structure (species composition, abundance and species diversity), indicator species (e.g. *Limnodrilus hoffmeisteri*) and by comparison to previous benthic studies, a reasonable picture of the health of the benthic community is possible.

At a minimum, benthic samples should be taken in the spring, summer and autumn at two sites (sites LO-1 and LO-2) west and east of the Genesee River (see Figure 4-2). Four replicates should be taken at each site for each season (total of 24 for the project). The entire sample for macrobenthos is counted and identified to the lowest practicable taxonomic level, if possible. (*NYSDEC reviewer comment: Site LO-2 may be influenced by Irondequoit Creek and the Genesee River. Also both sides may be not influenced by fine grained sediment from the Genesee River since this material will be further out in the Lake.*)

Phase 2

Another technique that evaluates environmental degradation is to focus on the responses of

affected individual organisms. Several studies have demonstrated the connection between chemical contamination and abnormalities of several chironomid genera, and the lack of any influence of nutrient loading or thermal discharge. Because the chironomid larvae are in close contact with the sediments, they are vulnerable to teratogens in the sediments. For example, contaminated sediments have been shown to correlate with mentum deformities in the Niagara River watershed. Thus, deformities in chironomid larvae have become a tool for evaluating the presence of teratogens in aquatic systems and can provide other evidence of degradation of the benthic community.

At least 100 chironomid heads would have to be mounted on microscope slides from each study site to get statistical validity. These heads could come from the samples taken in Phase 1. If 100 heads per site are not available, more samples would have to be taken. The microscopic slides would be examined to detect chironomid abnormalities.

Time required to complete: The lab aspect of this project could easily take eight weeks. It would take approximately one year to complete the project.

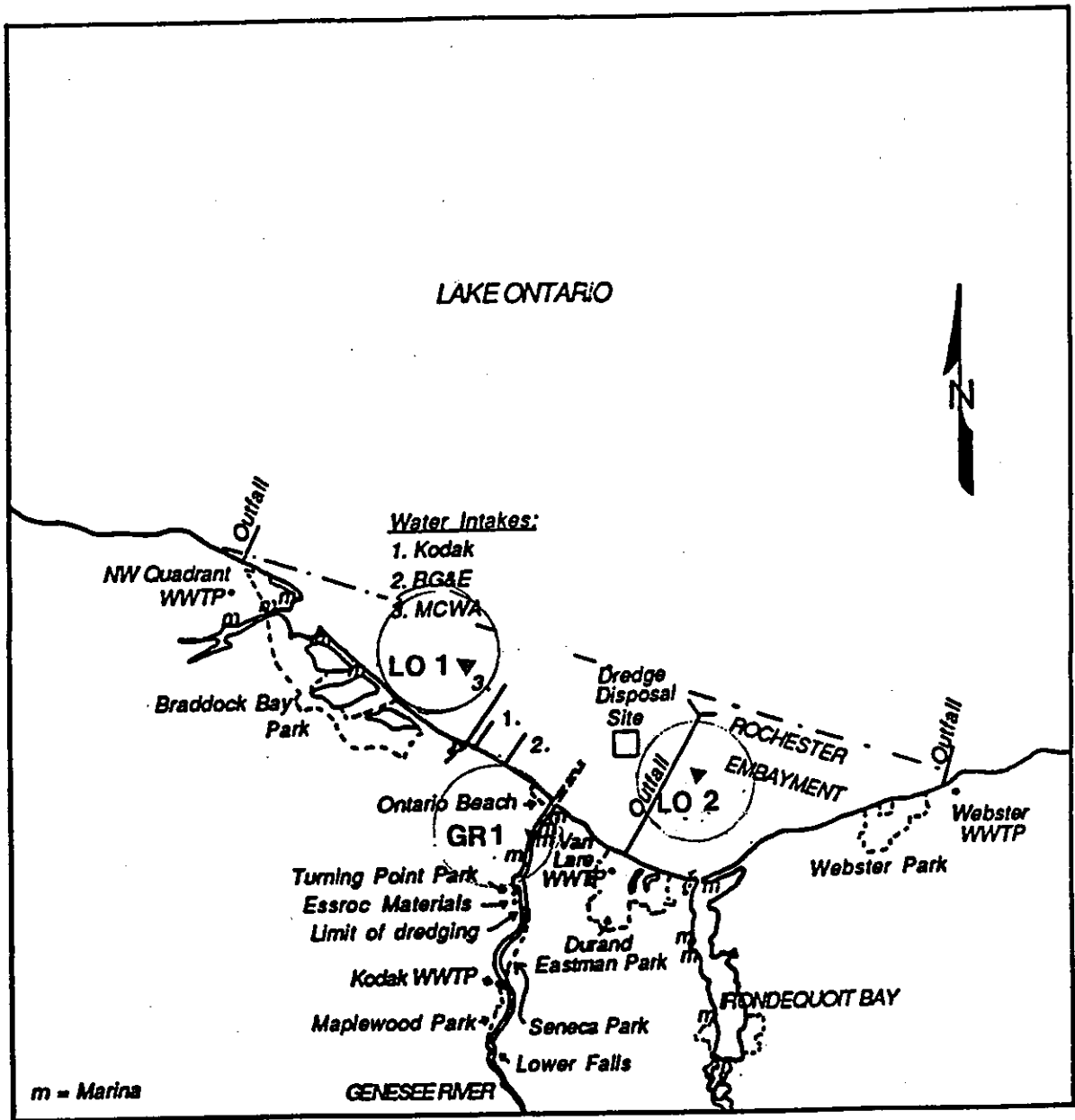
Estimated costs: \$15,000 to \$20,000 for Phase 1 and an additional \$10,000 for Phase 2
(*NYSDEC reviewer comment: The Phase 1 and 2 costs seem high.*)

