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**Trends and Emerging  
Environmental Issues in the Great Lakes:  
Perceptions and Assessments**

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Jonathan W. Bulkley  
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TRENDS AND EMERGING ENVIRONMENTAL ISSUES IN THE GREAT LAKES:  
PERCEPTIONS AND ASSESSMENTS

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## CHAPTER 1

### INTRODUCTION

This report considers water quality and other environmental issues as reported by representatives of United States and Canadian governmental units and other organizations whose jurisdiction or interest includes a portion of the Great Lakes shoreline. The report presents findings from a 1986 survey of those representatives utilizing a mail questionnaire. The questionnaire covered four major topics:

1. Water Quality - especially inshore water quality including both conventional pollutants and toxic pollutants.
2. Resource Utilization and Planning - especially issues dealing with the use and destruction of natural resources.
3. Changing Water Levels - especially high lake levels of the Great Lakes.
4. The Future - especially conditions viewed as a threat to local areas and to the entire Great Lakes region.

The 1986 questionnaire was similar in content to the questionnaire used in a study conducted in 1971.<sup>1</sup> The 1971 questionnaires were sent to 650 units of government in the United States and Canada; 300 were returned representing a response rate of 46 percent. In 1986, 1076 questionnaires were mailed to U.S. and Canadian units of government and others in the Great Lakes drainage basin. Four hundred and thirty five (435) were returned resulting in a somewhat lower response rate (40%). In 1986, the number of governmental units was expanded beyond those contacted in the 1971 survey. Furthermore, increased efforts were made to reach state and provincial units as well as federal agencies in both countries and to include representatives from the St. Lawrence Seaway region of the Province of Quebec. Finally, special interest groups and other non-governmental units were added to the list of those to whom questionnaires were mailed in 1986.

The main purpose of the 1986 study and its predecessor in 1971 was to systematically measure the perceptions of individuals representing various units of government throughout the Great Lakes Basin. How these representatives perceived the quality of Great Lakes water and other resources within their jurisdiction was the focus of both studies. The 1971 study was initiated just prior to the passage and implementation of major environmental legislation in the United States, i.e. the Water Pollution Control Act Amendments of 1972 (PL 92-500), now known as the Clean Water Act. Also, the 1971 study preceded the Bi-National Water Quality Agreements of 1972 and 1978 between the United States and Canada. Accordingly, the initial study produced baseline data gathered immediately prior to the implementation of major environmental pollution controls in both countries.

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<sup>1</sup> Bulkley, J.W. and A.P. Mathews, Water Quality Relationships in the Great Lakes: Analyses of a Survey Questionnaire, Proceedings of the 16th Conference on Great Lakes Research, 1973, pp. 872-889.

In addition to gathering new data which enables us to portray perceptual change over a 15-year period, the 1986 study was launched at the time when lake levels throughout the Great Lakes (except Lake Ontario) were at record high levels. Furthermore, the 1986 study was designed to identify issues requiring the attention of Great Lakes decision makers in the years ahead.

As noted, the two surveys cover responses to the same set of questions asked of the same population, although not necessarily the same respondents. The more recent survey identifies new issues that have emerged in the Great Lakes region since 1971 and highlights changes in perceptions and assessments of water quality and other environmental conditions. Moreover, the data from the two surveys point to trends associated with problems and with the actions necessary to mitigate or otherwise reduce the impact of problems.

The current research establishes within the University of Michigan's Institute for Social Research and the School of Natural Resources a repository for attitudinal survey data related to the natural resources of this critical region of North America. It is anticipated that these data will be used by Great Lakes planners, policymakers, and researchers in future years and become increasingly valuable as new survey data covering the same population become available.

The 1971 questionnaire served as a starting point for the development of the 1986 questionnaire. Wherever possible, questions used in 1971 were repeated verbatim in 1986. In some instances the questions and the response categories were modified for clarification and to simplify coding for subsequent analysis. New questions were added in 1986, especially on toxic pollution and lake levels, to reflect new environmental conditions in the Great Lakes region. The modified questionnaire was pre-tested in both the United States and Canada and revised prior to its being mailed to the expanded population of agencies and organizations in the fall, 1986. The questionnaire is shown in the Appendix.

This report is organized into nine chapters. Following this introductory chapter, Chapter 2 presents a detailed description of the responding agencies and organizations including the states and provinces they represent and the lakes with which they are associated. Chapter 3 addresses the inshore water quality issue and how ratings of water quality has changed over time. Chapters 4 and 5 consider specific aspects of quality including toxic pollutants and mechanisms for improving water quality. Chapter 6 covers perceptions of changing water levels which coincidentally were captured at the very moment when actual lake levels were at all-time highs. Next, Chapter 7 examines issues related to resource use and resource planning using data from the 1971 and the 1986 surveys. In Chapter 8, prospects for the future are considered by examining the perceptions of threats to local areas as well as to the Great Lakes system as a whole. Finally, Chapter 9 concludes with a summary of the main findings and a discussion of their implications for the future.

## CHAPTER 2

### CHARACTERISTICS OF RESPONDING AGENCIES AND ORGANIZATIONS

In October 1986 over 1,000 questionnaires were mailed to governmental agencies and organizations in the United States and Canada with jurisdiction over the shoreline of the Great Lakes (see Figure 2-1). The agencies represented substate (village, township, municipality, county, regional), state/provincial, federal, and international units of government. Organizations and interest groups involved in Great Lakes water resource issues also were included in the survey. The first part of Table 2-1 shows the proportion of agencies/organizations in each state and province contacted and asked to reply to the questionnaire. The second part of the table presents the proportion of agencies and organizations within each state/province that responded to the questionnaire.

Four hundred thirty-five (435) agencies/organizations responded to the questionnaire. Of these, 85% were from the U.S. and the remaining 15% were from Canada. In 1971, when a similar questionnaire was mailed to more than 600 units of government in the Great Lakes region, 300 questionnaires were returned. Somewhat more than three-quarters came from U.S.A. respondents and the remainder came from Canadian respondents.

#### Responses Associated with States/Provinces, Lakes, and Governmental Units

Table 2-2 presents the distribution of the 433 questionnaires returned from each state/province. (Two of the four hundred and thirty five questionnaires returned had an unidentifiable state/province identification number.) Because it is almost completely surrounded by Great Lakes water, the State of Michigan had the largest percentage of questionnaire recipients, and therefore the largest percentage of questionnaire responses (37.9%). In contrast, there were only six responses from Quebec and ten from the Commonwealth of Pennsylvania. These figures are indicative of the relative length of Great Lakes shoreline under the authority of each of the states/provinces.

Table 2-1  
1986 Questionnaire Distribution and Response, by State/Province  
(Percentage Distribution)

State	IL	IN	MI	MN	NY	OH	ONT	QU	PA	WI	Total
n=	64	72	364	32	114	85	112	37	42	154	1076
% of questionnaire sent	5.9	6.7	33.9	3.0	10.6	7.9	10.4	3.4	3.9	14.3	100.0
no. of responses	20	12	164	13	48	39	60	6	10	61	433*
% of state responding	31	17	45	41	42	46	54	16	24	40	

\*Two of the 435 respondents obliterated the state identification number on the questionnaire.



Figure 2-1  
1986 Study Area

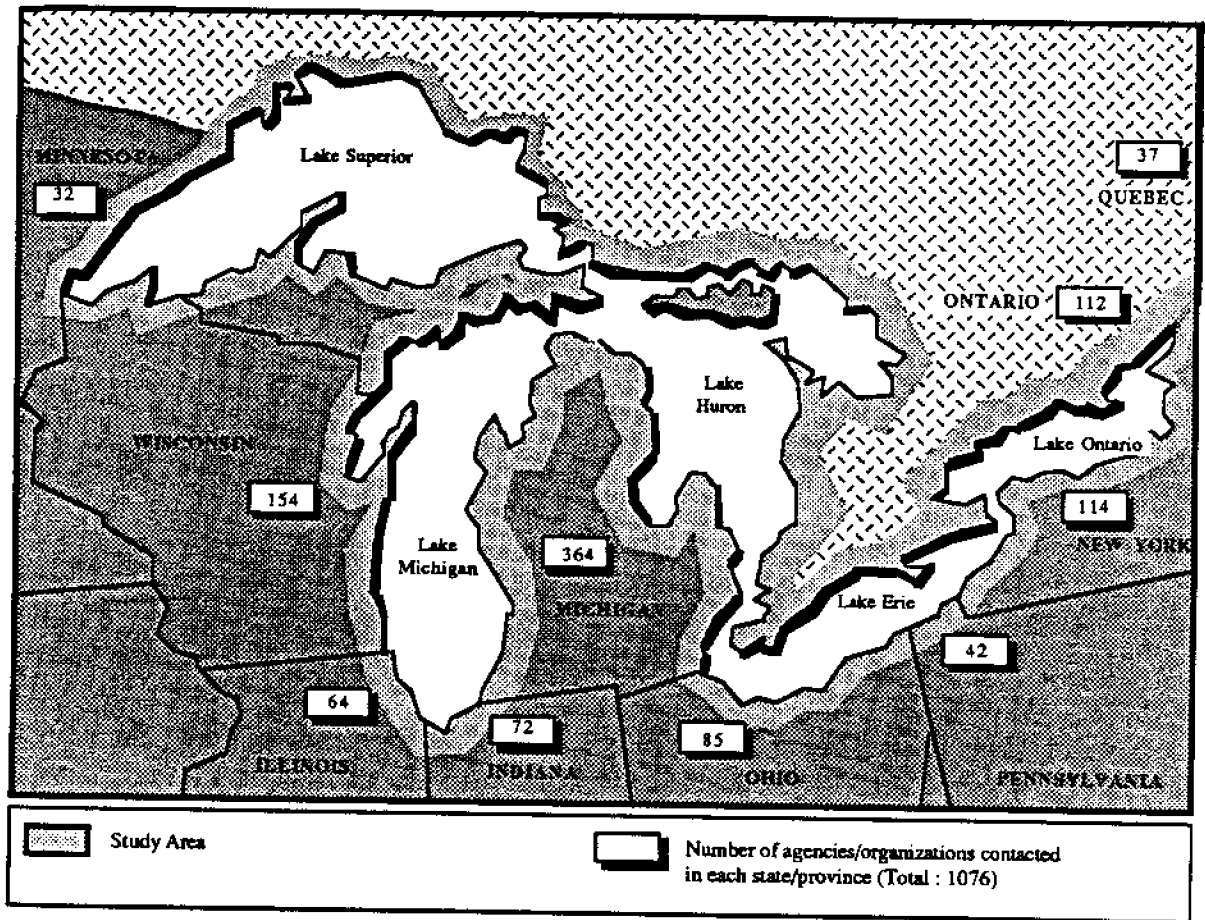


Table 2-2

1986 Respondents, by State/Province  
(Percentage Distribution)

State	IL	IN	MI	MN	NY	OH	ONT	QU	PA	WI	Total
1986	4.6	2.8	37.9	3.0	11.1	9.0	13.9	1.4	2.3	14.1	100.0
no. of responses	(20)	(12)	(164)	(13)	(48)	(39)	(60)	(6)	(10)	(61)	(433)

As shown in Table 2-3, the distribution of responses by lakes in 1986 is not significantly different from that of the 1971 survey. The "Others" category in the table includes respondents whose agencies have jurisdiction over the entire Great Lakes system and

communities located along Great Lakes connecting channels (i.e., the St. Lawrence Seaway, the St. Marys River, and the Detroit River).

Table 2-3  
Respondents in 1971 and 1986, by Lake  
(Percentage Distribution)

Lake	Ontario	Erie	Huron	Michigan	Superior	Others	Total
1971	13.3 (40)	20.3 (61)	17.0 (51)	32.3 (97)	12.3 (37)	4.7 (14)	100.0 (300) *
1986	12.0 (52)	18.5 (80)	14.3 (62)	34.2 (148)	13.2 (57)	7.9 (34)	100.0 (433)

\*Numbers in parentheses are the actual number of respondents.