Possible funding sources: NYSDEC

Possible implementors: NYSDEC, SUNY College at Brockport

Author: Joseph Makarewicz, SUNY Brockport

Figure 4 - 2



Phytoplankton, zooplankton, and benthos sampling sites on Lake Ontario and the lower Genesee River.

4.6. Investigate whether contaminants affect the benthic community in the lower Genesee River

4.6.1. Background:

Impairment that this study is planned to address:

Degradation of benthos

Data gaps that this study will fill:

The Stage I RAP states:

- "The presence of elevated levels of contaminants in tissues suggests that pollutants might be adversely affecting the benthic communities. More specific tests would be needed to determine whether these pollutants or other conditions are affecting these benthic communities" (page 4-16).
- "Although some suspected or historic causes have been identified..., cause and effect relationships have not been firmly established for...degradation of benthos" (page 4-33).

It is very difficult to study cause-and-effect relationships between sediment constituents and benthic organism toxicity. To simply expose an organism to the sediment is not adequate to determine the specific cause. Contaminated sediments can contain thousands of potentially toxic compounds. Therefore, it is impossible to know which chemical or combination of chemicals is responsible for toxicity. The compound causing toxicity might not even be one that is measured. It is difficult to predict the additive, antagonistic and/or synergistic interactions that may occur among contaminants.

Laboratory experiments can be performed to learn more about cause and effect relationships. They can be done in one of three ways:

- Using uncontaminated sediments that are similar to those being studied. This would allow the researcher to limit the number of contaminant variables.
- Using a synthetic sediment that matches the characteristics of the natural sediment as closely as possible. This would also allow the researcher to limit the number of contaminant variables.
- Using a Sediment Toxicity Identification Evaluation (TIE) procedure with a sediment from the location to be studied. TIE procedures use toxicity-based fractionation schemes to (1) characterize the general physical/chemical properties of sample toxicants, (2) identify and measure toxicants via different analytical methods, and (3) confirm that the suspect toxicants identified in the first two steps are the true toxicants responsible for toxicity. Confirmation is very important because procedures used in the first two steps may lead to erroneous conclusions. TIE procedures initially focused on identifying toxicants in effluents. However, it has been demonstrated that they can also be used to identify acutely toxic compounds in ambient waters and in aqueous fractions of sediments.

The problem with the first option is the difficulty in locating uncontaminated sediments that are similar in nature to those of the Genesee River. The first and second options may not provide information about interactions among contaminants. All the options are complex and costly.