Somewhat different distributions are shown for 1971 and 1986 when comparing the proportion of respondents according to governmental level (see Table 2-4). In both surveys, the largest proportions of respondents were from townships and villages--54% in 1971 and 40.6% in 1986.

Table 2-4  
Respondents in 1971 and 1986, by Governmental Level  
(Percentage Distribution)

Governmental Level	Township/ Village	County	City/ Municipal.	State/ Province	Regional	Others	Total
1971	54.0 (162)	22.3 (67)	15.3 (46)	2.0 (6)	3.7 (11)	2.7 (8)	100.0 (300)
1986	40.6 (176)	14.8 (64)	26.8 (116)	6.7 (29)	5.1 (22)	6.0 (26)	100.0 (433)

### Development Character of Responding Agency's Jurisdiction

The predominant land use (development character) and population density associated with areas represented by the 1971 and 1986 responding agencies are shown in Tables 2-5 and 2-6, respectively.

Table 2-5  
 Respondents in 1971 and 1986, by Development Character  
 (Percentage Distribution)

Land Use Character	Industrial/ Residential	Agricult. Residential	Recreation/ Wild	Total	
1971	26.6 (78)	23.2 (68)	28.3 (83)	21.8 (64)	100.0 (293)
1986	32.6 (111)	21.7 (74)	31.4 (107)	14.4 (49)	100.0 (341)

Table 2-6  
 Respondents in 1971 and 1986, by Population Density  
 persons per square mile  
 (Percentage Distribution)

Population Density	Less than 50	50-499	Greater than 499	Total
1971	37.7 (109)	35.3 (102)	27.0 (78)	100.0 (289)
1986	31.7 (113)	29.4 (105)	38.9 (139)	100.0 (357)

Over the 15-year period between the two surveys, the developmental character of the Great Lakes region has changed as indicated by the two tables. Whereas the number of respondents who described their jurisdictions as industrial or residential increased, there was a corresponding decrease in areas characterized as recreational or wild, and a slight decline in areas described as agricultural.

There was also a significant change in the population density of areas represented by respondents from the 1971 and 1986 surveys. Whereas, in 1971, the largest percentage of respondents (37.7%) described their communities as rural, having a population density of less than 50 people per square mile, the largest percentage of respondents (38.9%) in 1986 was at the opposite end of the scale, with a population density estimated at more than 499 people per square mile. The proportion of respondents who said they lived in areas having 50 to 499 people per square mile decreased somewhat over the 15-year period.

The respondents were subsequently classified according to the "Degree of Urbanization" or the extent to which the areas they represented were urbanized. This was accomplished by combining the responses of each respondent to the two questions about predominant land use and population density to form a new variable. Respondents were then categorized according to one of four groups representing the most to the least urbanized area. Each group was defined as follows:

- Group 4: The most urbanized areas. This group consists of respondents whose areas are industrial with a population density of more than 50 persons per square mile. This group also includes respondents whose jurisdictional areas are predominantly residential/industrial in character and with a population density of over 50 persons per square mile. Throughout this report, this group is noted as having a "high" degree of urbanization.
- Group 3: Areas that are moderately urbanized. This group consists of respondents whose areas are predominantly industrial and with a population density under 50 persons per square mile, and respondents representing a residential/industrial area with a population density under 50 persons per square mile. This group has a "medium" degree of urbanization.
- Group 2: This group consists of respondents whose areas contain predominantly residential land and have a population density under 50 persons per square mile, and respondents who describe their areas as predominantly recreation/wild or agricultural with a population density over 50 persons per square mile. This group represents a "low" degree of urbanization.
- Group 1: The least urbanized areas. This group consists of respondents whose jurisdictions are predominantly recreational/wild or agricultural and whose population density is less than 50 persons per square mile. This group represents a "very low" degree of urbanization.

The degree to which respondents in 1986 and 1971 represented places in these four groups is shown in Table 2-7 on the next page.

Table 2-7

Respondents in 1971 and 1986, by Degree of Urbanization  
(Percentage Distribution)

	Degree of Urbanization				Total(n)*
	High (Group 4)	Medium (Group 3)	Low (Group 2)	Very Low (Group 1)	
1971	24.6	19.7	31.8	23.9	100.0(289)
1986	28.6	30.0	21.2	20.2	100.0(297)

\* Numbers in parentheses are the total number of respondents and the bases for each proportion shown.

## CHAPTER 3 WATER QUALITY

Ninety five percent of the surface fresh water of the United States and Canada is contained within the Great Lakes. One-fifth of the total United States population and one-third of the total Canadian population presently rely on these waters for residential and other municipal uses. In a similar fashion, one-fourth of United States industry and one-third of Canadian industry rely on waters from the Great Lakes. Water for human consumption and other uses needs to be of high quality as does water serving as habitat for numerous aquatic species.

Not only do the Great Lakes serve as an important water source, they also receive wastes discharged by society. Perceptions of inshore water quality can be an indicator of the degree to which responsible actions are taken by government to assure high quality fresh water in the Great Lakes. Accordingly, monitoring the perceived quality of the Great Lakes water is a central issue examined in part of the study.

### Assessing Water Quality

A major purpose of the study was to determine how government officials and other organizational representatives assess inshore water quality and how these assessments have changed over time. Inshore water is defined as water extending from the shoreline out to an imaginary line where the water reaches a depth of 60 feet. In response to the question "How does your agency rate the quality of the inshore waters of the Great Lakes in your jurisdiction?", 13.2% of the respondents rated water quality as "high", about two-thirds

Table 3-1

1986 Ratings of Inshore Water Quality, by Country  
(Percentage Distribution)

Country	Inshore Water Quality				Total (n)
	High	Medium	Low	Very Low	
USA	13.9	71.7	11.6	2.9	100.0(346)
Canada	9.5	49.2	28.6	12.7	100.0(63)
Total	13.2	68.2	14.2	4.4	100.0(409)

(68.2%) rated it as medium and the remainder said it was "low" (14.2%) or "very low" (4.4%). A breakdown of the responses from the U.S. and Canada is shown in Table 3-1 and indicates that the Canadians viewed inshore water quality and "medium" response categories and "medium" response categories are frequently combined as are the "low" and "very low" responses. Otherwise, the complete distribution of responses or summary ratings with a mean score are presented. The mean is based on a 4-point scale where 4 equals "high", 3 equals "medium", 2 is "low" water quality, and 1 is "very low" water quality.

### Water Quality: Assessments by States/Provinces

As seen in Table 3-2, Michigan and Minnesota respondents gave the most favorable ratings, with more than nine in ten saying their inshore water quality was "high" or "medium." High and medium ratings were also reported by three-quarters of the respondents from Illinois and New York and about two-thirds of the Indiana, Ohio, and Ontario respondents. In Pennsylvania, however, just half of the respondents rated water quality as "high" or

Table 3-2

1986 Ratings of Inshore Water Quality, by State/Province  
(Percentage Distribution)

Water Quality	IL	IN	MI	MN	NY	OH	ONT	QU	PA	WI
High-Medium	78.9	66.7	94.8	92.3	78.3	68.7	65.5	-	50.0	86.7
Low-Very Low	21.1	33.3	5.0	7.7	21.7	31.2	34.5	100.0	50.0	13.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Respondents	(19)	(12)	(154)	(13)	(46)	(32)	(58)	(6)	(10)	(60)

"medium." All six respondents in the province of Quebec, whose agencies represented locations along the St. Lawrence Seaway, rated their water quality as either "low" or "very low."

### Water Quality: Assessments by Lakes

As shown in Table 3.3, highest ratings of water quality were reported among Lake Superior respondents, followed by those associated with Lakes Michigan and Huron. In the former group, virtually everyone gave a high or medium rating (96.4%) whereas somewhat less than nine in ten respondents from Huron and Michigan gave these ratings. Lowest ratings were reported by Lake Ontario respondents. Over one-third of the respondents from the "Global Agencies" rated inshore water quality as "low" or "very low." (Global agencies

include organizations, such as the International Joint Commission, with responsibilities for more than one of the Great Lakes.)

Table 3-3  
1986 Ratings of Inshore Water Quality, by Lake  
(Percentage Distribution)

Lake	Inshore Water Quality				Total(n)
	High	Medium	Low	Very Low	
Ontario	6.1	65.3	18.4	10.2	100.0(49)
Erie	5.6	68.1	18.1	8.3	100.0(72)
Huron	12.1	75.9	10.3	1.7	100.0(58)
Michigan	17.6	69.7	10.6	2.1	100.0(142)
Superior	27.3	69.1	3.6	-	100.0(55)
Global Agencies	-	64.3	35.7	-	100.0(28)
Total	13.4	69.3	13.6	3.7	100.0(404)

It was hypothesized that respondents from different states or provinces would differ in their ratings of inshore water quality even if they were associated with the same lake. In general, this hypothesis was confirmed by the survey data. Among respondents associated with Lake Huron, only 7.2% of those in Michigan reported water quality as "low" or "very low" whereas 25% of the Ontario respondents gave their Lake Huron waters "low" or "very low" ratings. These findings suggest that the actual inshore water quality is likely to differ from one part of the same lake to another. Prevailing currents and winds often shift pollutants and cause variations in water coloration which, in turn, can result in perceptions of severe water problems in some locations and good water quality in others.

Lake Superior water quality was given the highest ratings among all lakes in the Great Lakes system, irrespective of the respondents' state affiliation. All respondents from Michigan, Minnesota, and Wisconsin said Lake Superior water was either of "high" or "medium" quality although two of the four respondents in Ontario reported water quality in Lake Superior as "low."



### Water Quality: Agency Assessments

As shown in Table 3-4, about one in ten township respondents rated water quality as "low" or "very low". Nearly two in ten respondents from cities/municipalities, about one-quarter from counties, and more than half (54.2%) of the interest groups gave these unfavorable ratings to their inshore water quality.

Table 3-4  
1986 Ratings of Inshore Water Quality, by Agency/Organization  
(Percentage Distribution)

Agency/Organization	Inshore Water Quality				Total(n)
	High	Medium	Low	Very Low	
Township	15.2	75.2	6.9	2.8	100.0(145)
County	14.3	61.9	17.5	6.3	100.0(63)
City/Municipality	15.3	64.9	14.4	5.4	100.0(111)
State/Provincial	7.7	76.9	11.5	3.8	100.0(26)
Regional	-	83.3	16.7	-	100.0(18)
Interest Group	-	45.8	41.7	12.5	100.0(24)
Total	13.8	70.4	11.9	3.9	100.0(387)

Similar results appear when partitioning the types of agency respondents by lake. With the exception of Lake Superior, respondents had diverse opinions about the water quality of the lake with which they were associated. For example, those representing interest groups, irrespective of the lake, were more likely to rate water quality as "low" or "very low" than representatives of government agencies. In contrast, township respondents associated with each lake tended to rate inshore water quality higher than other types of agency respondents associated with the same lake. In Lake Superior, all respondents (townships, counties, states, regional agencies, interest groups, and municipalities) rated the water quality as "high" or "medium". Only two of the fourteen respondents from municipalities associated with Lake Superior viewed their inshore water quality as "low".

### **Water Quality: Assessments by "Areas of Concern"**

In 1987, the International Joint Commission (IJC) designated 42 "Areas of Concern" throughout the Great Lakes. These areas of concern or "hotspots" are locations where toxics and other pollutants contribute to poor water quality. As part of our analysis, the perceptions of respondents associated with each of these hotspots were examined to determine if, in fact, they were in accord with the IJC designation. The hotspots are shown in Figure 3-1.

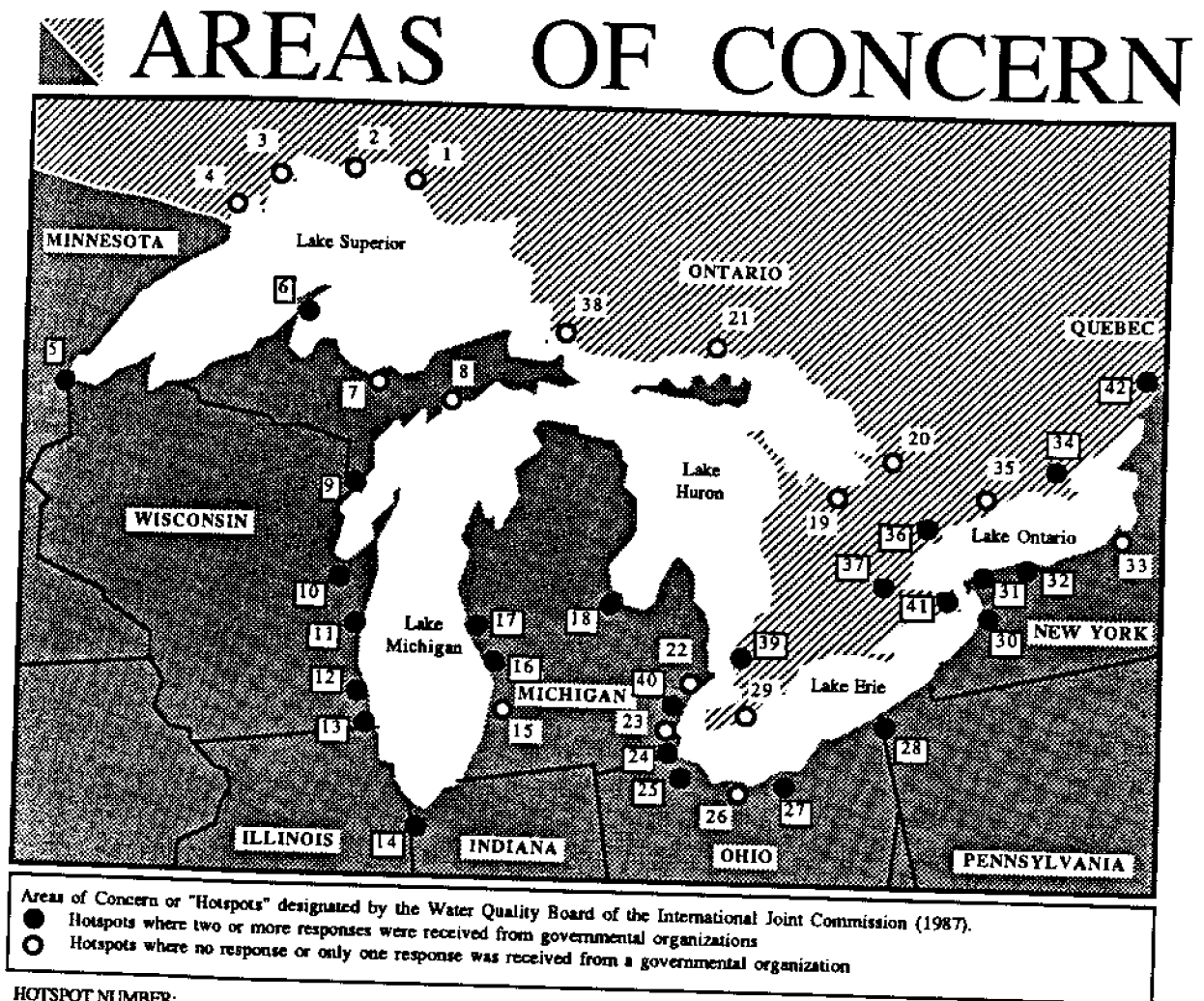
With the exception of the Lake Huron respondents, those from the "hotspot" locations were more likely to be negative in their assessment of water quality than non-hotspot respondents from the same lake (see Figure 3-2). Among Lake Ontario respondents, for example, the average water quality rating for the 23 communities associated with the seven hotspots was 2.5. In contrast, the average water quality rating of Lake Ontario respondents who had no connection with hotspots was higher at 2.9. Only respondents associated with the hotspots at Bay of Quinte and Port Hope gave water quality ratings roughly comparable to the non-hotspot respondents along Lake Ontario.

While the perceptions of hotspot respondents are generally in line with those of the IJC, there are exceptions. For instance, governmental respondents associated with Muskegon Lake adjacent to Lake Michigan were quite positive about the water quality of their inshore waters. At the same time, positive water quality ratings were also made by respondents at the Maumee River and the Ashtabula River on Lake Erie. It is quite possible that these discrepancies result from the way the question was worded. The questionnaire asked respondents to assess the quality of their inshore Great Lake water which was defined as the water from the shoreline to a depth offshore of sixty feet. In these discrepant cases, the respondents may not have viewed Muskegon Lake or the tributary rivers as affecting their inshore Great Lakes waters.

### **Water Quality: Assessments by "Degree of Urbanization"**

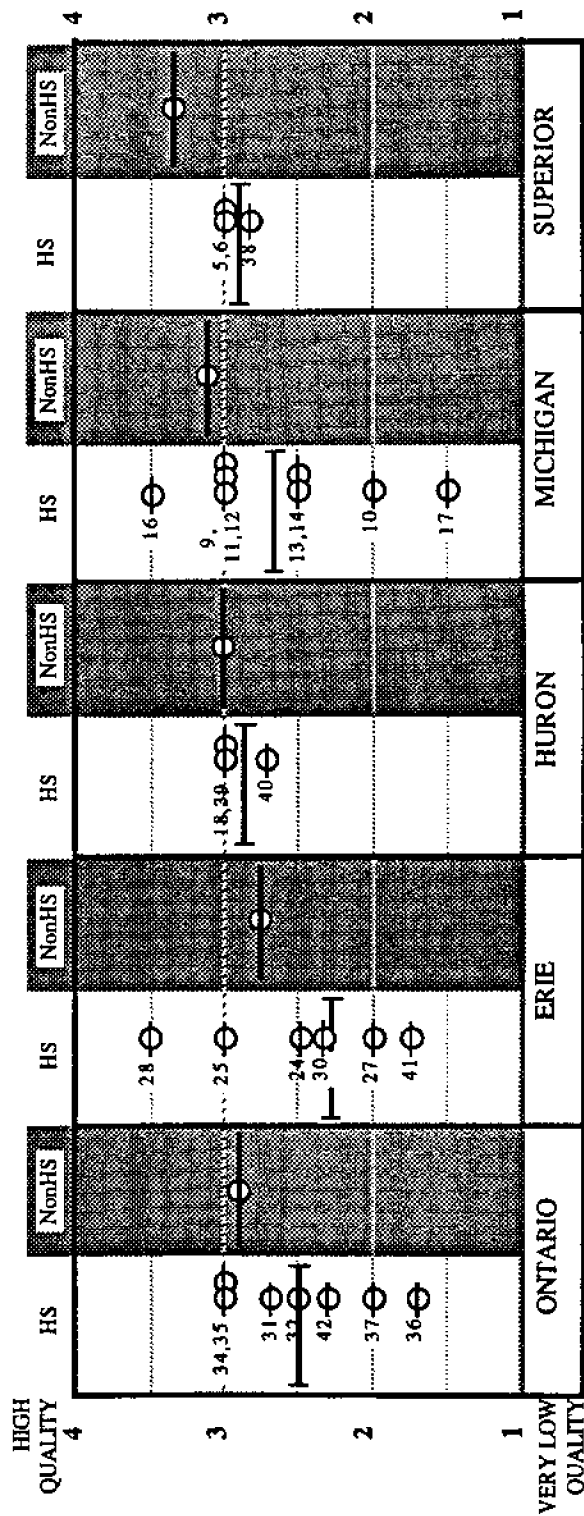
In the previous chapter, respondents were classified according to the degree of urbanization of the area they represented. It was expected that the severity of environmental problems, including low water quality, would vary depending on the extent to which respondents represented areas that were built up and heavily populated. The data confirm the expectation. As seen in Table 3-5, the proportion of respondents who said their inshore water quality is "low" and "very low" increases as the extent of urbanization increases.

Figure 3-1



- |   |  |                          |
|---|--|--------------------------|
| (1) Penninsular Harbour                 | (14) Grand Calumet River/<br>-Indiana Harbor Canal | (28) Ashtabula River     |
| (2) Jackfish Bay                        | (15) Kalamazoo River                               | (29) Wheatley Harbour    |
| (3) Nipigon Bay                         | (16) Muskegon Lake                                 | (30) Buffalo River       |
| (4) Thunder Bay                         | (17) White Lake                                    | (31) Eighteen Mile Creek |
| (5) St. Louise River                    | (18) Saginaw River/Saginaw Bay                     | (32) Rochester Embayment |
| (6) Torch Lake                          | (19) Collingwood Harbour                           | (33) Oswego River        |
| (7) Deer Lake-Carp Creek<br>-Carp River | (20) Penetang Bay to Sturgeon Bay                  | (34) Bay of Quinte       |
| (8) Manistique River                    | (21) Spanish River Mouth                           | (35) Port Hope           |
| (9) Menominee River                     | (22) Clinton River                                 | (36) Toronto Water Front |
| (10) Fox River/<br>-Southern Green Bay  | (23) Rouge River                                   | (37) Hamilton Harbour    |
| (11) Sheboygan                          | (24) Raisin River                                  | (38) St. Marys River     |
| (12) Milwaukee Estuary                  | (25) Maumee River                                  | (39) St. Clair River     |
| (13) Waukegan Harbor                    | (26) Black River                                   | (40) Detroit River       |
|   | (27) Cuyahoga River                                | (41) Niagara River       |
|   |  | (42) St. Lawrence River  |

Figure 3-2  
Average Water Quality Ratings Of Hotspot And Non-hotspot Respondents, By Lake



Hotspots and Number of Respondents from each location

ONTARIO:

- 31. Eighteen Mile Creek (3)
- 32. Rochester Embayment (5)
- 34. Bay of Quinte (6)
- 35. Port Hope (2)
- 36. Toronto Water Front (3)
- 37. Hamilton Harbour (2)
- 42. St. Lawrence River (4)

HURON:

- 18. Saginaw River/Saginaw Bay (3)
- 39. St. Clair River (8)
- 40. Detroit River (7)

ERIE:

- 24. Raisin River (2)
- 25. Maumee River (2)
- 27. Cuyahoga River (3)
- 28. Ashabula River (2)
- 30. Buffalo River (3)
- 41. Niagara River (4)

MICHIGAN:

- 9. Menominee River (3)
- 10. Fox River/Southern Green Bay (3)
- 11. Sheboygan (2)
- 12. Milwaukee/Esquary (4)
- 13. Waukegon Harbour (2)
- 14. Grand Calumet (2)
- 16. Muskegon Lake (2)
- 17. White Lake (2)

Note: Questionnaires were obtained from 91 respondents representing 27 of the 72 "hotspots" designated by the International Joint Commission

Table 3-5

1986 Respondents Rating Water Quality as "Low" or "Very Low", by Degree of Urbanization  
(Percentage Reporting "Low" or "Very Low")

	Degree of Urbanization			
	High (Group 4)	Medium (Group 3)	Low (Group 2)	Very Low (Group 1)
% reporting "Low" or "Very Low"	28.8	17.9	11.5	10.5
Mean Score*	2.8	2.9	3.1	3.0

\*Respondents rated water quality on a scale of 1 to 4, where 4=high quality, 3=medium quality, 2=low quality, 1=very low quality

### Water Quality Assessments: Changes Over Time

Of considerable interest to researchers and policy makers is the degree to which perceptions of water quality among government officials and organizational representatives change over time. Two approaches were used to address this issue. First, comparisons were made among responses to the water quality question asked in 1971 and again in 1986. These comparisons took into account respondents associated with the same lake, type of agency, and geographic location (i.e. state and national boundaries). Second, the respondents in the 1986 survey were asked the question, "Does your agency feel that water quality in your area is deteriorating?" Responses to this question also were compared for officials associated with different lakes, types of agencies, and geographic locations.