4.6.2. Study: Communicate regularly with local researchers regarding advances in sediment toxicology

Study description:

In place of complex and costly laboratory experiments, it is suggested that the Remedial Action Plan advisory committee stay in touch with local academic and industrial researchers regarding advances in sediment toxicology because a study may be feasible at some time in the future. The advisory committee would stay in touch with the researchers via staff of the Water Quality Planning Bureau of the Monroe County Department of Health.

By the end of 1997, a list should be prepared of local researchers and other contacts in Monroe County that will volunteer their time to give at least an annual verbal report directing the Water Quality Planning staff to recent literature and other information about sediment toxicity to benthic macroinvertebrates. Of special interest would be work involving:

- Sediment conditions similar to the lower Genesee River.
- Benthic macroinvertebrate organisms common to the lower Genesee River.
- Contaminants that were detected in the Genesee River Toxics Survey and the Lower Genesee River Study (see Chapter 6 sections by those names).
- Simplified laboratory methods for sediment toxicity.

Time required to complete: One environmental planner would make annual contacts with researchers, collect the recommended information, read it and report on it briefly to the RAP advisory committee. The time would be about 24 hours per year. There are three alternatives to this proposal:

- A member of the RAP advisory committee could volunteer time to perform this task.
- A student intern could perform this task.
- This task could be performed every other year.

Estimated costs: \$600 per year if the task is performed by an environmental planner. If a volunteer or a student intern working for college credit performs the task, the costs would be less.

Possible funding sources: Monroe County

Possible implementors: Monroe County Department of Health Water Quality Planning Bureau

Author: Carole Beal

4.7. Are phytoplankton and zooplankton populations in the Lake Ontario portion of the Rochester Embayment impaired?

4.7.1. Background:

Impairment that this study is planned to address: Degradation of phytoplankton and zooplankton populations

Data gaps that this study will fill: The status of phytoplankton and zooplankton populations in the Lake Ontario portion of the Rochester Embayment is unknown. (See Stage I RAP, p. 4-28).

4.7.2. Study: Phytoplankton and zooplankton populations in the Lake Ontario portion of the Rochester Embayment

Study description:

The goal of this study is to determine whether the Lake Ontario portion of the Rochester Embayment suffers from phytoplankton and zooplankton community degradation. By comparing abundance, biomass, and species composition of the plankton communities with historical data from the open-water region and from the nearshore, it will be possible to determine if the plankton community is impacted. To accomplish this, it is important to use methods similar to the previous work on Lake Ontario. The methodology suggested below follows the work of Makarewicz for the U.S. Environmental Protection Agency (EPA) and will allow valid comparisons of the Rochester Embayment to previous EPA related work.

Sampling

Zooplankton: Zooplankton samples should be collected every other week at two sites (LO-1 and LO-2) from 1 May to 30 October of one year (see Figure 4-2). All samples would be preserved. Enumeration of zooplankton will follow methods outlined by Gannon (1971) while identification will follow Stemberger (1979), Edmondson (1959), Brooks (1957) and Ruttner-Kolisko (1974).

Phytoplankton: Phytoplankton would be collected simultaneously with zooplankton by compositing samples from 1m, 3m, 6m and 9m (depth from the surface) to form a composite sample at each site (Figure 4-2) and fixing with a solution to prepare it for microscopic study.

Chemistry: Accompanying the phytoplankton and zooplankton sampling, water samples would be collected for chlorophyll, soluble reactive phosphorus, total phosphorus, and nitrate/nitrite analysis. This will allow better interpretation of the phytoplankton data.

Identification and enumeration

Zooplankton: Identification and enumeration would be performed for the following groups of zooplankton:

- Total immature Copepods
- Total mature Copepods
- Total Cladocera
- Total Rotifera
- Total Zooplankton

Phytoplankton: Identification and enumeration would be performed for the following groups of phytoplankton:

- Total blue-green algae
- Total green algae
- Total flagellates
- Total other algae
- Total centric diatoms
- Total pennate diatoms
- Total algae

Time required to complete: Approximately two years

Estimated costs: \$40,000 to \$50,000.

Possible funding sources: New York State Department of Environmental Conservation (NYSDEC), EPA

Possible implementors: University, NYSDEC

Author: Joseph Makarewicz, SUNY Brockport

4.8. Estimate the loadings of cadmium and lead from vehicle tires

4.8.1. Background:

Impairment that this study was suggested to address:

Degradation of benthos

Data gaps that this study will fill:

A statement in the Stage I RAP, page 5-16 says: "Some of the cadmium that reaches waterways comes from vehicle tires. Cadmium is contained in tires and wears off onto road surfaces." Documentation for the statement is not included. The mass of cadmium that reaches waterways is unknown.

Additional information (since Stage I):

Scrap Tire Management Council:

- Cadmium is not an ingredient in the manufacture of tires. It occasionally is a contaminant in the zinc compounds that are used in manufacture. Manufacturers are requesting purer raw material.
- The Council states that those who have tested have found no significant increase in cadmium in air due to the burning of tires as fuel. (Coal and other fuels contain cadmium.) However, documentation was not provided.

New York State Department of Environmental Conservation (NYSDEC), Albany:

- Cadmium is present in tires at less than 5 parts per million. It is not a manufacturing additive.
- Lead is present in tires at 51 parts per million.

Literature sources:

- In sources about uses of cadmium, "tires" is absent.

4.8.2. Study: Estimate the loadings of cadmium and lead from vehicle tires

Study description:

An intern would estimate the annual loadings of cadmium and lead in runoff due to wear of vehicle tires. The purpose would be to obtain data for a mass balance for cadmium and lead for the Rochester Embayment. The calculations would include cadmium and lead in runoff whether or not it reaches a waterway.

The required steps are as follows:

- Review information in the Nationwide Urban Runoff Program (NURP) to learn:
 1. Background information about the amounts and types of chemical contamination in urban runoff at the time of the NURP Study.

2. Potential information sources for the RAP study.
- Learn the concentration of cadmium and lead in various brands and ages of tires. Take into account that the rubber in treads, retreads and sidewalls may be different.
Information source: Manufacturers of tires
 - Learn what brands and ages of tires are on the road in the watershed.
Information sources: Sellers of tires and sellers of automobiles in the watershed
 - Learn how much rubber from each brand and age of tire wears off per mile driven.
Information source: Manufacturers of tires
 - Learn how many miles are driven within the watershed per year.
Information sources: American Automobile Association, New York State Department of Transportation; automobile maintenance shops

Time required to complete: About three months

Estimated costs: \$3,200 for a student intern for about three months time. (The cost would be lower if the intern is working for college credit instead of wages.)

Possible funding sources:

Monroe County Department of Health; New York State Department of Health; New York State Department of Transportation; U.S. Geological Survey

Possible implementors:

Monroe County Department of Health; U.S. Geological Survey (The intern would be employed by one of these.)

Author: Carole Beal

4.9. Quantify cyanide loadings to air

4.9.1. Background:

Impairment that this study is planned to address: Cyanide is not known to be causing any impairments in the AOC (Stage I RAP, page 5-16). However, it is listed on the Preliminary List of High Priority Pollutants for the Rochester Embayment (see Stage I RAP, page 5-40 and Stage II RAP, Chapter 3). Air loading data is important to a water quality study, because deposition from the air is a major component of runoff to waterways.

Data gaps that this study will fill: In the discussion of pollutants definitely or possibly causing impairments in the AOC, the Stage I RAP states: "We were not able to obtain air loading data [for cyanide] in time to include in this document" (page 5-16). Since the Stage I RAP was completed, the New York State Department of Environmental Conservation (NYSDEC) searched the Toxics Release Inventory (TRI) database for cyanide releases, in a manner similar to that for other chemicals as shown on page 5-45 of the Stage I RAP. The results showed that there were *no* cyanide releases reported in the Rochester Embayment watershed counties for either 1990 or 1991.

Also since the Stage I RAP was completed, a question has arisen about possible cyanide loadings to air from wastewater treatment plant incinerators. A study is suggested to answer the question.