### Comparing 1971 and 1986 Water Quality Assessments

In the 1971 survey, the respondents were asked, "How does your agency rate the quality of the waters along the shorelines of the Great Lakes in your area of jurisdiction?". With a slight wording modification, the question was repeated in 1986. Overall, ratings of respondents in 1986 were higher than the ratings given by the 1971 respondents. As seen from Table 3-6, the proportion of 1986 respondents that said water quality was "high" was nearly twice that of the 1971 respondents (13.2% vs. 7.9%).

Table 3-6  
Ratings of Inshore Water Quality in 1971 and 1986, by Country  
(Percentage Distribution)

Country		Inshore Water Quality				Total(n)
		High	Medium	Low	Very Low	
USA	1971	8.1	58.3	29.1	4.5	100.0(223)
	1986	13.9	71.7	11.6	2.9	100.0(346)
Canada	1971	7.4	54.4	35.3	2.9	100.0(68)
	1986	9.5	49.2	28.6	12.7	100.0(63)
Total	1971	7.9	57.4	30.6	4.1	100.0(291)
	1986	13.2	68.2	14.2	4.4	100.0(409)

As noted earlier, respondents from the U.S. were more positive in their assessments of water quality in their jurisdiction than Canadian respondents. Within the U.S., a higher proportion of 1986 respondents rated water quality as "high" and "medium" compared to the 1971 respondents, (85.6% vs 66.4%). At the same time, the proportion of the 1986 Canadian respondents who rated inshore water quality as "very low" increased between 1971 and 1986 (2.9% to 12.7%). This, in part, may be explained by the geographic location of the Canadian respondents, who generally were located along the eastern end of the Great Lakes where water flows into the St. Lawrence Seaway. Contaminant accumulation is magnified in this location as the water travels through the Basin from west to east. In part, this may explain why the six respondents from Quebec gave water quality poor ratings in 1986.

A comparison of the 1971 and 1986 water quality ratings among the states/provinces in the Great Lakes region is presented in Table 3-7. With the exception of Pennsylvania, all states/provinces reported improved inshore water quality over this time period (1971-1986). The greatest water quality improvements are reported among Illinois and Ohio respondents, where high and medium ratings increased by nearly 40 percentage points between 1971 and 1986. Figure 3-3 presents these comparisons graphically.

An examination of ratings of water quality by respondents associated with each lake indicates that, in general, inshore water quality was perceived more favorably in 1986 than in 1971. However, exceptions can be seen in Table 3-8. While the proportion of respondents rating inshore water as "high" is higher in 1986 than in 1971 for all lakes, the proportion of respondents associated with Lake Huron who rated water quality as "high" decreased from 16% in 1971 to 12.1% in 1986. At the same time, the proportion of respondents associated with Lake Ontario rating the inshore water as "very low" increased considerably (2.8% to 10.2%). Overall, the data indicate that Lake Erie is viewed as having the greatest improvement

of inshore water quality over the period from 1971 to 1986. This is consistent with the fact that this lake had the most serious overall water pollution problem in 1971.

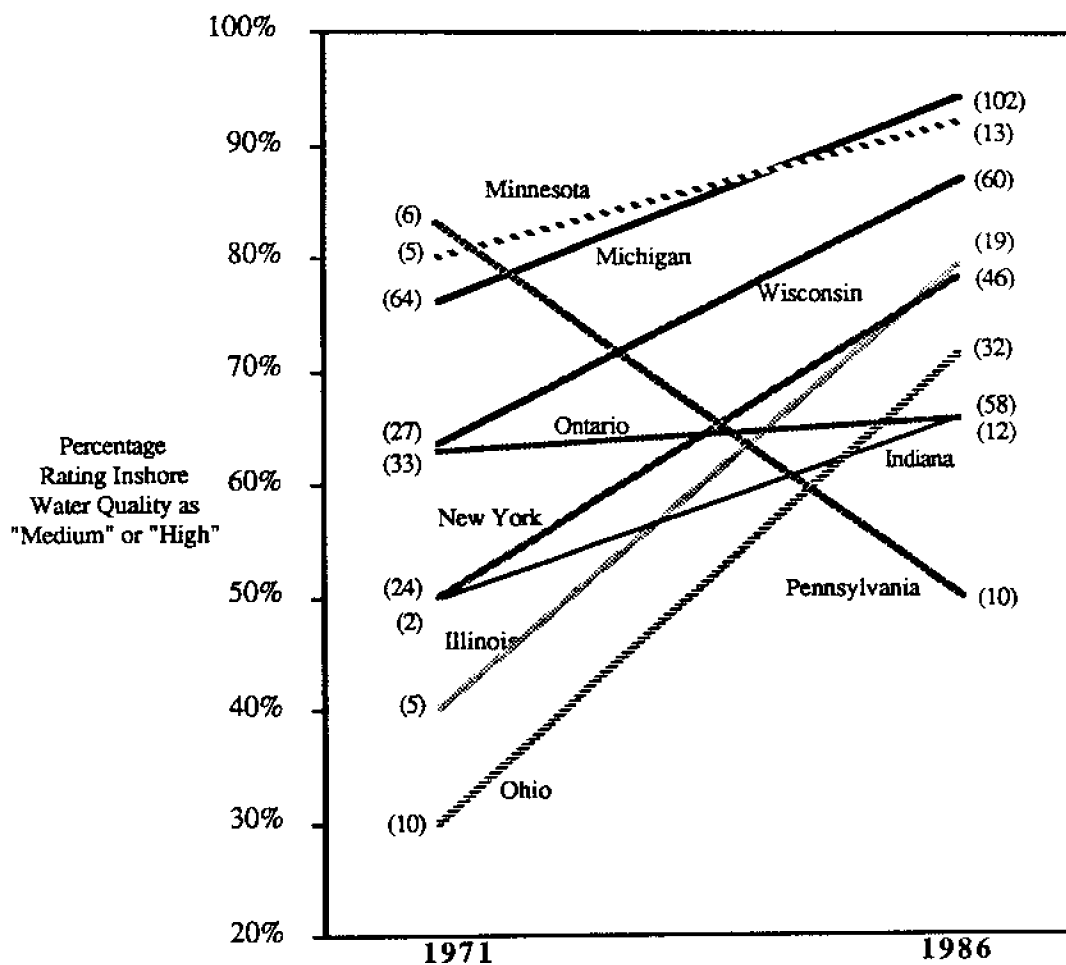
Table 3-7

Ratings of Inshore Water Quality in 1971 and 1986, by State/Province  
(Percentage Distribution)

State/Province		Inshore Water Quality				Total(n)
		High	Medium	Low	Very Low	
Illinois	1971	-	40.0	40.0	20.0	100.0( 5)
	1986	5.3	73.7	21.1	-	100.0(19)
Indiana	1971	-	50.0	50.0	-	100.0( 2)
	1986	8.3	58.3	25.0	8.3	100.0(12)
Michigan	1971	10.8	65.7	16.7	6.9	100.0(64)
	1986	16.9	77.9	2.6	2.6	100.0(102)
Minnesota	1971	-	80.0	20.0	-	100.0(5)
	1986	38.5	53.8	7.7	-	100.0(13)
New York	1971	-	50.0	45.8	4.2	100.0(24)
	1986	8.7	69.6	21.7	-	100.0(46)
Ohio	1971	-	30.0	70.0	-	100.0(10)
	1986	3.1	65.6	28.1	3.1	100.0(32)
Pennsylvania	1971	-	83.3	16.7	-	100.0(6)
	1986	-	50.0	20.0	30.0	100.0(10)
Wisconsin	1971	3.7	59.3	33.3	3.7	100.0(27)
	1986	16.7	70.0	11.7	1.7	100.0(60)
Ontario	1971	3.0	60.6	36.4	-	100.0(33)
	1986	10.3	55.2	25.9	8.6	100.0(58)
Quebec	1971	-	-	-	-	-
	1986	-	-	50.0	50.0	100.0(6)
Total	1971	6.1	60.7	28.5	4.7	100.0(214)
	1986	13.2	68.3	14.1	4.4	100.0(358)

Figure 3-3

Changes in Ratings of Inshore Water Quality, by State/Province



Note: Numbers in parentheses indicate number of respondents.



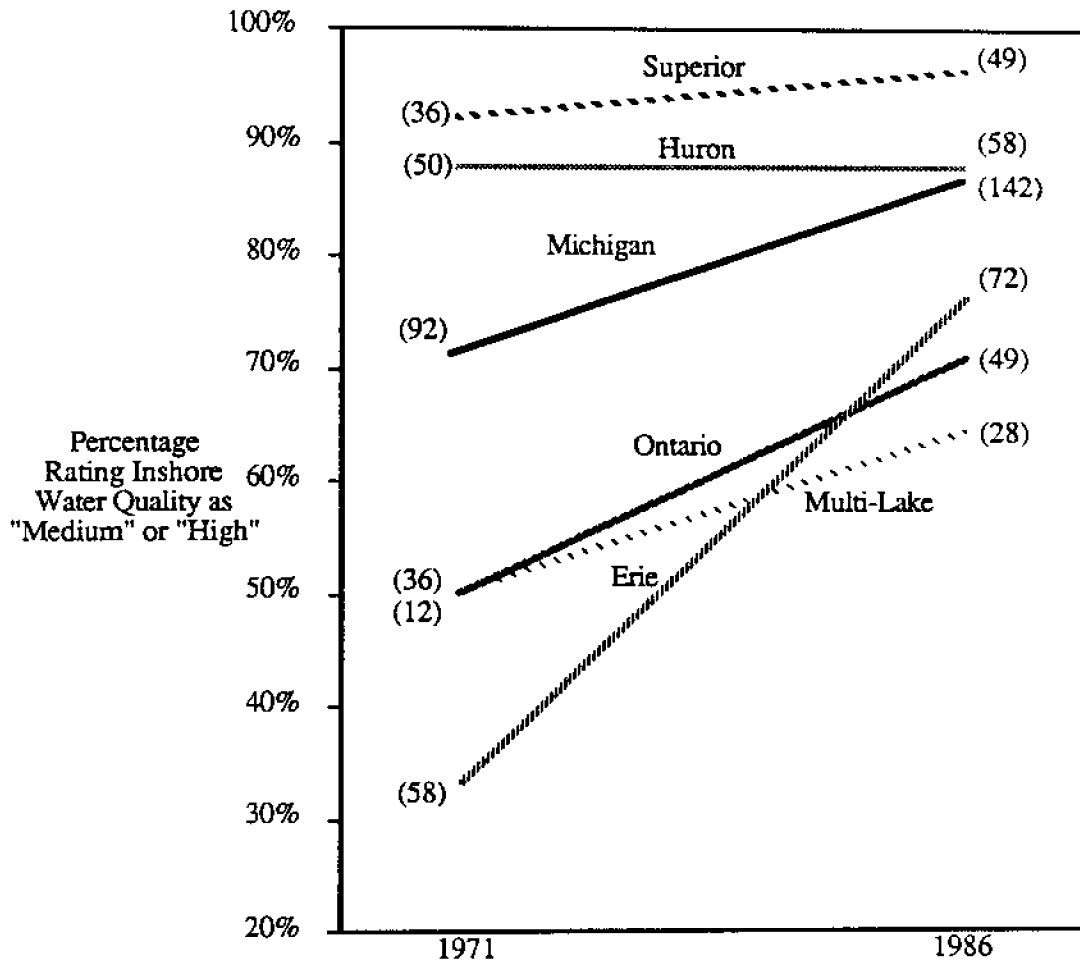
Table 3-8  
Ratings of Inshore Water Quality in 1971 and 1986, by Lake  
(Percentage Distribution)

Lake		Inshore Water Quality				Total(n)
		High	Medium	Low	Very Low	
Ontario	1971	-	50.0	47.2	2.8	100.0(36)
	1986	6.1	65.3	18.4	10.2	100.0(49)
Erie	1971	1.7	31.0	55.2	12.1	100.0(58)
	1986	5.6	68.1	18.1	8.3	100.0(72)
Huron	1971	16.0	72.0	12.0	-	100.0(50)
	1986	12.1	75.9	10.3	1.7	100.0(58)
Michigan	1971	7.6	64.1	25.0	3.3	100.0(92)
	1986	17.6	69.7	10.6	2.1	100.0(142)
Superior	1971	18.4	73.7	7.9	-	100.0(38)
	1986	27.3	69.1	3.6	-	100.0(55)
Multi-lake	1971	-	50.0	50.0	-	100.0(12)
	1986	-	64.3	35.7	-	100.0(28)
Total	1971	8.0	57.7	30.4	3.8	100.0(286)
	1986	13.4	69.3	13.6	3.7	100.0(404)

Figure 3-4 graphically presents a comparison between 1971 and 1986 respondents associated with each lake who rated water quality as "medium" or "high." The figure clearly displays the changing perceptions among Lake Erie respondents. The figure also shows that assessments of water quality improved similarly among the respondents associated with Lake Michigan and Lake Ontario, although a higher proportion of Lake Michigan respondents rated water quality as "medium" and "high" than those associated with Lake Ontario in both 1971 and 1986. Only a slight increase and no change in water quality ratings are shown for Lake Superior and Lake Huron respondents, respectively. However, most respondents associated with these two lakes had rated water quality as "very high" in 1971 (88% and 92% respectively).