4.9.2. Study: Perform a literature search on cyanide loadings from wastewater treatment plant (WWTP) incinerators

Study description:

Cyanide has been detected in the scrubber solution of Monroe County WWTP sludge incinerators, mostly at the Gates-Chili-Ogden (GCO) plant. The purpose of the scrubber is to clean stack gases, but a small percentage of gas can escape the scrubber. There is a question about whether or not some cyanide may be escaping the scrubber at the plants and rising into the atmosphere.

Cyanide does not enter the plants as influent. It is a product of combustion if there is insufficient oxygen in the incinerator to oxidize the cyanide to carbon dioxide. There can occasionally be insufficient oxygen because incinerator operators attempt to balance the amount of oxygen in order to use a minimal amount of fuel, but also to have sufficient oxygen for complete combustion. Since 1995, cyanide in incinerator effluent is less likely to be a problem, because of the installation of continuous effluent monitoring equipment that allows incinerator operators to more tightly control incinerator combustion parameters.

Cyanide is very soluble in water and incinerator effluent should be captured in the stack scrubber solution, which is recycled back into the WWTP process. However, it is desirable to learn more

about the fate of cyanide when it goes up the incinerator stack. A literature search is suggested as a first step.

Time required to complete: An intern could complete a literature search and write a report in about 80-100 hours.

Estimated costs: A paid intern would earn about \$560-\$700 and would require training and supervision at a cost of about \$500. However, the intern could also be an unpaid student earning college credit.

Possible funding sources: Monroe County Departments of Environmental Services or Health

Possible implementors: Monroe County Department of Health, Monroe County Department of Environmental Services

Author: Carole Beal

4.10. Update the Genesee River and treatment plant pollutant loading calculations to verify previous conclusions

4.10.1. Background:

Impairment that this study is planned to address: Not applicable

Data gaps that this study will fill:

Phosphorus is a pollutant that is found to cause several use impairments. In chapter 5 of the Stage I RAP, an attempt is made to identify the relative contribution of phosphorus from several different sources. Two of the significant sources of phosphorus to the Rochester Embayment of Lake Ontario include point and non-point source runoff from the Genesee River Basin, and contributions from wastewater treatment plants that discharge to Lake Ontario in the general vicinity of the Rochester Embayment. In chapter 5 of the Stage I RAP, estimates of Genesee Basin phosphorus loadings to the Rochester Embayment were made by extrapolating limited River data collected by the U.S. Geological Survey.

This comparison (Table 5-14 of the Stage I RAP) indicated that the discharges of most pollutants from the Genesee River to the Embayment are generally 10 to 100 times greater than that of the treatment plants for 11 pollutants. However, phosphorus does not conform to this generalization. The results of the phosphorus calculations show the river discharging about twice the amount of the treatment plants. Questions were raised in the Stage I RAP about why the ratio of phosphorus from the river and treatment plants is so different from the ratio of other pollutants.

Because phosphorus is such a critical pollutant to many of the use impairments in the Rochester Embayment, and because the strategies to reduce phosphorus will be different depending on the source, it is believed that there may be a need to update the pollutant loading calculations, particularly for phosphorus, to help explain the difference.

4.10.2. Study: Update the Genesee River and treatment plant pollutant loading calculations to verify previous conclusions related to relative contributions of Genesee River and direct wastewater treatment plant discharges to the Rochester Embayment

Study description:

The Monroe County Environmental Health Laboratory should coordinate an effort to calculate pollutant loadings to the Rochester Embayment from the Genesee River and the Wastewater treatment plants that discharge directly to the Rochester Embayment. To facilitate this effort, the Monroe County Environmental Health Laboratory will take the lead in compiling data on the pollutant loadings entering the Rochester Embayment from the Genesee River. In addition, the Monroe County Environmental Health Laboratory will request that the Monroe County Department of Environmental Services and the Town of Webster compile pollutant loading data

from their wastewater treatment facilities that discharge to Lake Ontario. The Environmental Health Laboratory will also consider SARA Title III data to consider other pollutant discharge pathways.

As a result of the updated information, the Monroe County Environmental Health Laboratory will convene an appropriate task group to determine if the revised data raises any questions. The results of this effort will be documented by the Monroe County Environmental Health Laboratory and reviewed with the Monroe County Water Quality Coordinating Committee and the Monroe County Water Quality Management Advisory Committee.