Figure 3-4

Changes in Ratings of Inshore Water Quality, by Lake



When the respondents' ratings of water quality are compared according to their governmental level, improvements are shown once again between 1971 to 1986 (See Table 3-9). For example, county and city/municipality respondents rated water quality higher in 1971 than in 1986. Although none of the state/provincial agencies rated inshore water as "high" in 1971, 7.7% gave a high rating in 1986. Interestingly, one in ten (9.1%) of the regional respondents rated water quality as "high" in 1971 but none did so in 1986. However, the proportion of regional respondents who rated water quality as "medium" increased most dramatically, rising from about 45% in 1971 to over 80% in 1986.

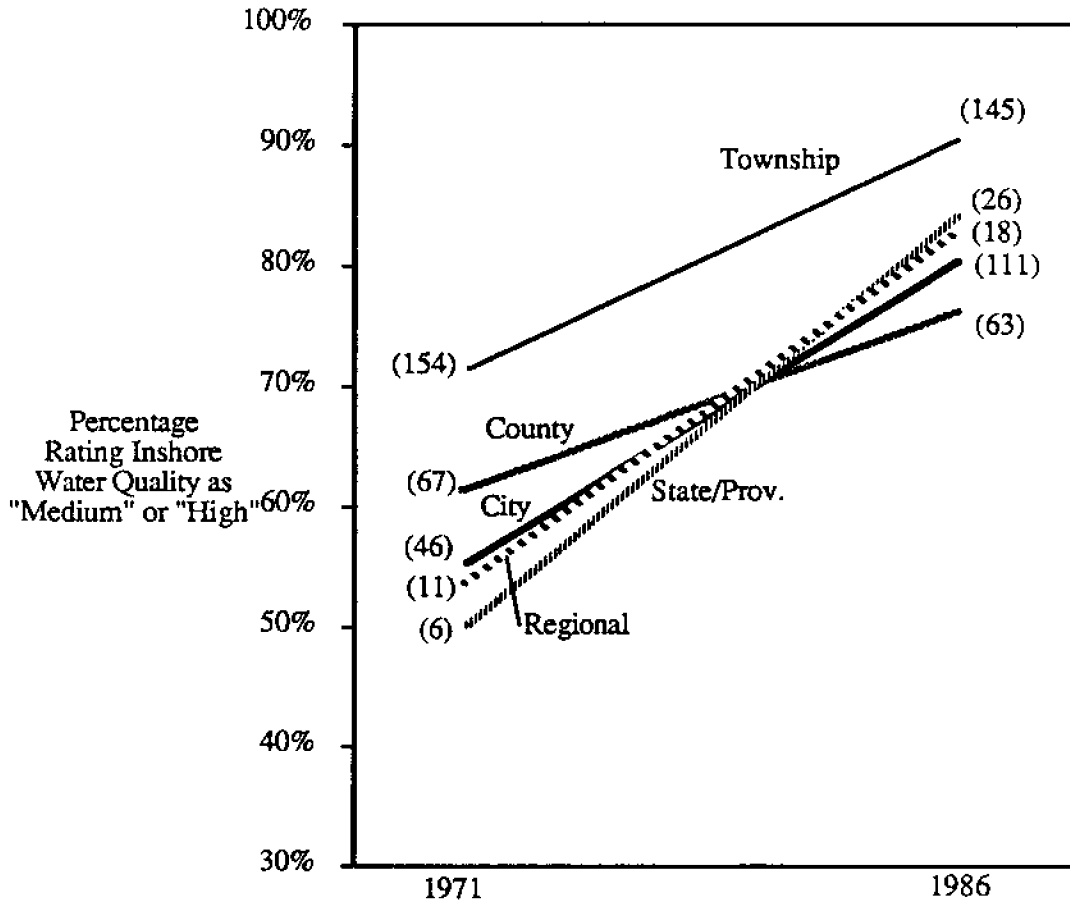
When comparing inshore water quality ratings by different types of agencies/organizations over time, representatives of each type reported better water quality in 1986. Changes in water quality ratings among agencies/organizations are graphically displayed in Figure 3-5.

Table 3-9  
Ratings of Inshore Water Quality in 1971 and 1986, by Agency/Organization  
(Percentage Distribution)

Agency/Organization		Inshore Water Quality				Total(n)
		High	Medium	Low	Very Low	
Township	1971	11.0	60.4	26.6	1.9	100.0(154)
	1986	15.2	75.2	6.9	2.8	100.0(145)
County	1971	3.0	58.2	35.8	3.0	100.0(67)
	1986	14.3	61.9	17.5	6.3	100.0(63)
City/Municipality	1971	6.5	50.0	30.4	13.0	100.0(46)
	1986	15.3	64.9	14.4	5.4	100.0(111)
State/Provincial	1971	-	50.0	33.3	16.7	100.0(6)
	1986	7.7	76.9	11.5	3.8	100.0(26)
Regional	1971	9.0	45.5	45.5	-	100.0(11)
	1986	-	83.3	16.7	-	100.0(18)
Total	1971	8.0	57.8	30.4	3.8	100.0(284)
	1986	13.8	70.4	11.9	3.9	100.0(362)

Figure 3-5

Changes in Ratings of Inshore Water Quality, by Governmental Unit



With regard to degree of urbanization, it was found that land use and population density in 1971 were two critical variables explaining differential water quality ratings of inshore waters. A similar pattern exists when examining the 1986 data (See Table 3-10). It is important to note the change in water quality ratings between 1971 and 1986 for the most urbanized areas (Group 4); the mean score for water quality was 2.3 in 1971 and 2.8 in 1986 (4 = high quality, 1 = very low quality). To a large extent, this reflects improvements in the treatment of wastewater in the urbanized areas of the U.S. and Canada. The change in perceptions among respondents in the most urbanized areas is also shown in Figure 3-6.

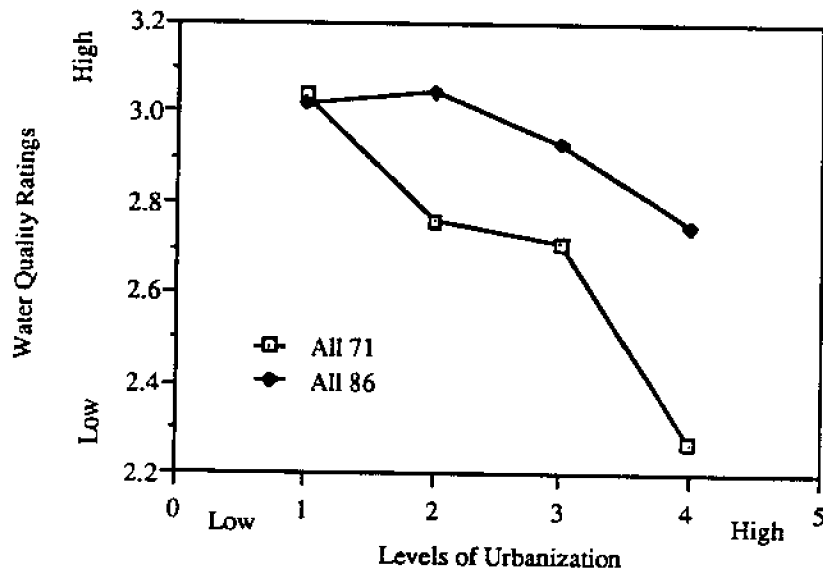
Table 3-10

Respondents Rating of Water Quality as "Low" or "Very Low", by Degree of Urbanization (Percentage and Mean Scores)

Degree of Urbanization	1971		1986	
	Percentage Reporting 'Low' or 'Very Low'	Mean Score	Percentage Reporting 'Low' or 'Very Low'	Mean Score
Group 1 (Very Low)	13.2	3.0	10.5	3.0
Group 2 (Low)	28.4	2.8	11.5	3.1
Group 3 (Medium)	34.5	2.7	17.9	2.9
Group 4 (High)	62.3	2.3	28.8	2.8

Figure 3-6

Water Quality Ratings at Different Levels of Urbanization



Differences in the low ratings by degree of urbanization over the 15-year period are shown separately for the U.S. and Canada in Tables 3-11 and 3-12. It can be seen from the two tables and Figure 3-7 that, irrespective of the degree of urbanization, Canadian respondents gave lower ratings in 1986 than their American counterparts.

Table 3-11

U.S. Respondents Rating of Water Quality as "Low" or "Very Low",  
by Degree of Urbanization  
(Percentage and Mean Scores)

Degree of Urbanization	1971		1986	
	Percentage Reporting 'Low' or 'Very Low'	Mean Score	Percentage Reporting 'Low' or 'Very Low'	Mean Score
Group 1 (Very Low)	8.3	3.1	4.8	3.1
Group 2 (Low)	21.0	2.8	7.7	3.1
Group 3 (Medium)	34.1	2.7	16.4	2.9
Group 4 (High)	62.3	2.3	24.6	2.8

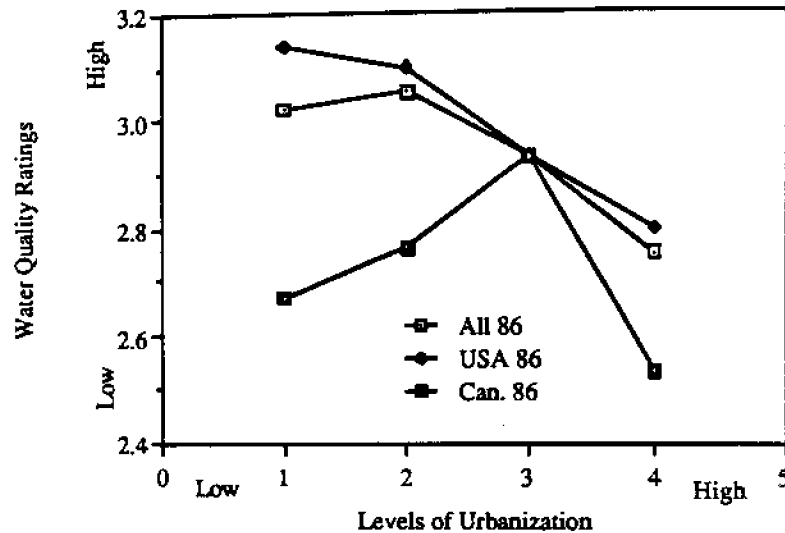
Table 3-12

Canadian Respondents Rating of Water Quality as "Low" or "Very Low",  
by Degree of Urbanization  
(Percentage and Mean Scores)

Degree of Urbanization	1971		1986	
	Percentage Reporting 'Low' or 'Very Low'	Mean Score	Percentage Reporting 'Low' or 'Very Low'	Mean Score
Group 1 (Very Low)	25.0	2.9	26.7	2.7
Group 2 (Low)	46.2	2.6	33.3	2.8
Group 3 (Medium)	36.4	2.7	27.3	2.9
Group 4 (High)	62.5	2.2	46.7	2.5

Figure 3-7

Water Quality Ratings - 1986 Comparison



### Perceptions of Deteriorating Water Quality

As seen in Table 3-13, approximately three out of every ten respondents (29.2%) in the 1986 survey said that water quality in their area was deteriorating. About one in five (21.3%) gave a "don't know" response and half said water quality was not deteriorating. When comparing responses to the question for individuals associated with different lakes, a slightly higher proportion from Lake Superior felt water quality was deteriorating whereas the smallest proportion of respondents perceiving deteriorating water quality on their lake is shown among those on Lake Huron (26.1%).