Time required to complete: Not calculated

Estimated Costs: Staff time costs approximating \$1,000.

Possible funding sources: Monroe County Environmental Health Laboratory, Monroe County Department of Environmental Services, Town of Webster

Possible implementors: Monroe County Environmental Health Laboratory, Monroe County Department of Environmental Services, Town of Webster

Author: Margy Peet

Chapter 5: Specific Goals and Objectives for Restoration of Beneficial Uses

5.1 Process for establishing goals and objectives

5.1.1 Goals listed in the Stage I RAP

As part of the Stage I Rochester Embayment Remedial Action Plan (RAP), the Monroe County Water Quality Management Advisory Committee (WQMAC) developed a list of water quality goals and objectives for the Rochester Embayment watershed (see Chapter 3 "Water Use and Quality Goals and Objectives" of the Stage I RAP). The WQMAC used the following definitions for goals and objectives:

Goals - A goal is a statement of purpose about the end result (desired state of being) of a proposed management activity.

Objectives - An objective is a specific, quantifiable step that will lead to fulfilling the goal (statement of condition).

The goals and objectives were based on the list of Beneficial Use Impairments developed by the International Joint Commission (IJC) and applied to the Rochester Embayment. The goals were devised to reflect unique local conditions or to reflect specific concerns of the WQMAC. Ultimately, the goals and objectives were formally adopted by the WQMAC and included in the Stage I RAP.

For a discussion of the relationship between the RAP goals/objectives/delisting criteria and federal and state standards/objectives/guidelines see Figure 4-1 "Guidelines for Recommending the Listing and Delisting of Great Lakes Areas of Concern" and Appendix B "Water Resources Goals" of the Stage I RAP.

Actions which would contribute to the achievement of the listed objectives were also developed as part of this process. These actions formed the basis of the remedial measures which are discussed in Chapter 7 "Possible New Remedial Measures".

5.1.2 Incorporation of human health considerations in the RAP

The suggestion that WQMAC examine how human health concerns were being incorporated into the RAP arose from two sources: WQMAC review of proposed new remedial actions, and encouragement by the IJC that human health concerns be incorporated into RAPs. The WQMAC listed the pros and cons of including human health issues in the RAP, examined the contents of Stage I and the major chapters of Stage II, and suggested ways that human health issues could be or already were included. The WQMAC then asked its Executive Committee to develop options for the full Committee to vote on. The Executive Committee developed the following two options:

Option #1: Recognize that human health is a consideration in the RAP and will be referred to in Chapters 1 (Introduction) and 5 (Goals).

Option #2: Further develop the existing RAP goals (see Stage I, pages 3-10 through 3-12) to incorporate human health concerns.

The Executive Committee recommended that the WQMAC select:

- Option #1 only, or
- Option #1 and #2 together.

The WQMAC reached consensus on Option #1, and formed a task group to examine the existing goals to see if changes should be made. The task group recommended changing the first goal.

Former text: Virtual elimination of toxic substances causing fish consumption advisories.

Suggested text: Virtual elimination of toxic substances that impair (adversely affect) human health and/or cause fish and wildlife consumption advisories.

The WQMAC reached consensus that the suggested text be adopted, and also reviewed and commented on the narrative regarding the incorporation of human health considerations in the RAP (see 5.3.2).

5.2 Linking locally developed goals with related use impairments

The following table links the locally developed goals with the use impairments that were identified as part of the Stage I Rochester Embayment RAP (see Stage I RAP, Chapter 4 "Water Quality Conditions/Problems").

Table 5-1. Locally Developed Water Quality Goals

Goals (summarized)	Use Impairments *												
	1	3	5	6	7	8	9	10	11	12	13	14	
Virtual elimination of toxic substances that impair human health	X	X	X	X	X							X	
Public beaches are open for swimming					X	X		X	X				
Shorelines are free of aesthetically objectionable materials									X				
Contaminated sediments in the lower Genesee River have no negative impact upon water quality & biota		X	X	X	X							X	X
Water/ shore habitats support thriving fish & wildlife populations		X	X	X		X						X	X
Diversity of plant & animal communities		X	X	X								X	X
Drinking water produced from Lake Ontario has no unusual or unpleasant taste						X	X			X			
Benthic macroinvertebrate community in the lower Genesee River is not degraded by pollution				X									
Littoral zone is mesotrophic rather than eutrophic						X							
Water from the Embayment can be used with minimum added cost due to exotic species										X			

* Use Impairments Identified in the Rochester Embayment:

- | | |
|--|---|
| 1. Restrictions on fish and wildlife consumption | 9. Drinking water taste and odor problems |
| 3. Degradation of fish and wildlife populations | 10. Beach closings |
| 5. Bird or animal deformities or reproductive problems | 11. Degradation of aesthetics |
| 6. Degradation of benthos | 12. Added cost to agriculture or industry |
| 7. Restrictions on dredging activities | 13. Degradation of plankton populations |
| 8. Eutrophication or undesirable algae | 14. Loss of fish and wildlife habitat |

5.3 Additional Information

5.3.1 Federal and New York State water quality goals

Federal and New York State water quality goals, outlined in laws and regulations that support water quality, were described in the Stage I RAP. However, New York State water quality regulations Parts 800 through 941 of Title 6 of the Codes, Rules and Regulations of the State of New York: Stream and Pond Classification, were omitted.

In New York State a stream classification system has been developed to protect the highest and best use of State water resources as determined by the New York State Department of Environmental Conservation (NYSDEC). It does not necessarily reflect existing water use or quality. The classification system is as follows:

Class A Special	International boundary waters
Class AA and A	Drinking and food processing
Class B	Primary contact recreation (i.e., swimming)
Class C	Secondary contact recreation (i.e., fishing and boating)
(ts)	Trout spawning
(t)	Trout fishing

Note that (t) or (ts) may appear as a suffix to Classes AA, A, B and C. When added, these suffixes indicate the waterbody shall receive protection for trout fishing or for trout spawning, as well as the designated best use classification. The lower Genesee River is designated as Class B and the Rochester Embayment of Lake Ontario is designated as Class A. Information regarding the classification of other segments or streams within the Rochester Embayment watershed is available from the NYSDEC.

The NYSDEC has also established New York Water Quality Standards (chemical, physical and biological) for each water classification. These Standards are used to define State Permit Discharge Elimination System (SPDES) permit limits that assure that a waterbody can be used for its best use classification.

5.3.2 Incorporation of human health considerations in the Rochester Embayment RAP

Human health considerations are incorporated in the RAP process in the following ways.

5.3.2.1 Recognition that "ecosystem" includes humans

The definition of "Great Lakes Basin Ecosystem" in the Great Lakes Water Quality Agreement is: "The interacting components of air, land, water and living organisms, *including humans*, within the drainage basin..." (GLWQA as amended in 1987, page 3).

It has been recognized throughout the Stage II RAP process that remedial measures to restore beneficial uses of the environment and to protect wildlife health also protect human health.

5.3.2.2 Development of local goals that are related to human health

Two of the local goals developed for the Rochester Embayment Remedial Action Plan, as part of the Stage I process, are directly related to human health.

- "Virtual elimination of toxic substances that impair (adversely affect) human health and/or cause fish consumption advisories" (amended since the Stage I RAP was completed).
- Public beaches in the Rochester Embayment are open for swimming, based upon best available health and safety standards.

5.3.2.3 Continuation of educational activities related to human health

The Monroe County Water Quality Management Advisory Committee has demonstrated a commitment to human health. One of its task groups developed and distributed a pamphlet that explains the New York State Department of Health fish consumption advisory. Another task group sponsored a conference that reviewed what is known about the effects of hormone-mimicking chemicals on humans and wildlife. Educational programs such as these will be developed in the future.

5.3.2.4 After the Stage II RAP has been completed, there will be continual evaluation of proposed new remedial measures that involve human health

Any proposals for new remedial measures related to human health that are submitted as part of the Stage II RAP review process will be evaluated early in 1997. After that, proposals may be submitted and will be reviewed every other year. (See the Chapter 7 section on "Continually evaluate proposals for possible new remedial measures".)

Authors: Carole Beal and Todd Stevenson