Differences can also be seen when comparing respondents from each of the states/provinces (Table 3-14). For example, all respondents in Quebec indicated the water quality was deteriorating whereas only one of the 19 respondents from Illinois reported deteriorating water quality. In the U.S., the most pessimistic respondents were found in Indiana, Ohio and Michigan; those in Pennsylvania, Minnesota and Illinois were least likely to report deteriorating water quality.

Table 3-13

Proportions of Respondents Who Think Water Quality is Deteriorating, by Lake

Lake	Percent Responding Affirmatively	N
Multi-Lake	37.5	(24) *
Superior	32.4	(37)
Ontario	30.6	(36)
Erie	30.6	(62)
Michigan	28.3	(120)
Huron	26.1	(46)
All Lakes	29.2	(325)

\*Numbers in parentheses are the total number of respondents answering this question.

Table 3-14

Proportions of Respondents Who Think Water Quality is Deteriorating, by State/Province

State	Percent Responding Affirmatively	N
Quebec	100.0	(5)
Indiana	45.5	(11)
Ontario	40.5	(37)
Ohio	36.7	(30)
Michigan	29.6	(125)
Wisconsin	28.9	(45)
New York	27.5	(40)
Pennsylvania	25.0	(8)
Minnesota	20.0	(10)
Illinois	5.3	(19)
All States	30.9	(330)

These differences are highlighted when comparing Canadian and U.S. respondents. Almost half (47.6%) of the Canadian respondents said the water quality was deteriorating



whereas less than a third (28.5%) in the U.S. responded in this manner. This difference in two countries may reflect different environmental policies aimed at protecting Great Lakes water quality (See Table 3-15).

Table 3-15  
Proportions of Respondents Who Think Water Quality is Deteriorating, by Country

Country	Percent Responding Affirmatively	N
Canada	47.6	(42)
USA	28.5	(288)
All	30.9	(330)

For all lakes, those respondents representing municipalities were less negative in the views on water quality deterioration than respondents from other units of government--i.e., township/village, county, state/provincial, and regional. This difference is shown in Table 3-16 and to a large extent, it is attributed to the fact that most of the pollution control funds in the U.S. have been used by municipalities to improve the quality of wastewater discharge in the areas.

Table 3-16  
Proportions of Respondents Who Think Water Quality is Deteriorating, by Agency/Organization

Agency/Organization	Percent Responding Affirmatively	N
Township/Village	30.0	(130)
County	37.0	(43)
Municipality	16.0	(88)
State/Provincial	23.0	(13)
Regional	33.0	(18)
All*	30.9	(292)

\* Excludes respondents associated with interest groups and Federal agencies.

## CHAPTER 4

### TOXIC POLLUTION

Since 1971, contamination of surface water and ground water by toxics has become a critical issue in many areas of the United States. Major federal legislation in the United States has been enacted to address these pollution problems and to minimize future contamination of such waters. This legislation includes the 1976 Toxic Substances Control Act (TOSCA), the 1976 Resources Conservation and Recovery Act (RCRA), the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or SUPERFUND), and the 1986 Superfund Amendments and Reauthorization Act (SARA). These acts collectively address many of the critical problems associated with proper control of the manufacturing, use, and disposal of toxic and hazardous materials.

The Great Lakes have been affected by toxic pollutants which reach the lakes through a variety of pathways including point source discharges, nonpoint source loadings, and air deposition (both wet fall and dry fall). The bio-accumulation of toxics in certain fish species is one manifestation of the actual and potential adverse impacts of these pollutants.

In order to better understand the toxic pollution problem, the 1986 survey posed four questions about toxics and their impacts on the inshore waters within the area of jurisdiction of the responding agency. These questions addressed the following: (1) the magnitude of the toxic pollution problem in the area; (2) the location of the toxic pollutants in the area, i.e., in the water column, in sediments, and/or in fish; (3) the impact of toxic pollutants on key activities; and (4) the source(s) of the toxic pollutants affecting the area. This chapter summarizes findings from the 1986 survey. Unlike the issue of water quality, no comparisons are made with 1971 survey results since the findings represent a new set of questions.

#### **Perceptions of the Problem**

The discharge of toxics in the region is certainly not uniform and, as a consequence, one would expect that toxic pollution would not be perceived in a uniform fashion throughout the Great Lakes. Indeed, of the 406 respondents who answered the question, "How much of a problem are toxic pollutants in the shore waters within your jurisdiction?" 10.1% indicated it was a "very big problem," 38.3% said it was "not a problem," and the remainder responded to one of the middle three categories. As shown in Table 4-1, Canadians were somewhat more likely to view toxic pollutants as problematic compared to their U.S. counterparts. Whereas 22% of the Americans marked the 1 or 2 categories (toxics are a problem) on the 5-point scale, 31.1% of the Canadians responded in this manner. Throughout the remainder of this chapter, findings are reported for those groups of respondents who viewed toxic pollutants as a problem (categories 1 and 2) and those who said toxics were not a problem (category 5).

Table 4-1

## 1986 Ratings of Toxic Pollution, by Country (Percentage Distribution)

Country	Not a Problem	4	3	2	Very Big Problem	Total (n)
	5				1	
USA	38.3	23.8	15.9	11.9	10.1	100.0(345)
Canada	32.8	19.7	16.4	21.3	9.8	100.0(61)
Total	37.4	23.2	16.0	13.3	10.1	100.0(406)

**Toxic Pollution: Assessments by States/Provinces**

Table 4-2 shows responses to the toxic pollution problem among the respondents in each state/province. Most likely to view toxics as a problem were respondents from Quebec (50%), Ohio (45.5%) and New York (36.1%). In contrast, significant numbers of respondents from Michigan (46.4%) and Minnesota (30.8%) indicated that toxic pollution is not at all a problem while the views of respondents from Indiana, Illinois, and Ontario were varied as to the seriousness of the toxic pollution problem in their area of jurisdiction. These findings suggest that the toxic pollution problem is localized and site-specific throughout the Great Lakes region.

Table 4-2

1986 Ratings of Toxic Pollution, by State/Province  
(Proportion of Respondents Reporting No Problem and Big-Very Big Problem)

Problem	IL	IN	MI	MN	NY	OH	ON	QU	PA	WI
No Problem	47.4(9)	50.0(6)	46.4(71)	30.8(4)	17.0(8)	27.3(9)	35.7(20)	-	10.0(1)	41.4(24)
Big-Very Big	31.6(6)	33.3(4)	13.1(20)	7.7(1)	36.1(17)	45.5(15)	28.6(16)	50.0(3)	20.0(2)	18.9(11)

**Toxic Pollution: Assessments by Lakes**

Table 4-3 and Figure 4-1 present a breakdown of the respondents' views on the toxic pollution problem by the lake with which they are associated. These summary data indicate that respondents from Lakes Superior, Michigan, and Huron were most likely to feel their lakes have no problem with toxic pollution, while respondents located along Lake Erie and Lake Ontario were most likely to say their water bodies have serious problems with toxic pollution.

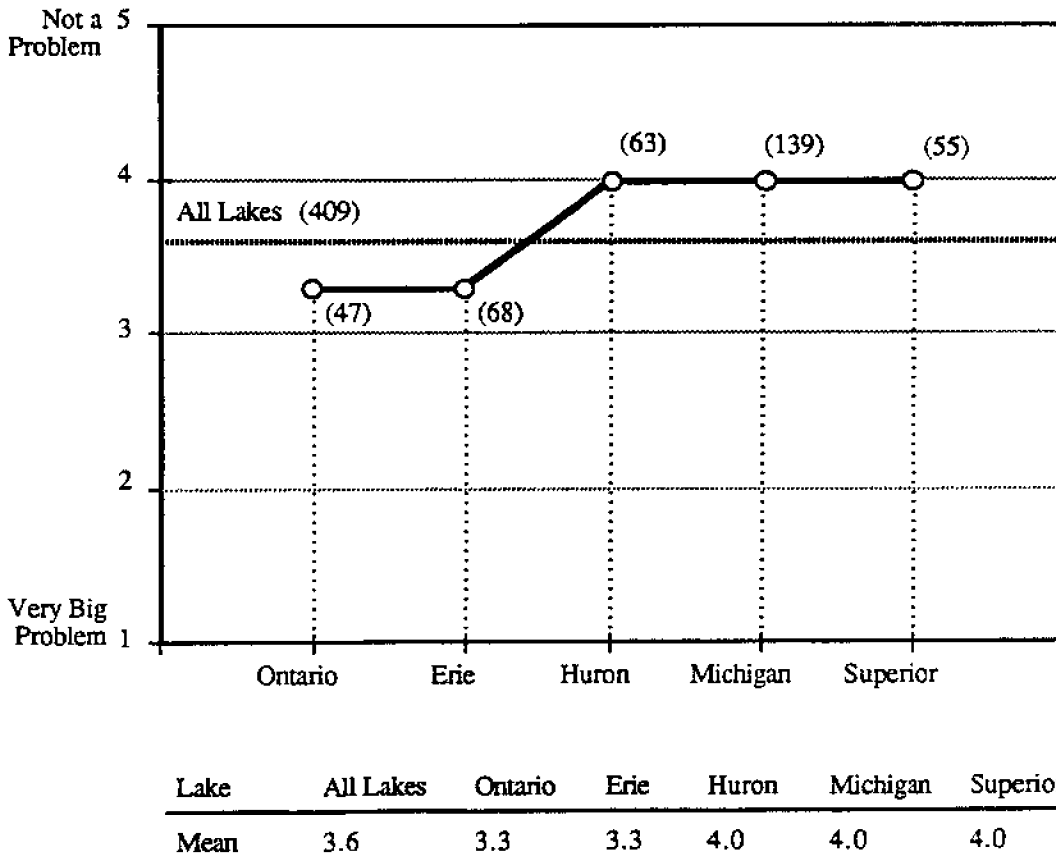
Table 4-3

1986 Ratings of Toxic Pollution, by Lake  
(Proportion of Respondents Reporting No Problem and Big-Very Big Problem)

	Ontario	Erie	Huron	Michigan	Superior	All Lakes
No Problem	25.0(12)	23.3(17)	50.8(30)	50.7(71)	40.0(22)	37.3(152)
Big-Very Big	29.2(14)	34.2(25)	18.7(11)	15.0(21)	10.9(6)	23.4(77)

Figure 4-1

Perceptions of Toxic Pollution Problem in the Shore Waters in 1986, by Lake  
(Mean Rating)



The data indicate that toxic pollution has greater spatial variation than more conventional inshore water quality problems, and furthermore, that toxic pollution is site-specific. To illustrate, among Lake Superior respondents, only 7.7% and 8.3% from the states of Michigan and Wisconsin, respectively, reported toxic pollution as a "big" or "very big" problem and none of the twelve Minnesota respondents associated with Lake Superior considered toxic pollution problematic. On the other hand, three of the five Ontario respondents on Lake Superior thought that toxic pollutants are causing "big" or "very big" problems in the lake.

Similarly diverse opinions concerning toxic pollution were reported among Lake Ontario and Lake Erie respondents. For Lake Ontario, 23.1% (6) from the State of New York reported "big" or "very big" problems with toxic pollution, and 38.1% (8) from the Province of Ontario gave these responses. For Lake Erie, only one of the five respondents from Ontario rated toxic pollution as "big" problem. But the proportions of respondents from the states adjacent to Lake Erie who rated toxic pollution as a "big" or "very big" problem are the same or higher: Pennsylvania: 20.0% (2), Michigan: 23.1% (3), Ohio: 41.9% (13), and New York: 42.8% (6).

#### Toxic Pollution: Agency Assessments

Toxic pollution is seen as a big problem among most representatives of interest groups and federal and international agencies (see Table 4-4). On the other hand, the village respondents were not likely to say that toxic pollution was a problem. These differences in part reflect the jurisdictional focus of federal and international agencies and special capabilities of interest groups to focus upon issues of particular concern to their membership. Furthermore, the site-specific nature of toxic contamination may be reflected in these data, i.e., toxics are a major problem for some townships and local units of government but not for the majority of townships and local units. At the same time, few representatives of states/provinces thought that toxic pollution was not a problem; these responding agencies were likely to think about an entire shoreline within their jurisdiction rather than a single location when asked about toxic pollution.

Table 4-4

1986 Ratings of Toxic Pollution, by Agency/Organization  
(Proportion of Respondents Reporting No Problem and Big-Very Big Problem)

	Tnshp.	Village	County	Munic.	Sta./Pro.	Regl.	Fed.	Intl.	I.G.
No Problem	49.3(72)	55.0(11)	33.9(21)	38.5(42)	3.8(1)	27.8(5)	-	-	-
Big-Very Big	13.0(19)	10.0(2)	30.7(19)	19.3(21)	38.4(10)	22.2(4)	100.0(2)	100.0(2)	72.7(16)

When respondents from each state/province are grouped according to the lake with which they are associated, diverse opinions emerge about toxic pollutants. For instance, of

the four states bordering Lake Michigan, Illinois and Indiana respondents reported greater toxic pollution problems; about one-third said toxic pollution was a "big" or "very big" problem. Only three of the Michigan respondents and 18.6% (8) of the Wisconsin respondents viewed toxic pollution in Lake Michigan as a "big" or "very big" problem. This pattern of responses for Lake Michigan is consistent with the actual location of identified toxic pollution which is primarily in the southern waters adjacent to heavy industrial areas.

Similar results are found when grouping respondents associated with the same lake by the type of agency/organization. For all lakes, respondents from counties and municipalities tended to report problems with toxic pollution. On the other hand, a relatively small proportion of township/village respondents on each lake reported problems with toxic pollutions.

### **Toxic Pollution: Assessments by "Areas of Concern"**

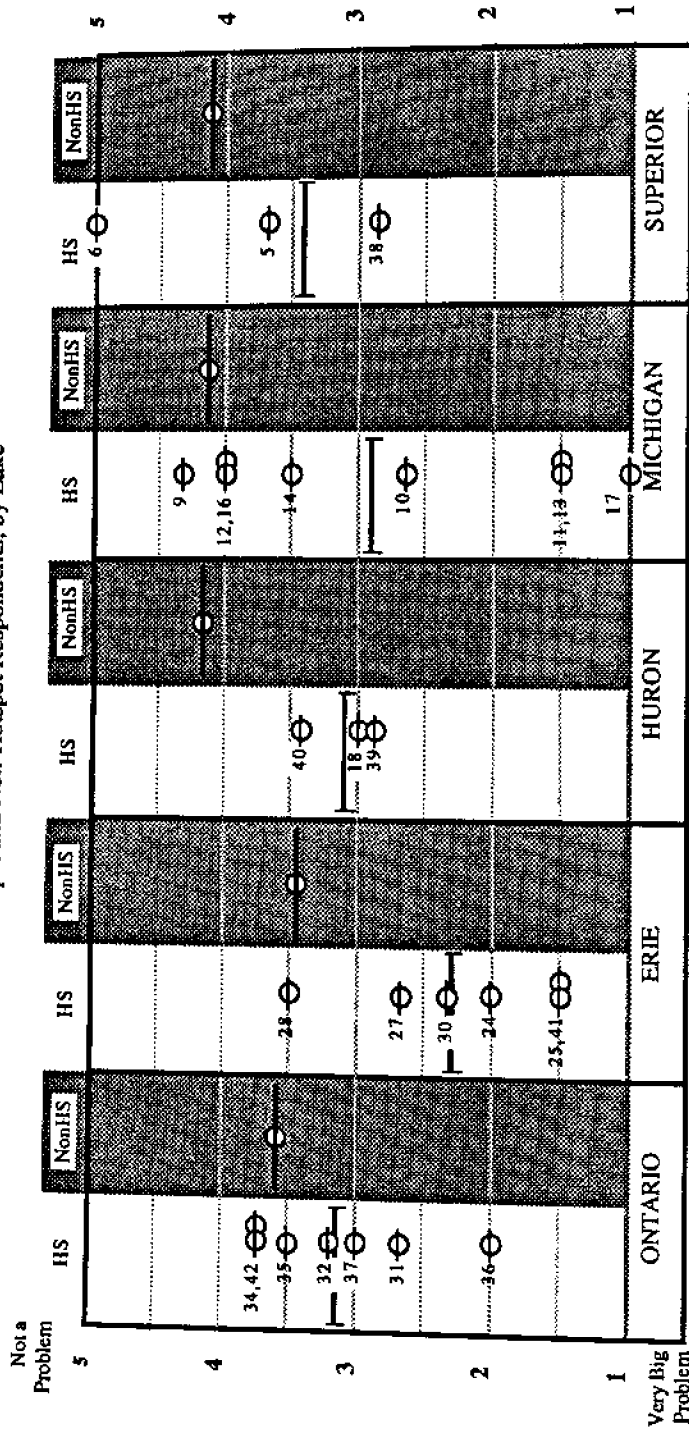
As mentioned in the previous chapter, 42 "areas of concern" or "hotspots" in the Great Lakes were identified by the International Joint Commission (IJC) in 1987. Analysis of water quality assessments relative to those hotspots showed a reasonably high degree of correspondence between the views of survey respondents and the official IJC designations. In a similar manner, respondent ratings of the toxic pollution problem were examined for hotspot and non-hotspot locations.

As shown in Figure 4-2, respondents associated with hotspots on each lake were more likely to report problems with toxic pollution than respondents at non-hotspot locations on the same lake. Major discrepancies can be noted in the figure, however. For instance, respondents associated with hotspot number 6 on Lake Superior did not view toxic pollution as a problem in their inshore waters. Similarly, several hotspot respondents along the Lake Michigan and Lake Ontario shorelines weren't very concerned about the toxic pollution problem. Also, respondents associated with the Bay of Quinte hotspot on Lake Ontario and the St. Lawrence River hotspot reported toxic pollutants as less problematic than non-hotspot respondents on Lake Ontario and on the St. Lawrence River. Similarly, respondents associated with the Menominee River hotspot on Lake Michigan were not likely to view toxic pollutants as a problem. Finally, Lake Erie respondents near the Ashtabula River hotspot were comparable in their views of the toxic pollutants problem to the non-hotspot respondents elsewhere on Lake Erie. Nonetheless, most of the respondents associated with areas designated as hotspots by the IJC were sensitive to the problem of toxics in their inshore waters.

### **Location of Toxic Pollutants**

Respondents who said toxic pollutants were problematic within their jurisdiction were asked about the location of the pollutants. (Respondents who said toxic pollution was not a problem (1 or 2 on the 5-point scale) were asked to skip the next questions dealing with toxic locations and sources.) As shown in Figure 4-3, nearly one in three respondents (29%) for all lakes reported that toxic pollutants are located in the sediments and in fish,

Figure 4-2  
Average Toxic Pollutants Problem Ratings of  
Hotspot and Non-Hotspot Respondents, by Lake



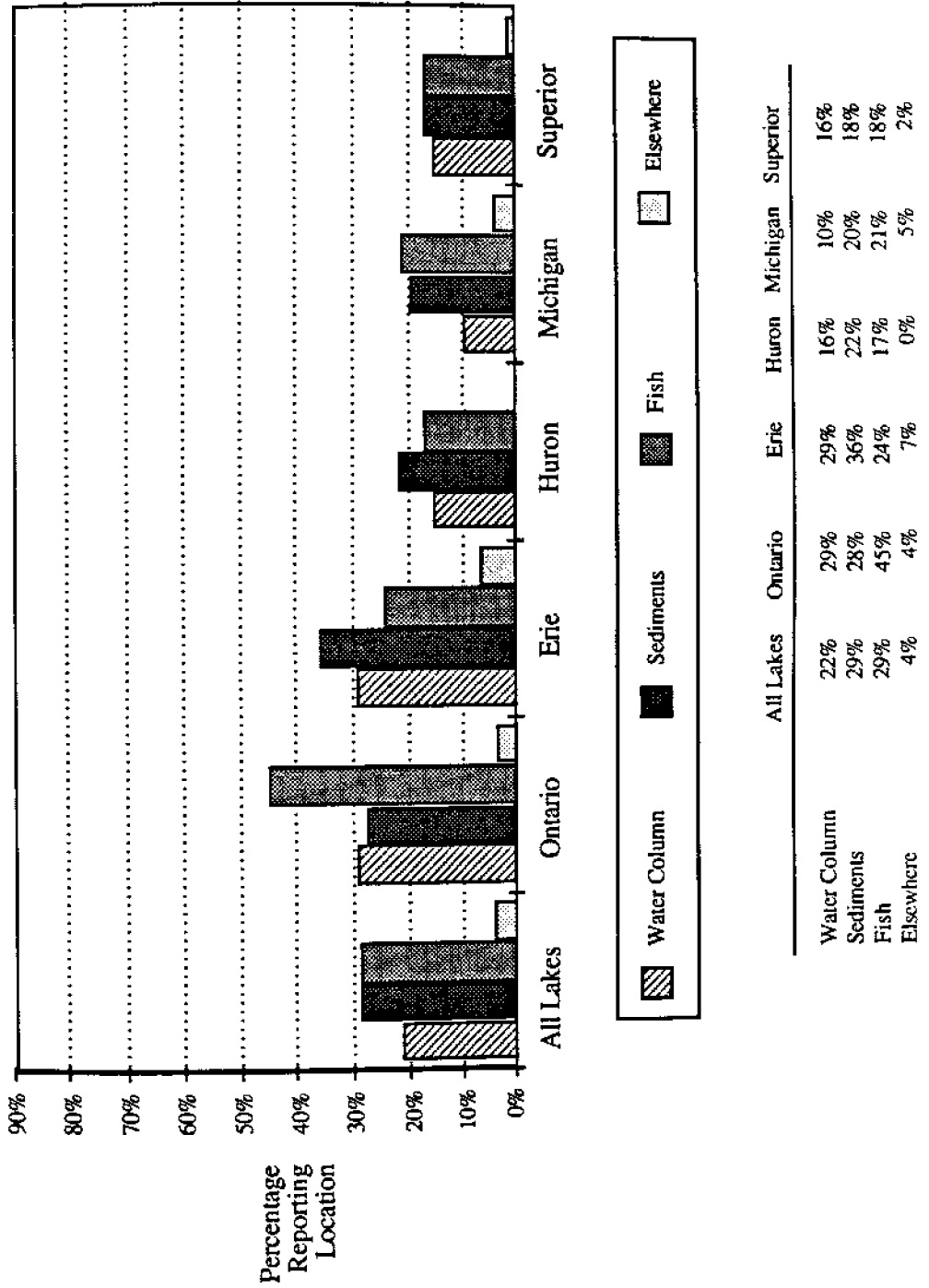
Water Quality Average Ratings of  
Hotspot and Non-Hotspot Respondents by Lake

Lake	Hotspot	Non-Hotspot
Ontario	2.5	2.9
Erie	2.3	2.7
Huron	2.8	3.0
Michigan	2.7	3.1
Superior	2.9	3.3

Toxic Pollutant Problem Average Ratings of  
Hotspot and Non-Hotspot Respondents by Lake

Lake	Hotspot	Non-Hotspot
Ontario	3.2	3.6
Erie	2.3	3.4
Huron	3.1	4.2
Michigan	2.9	4.2
Superior	3.4	4.1

Figure 4-3  
Location of Toxic Pollutants, by Lake - 1986





while one in five (21.5%) said the toxics are in the water column itself. Less than one in twenty (4%) said the toxic pollutants are located elsewhere (e.g., algae, drinking water, and the ecosystem generally).

Differences in the location of toxic pollutants among respondents associated with each lake are also shown in Figure 4-3. For example, 45% of the Lake Ontario respondents indicated that the toxics are in the fish compared to less than one in five respondents from Lakes Huron and Superior. At the same time, more than a third (36%) of Lake Erie respondents said the toxic pollutants are located in the sediments. It should be noted that the bio-accumulation of toxics in certain fish species in the Great Lakes has been identified as posing the highest risk to humans.

### **Sources of Toxic Pollutants**

A significant proportion of respondents identified multiple sources of toxic pollutants. These were: point sources (52.7%), non-point sources (36.0%), and airborne sources (23.0%). Other sources (e.g., toxic waste dumps, sediments, and undetermined sources) were also seen as contributing to toxic pollution, although to a lesser degree. U.S. and Canadian respondents were not significantly different in their perceptions of airborne sources of toxic pollution. However, more than 70% (26) of the Canadians considered point sources as the major source for their lakes while less than half (48.7%) of the American respondents said point sources were most significant in contributing to toxic pollution in their Great Lakes. The relative importance of the toxic pollutants sources in each of the Great Lakes is shown in Table 4-5.

When the respondents were grouped according to their state or province, those from Minnesota had the highest percentage reporting airborne sources of toxic pollutants (57.1%). Research in the Great Lakes region on airborne sources of toxic pollutants has been undertaken at the University of Minnesota in recent years and in all likelihood, the dissemination of that research has contributed to the increased sensitivity of respondents from the state.

With the exception of Minnesota and Pennsylvania, all states/provinces reported point sources as the major contributors to toxic pollutants. Non-point sources are seen as the major contributor among Wisconsin, Quebec, Ohio, New York, and Ontario respondents.

Groundwater was not seen as a major toxic pollution source by most respondents although it was considered a minor source in some localities. Other sources (e.g., toxic waste dumps, sediments, and various undetermined sources) were reported by Quebec, Ontario, and Michigan respondents.

### **Impacts of Toxic Pollutants**

All respondents in the survey who reported problems with toxic pollution in their jurisdiction indicated that the pollutants adversely affect commercial fishing, sport fishing, recreation, drinking water, tourism, and other water uses to varying degrees. As seen in

Table 4-6, the impact of toxic pollutants on sports fishing is greatest for Lake Ontario (48.1%) and Lake Michigan (40.5%) while their impact on commercial fishing is most likely to be reported by Lake Ontario respondents (38.1%).

Table 4-5  
Sources of Toxic Pollutants, by Lake  
(Proportion of Respondents Reporting Major Source and Not a Source)

Sources	Ontario	Erie	Huron	Michigan	Superior	All Lakes
<b>Airborne</b>						
Major Source	25.0(5)	12.5(5)	15.0(3)	17.0(9)	27.3(6)	23.1(28)
Not a Source	25.0(5)	32.5(13)	30.0(6)	34.0(18)	40.9(9)	31.9(51)
<b>Point Sources</b>						
Major Source	66.7(16)	47.4(18)	66.7(14)	43.6(24)	27.8(5)	52.9(77)
Not a Source	20.8(5)	18.4(7)	14.3(3)	18.2(10)	33.3(6)	17.1(31)
<b>Non-Point Sources</b>						
Major Source	47.8(11)	28.6(10)	23.5(4)	37.3(19)	12.5(2)	36.6(46)
Not a Source	13.0(3)	20.0(7)	41.2(7)	23.5(12)	50.0(8)	23.4(37)
<b>Groundwater</b>						
Major Source	19.0(4)	17.1(7)	11.1(2)	15.7(8)	5.9(1)	14.8(22)
Not a Source	28.6(6)	39.0(16)	50.0(9)	37.3(19)	76.5(13)	41.5(63)
<b>Other</b>						
Major Source	-	66.7(2)	50.0(2)	25.0(2)	-	36.4(6)
Not a Source	100.0(1)	-	25.0(1)	50.0(4)	100.0(4)	45.5(10)

According to most respondents, toxic pollutants did not have a significant impact on recreation, drinking water, and tourism in the Great Lakes system. About half said pollutants were not a problem for these water uses and one in four said they were a big or very big problem. The perceptions are in line with the relative risks that have been calculated for the toxic contaminants in Great Lakes fish and in the waters of the Niagara River.

Although there is no significant difference between the respondents from the U.S. and Canada as to the impact of toxic pollution on water use activities, differences exist when respondents are grouped according to their state/province (See Table 4-7). The following summarizes the relative importance of toxic pollution on each of the identified impacts among state/province respondents.

Table 4-6  
Impacts of Toxic Pollutants  
(Proportion of Respondents Reporting No and Big-Very Big Problem)

Impact	Ontario	Erie	Huron	Michigan	Superior	All Lakes
Commercial Fishing						
No Problem	47.6(10)	52.5(21)	56.5(13)	45.5(25)	50.0(12)	44.0(81)
Big-Very Big	38.1(8)	20.0(8)	21.7(5)	27.3(15)	12.5(3)	29.9(39)
Sport Fishing						
No Problem	18.5(5)	44.5(20)	62.9(17)	30.6(19)	64.0(16)	37.4(77)
Big-Very Big	48.1(13)	28.9(13)	11.1(3)	40.3(25)	12.0(3)	35.0(57)
Recreation						
No Problem	44.4(12)	36.4(16)	59.2(16)	50.0(30)	56.5(13)	47.9(87)
Big-Very Big	29.6(8)	27.3(12)	18.5(5)	28.3(17)	13.0(3)	25.8(45)
Drinking Water						
No Problem	40.0(10)	51.1(24)	57.7(15)	56.7(34)	52.0(13)	49.3(96)
Big-Very Big	20.0(5)	25.6(12)	19.2(5)	26.6(16)	28.0(7)	26.1(45)
Tourism						
No Problem	54.1(13)	45.2(19)	59.2(16)	53.3(32)	65.2(15)	52.1(95)
Big-Very Big	37.5(9)	31.0(13)	14.8(4)	30.0(18)	8.7(2)	26.3(46)

Table 4-7  
Impacts of Toxic Pollutants, by State/Province  
(Proportion of Respondents Reporting No and Big-Very Big Problem)

Impact	IL	IN	MI	MN	NY	OH	ONT	QUE	PA	WI	All States/Provinces
Commercial Fishing											
No Problem*	33.3 (3)	28.6 (2)	46.5 (33)	42.9 (3)	48.1 (13)	66.6 (10)	55.5 (15)	- (0)	20.0 (1)	21.1 (4)	44.0 (84)
Big-Very Big*	33.3 (3)	14.3 (1)	31.0 (22)	14.3 (1)	37.0 (10)	13.3 (2)	22.2 (6)	50.0 (2)	20.0 (1)	47.4 (9)	29.8 (57)
Sport Fishing											
No Problem	20.0 (2)	25.0 (2)	48.7 (37)	57.2 (4)	29.1 (9)	42.8 (9)	42.0 (13)	- (0)	- (0)	20.9 (5)	37.4 (80)
Big-Very Big	50.0 (5)	25.0 (2)	27.7 (21)	14.3 (1)	51.7 (16)	19.1 (4)	29.0 (9)	50.0 (2)	60.0 (3)	54.2 (13)	35.0 (76)
Recreation											
No Problem	60.0 (6)	50.0 (4)	56.0 (42)	83.4 (5)	51.6 (16)	31.8 (7)	43.3 (13)	40.0 (2)	20.0 (1)	28.5 (6)	47.9 (102)
Big-Very Big	- (0)	25.0 (2)	21.3 (16)	- (0)	19.4 (6)	40.9 (9)	30.0 (9)	40.0 (2)	60.0 (3)	38.1 (8)	25.8 (55)
Drinking Water											
No Problem	60.0 (6)	75.0 (6)	48.7 (37)	42.9 (3)	53.3 (16)	40.9 (9)	40.0 (12)	33.3 (2)	50.0 (2)	59.1 (13)	49.3 (106)
Big-Very Big	10.0 (1)	12.5 (1)	27.7 (21)	14.3 (1)	23.3 (7)	31.8 (7)	30.0 (9)	33.3 (2)	25.0 (1)	27.2 (6)	26.1 (56)
Tourism											
No Problem	70.0 (7)	71.5 (5)	50.7 (38)	83.4 (5)	44.8 (13)	35.0 (7)	60.0 (18)	50.0 (3)	75.0 (3)	45.4 (10)	52.1 (109)
Big-Very Big	10.0 (1)	28.6 (2)	24.0 (18)	16.7 (1)	27.6 (8)	45.0 (9)	23.3 (7)	16.7 (1)	25.0 (1)	31.8 (7)	26.3 (55)

\* "No Problem" covers respondents who marked a "1" or "2" on the 5-point scale.  
 "Big-Very Big" problem covers respondents who marked a "4" or "5" on the 5-point scale.  
 Numbers in parentheses are the actual number of people responding to the item in the respective categories.

**Commercial Fishing:** The State of Wisconsin and Province of Quebec have a higher percentage of respondents (47.4% and 50%, respectively) who thought toxic pollutants are causing "big" or "very big" problems to commercial fishing. Among the respondents from Illinois, Michigan, New York, Pennsylvania, and Indiana, the impact of toxic pollution on commercial fishing varied greatly ranging from "no problem at all" to "very big problem". This result may further illustrate the site-specific nature of toxic pollution. Higher percentages of respondents from Ohio and Minnesota as well as from Ontario reported that toxic pollutants are not causing problems to commercial fishing.

**Sport Fishing:** Pennsylvania (60.0%), Wisconsin (54.2%), New York (51.7%), Illinois (50.0%), and Quebec (50.0%) ranked at the top for respondents who reported a "big" or "very big" problem with toxic pollution for sport fishing. In contrast, a significant number of respondents from the other states/provinces associated with the Great Lakes (Indiana, Michigan, Minnesota, Ohio, and Ontario) said that toxic pollution does not impact on sport fishing.

**Recreation:** Pennsylvania (60.0%), Ohio (40.9%), and Quebec (40%) respondents reported the highest percentages ranking toxic pollutants as a "big" or "very big" problem for recreational activities. The two states are located along Lake Erie and the province is at the outlet of the Great Lakes into the St. Lawrence River. As shown in Figure 3-1, there are eleven (11) hotspots located along Lake Erie. An additional eight (8) hotspots are located along Lake Ontario and the St. Lawrence River itself is identified as a hotspot.

**Drinking Water:** No state or province had a majority of its respondents rating toxic pollutants as a "big" or "very big" problem in their area of jurisdiction. This outcome is in accord with findings of scientists who have assessed the risks of toxic pollutants in the waters of the Niagara River and Lake Ontario. These studies concluded that the risk to human health from drinking these waters is very slight. The risk from eating Great Lakes fish contaminated with toxic pollutants is significantly greater.<sup>1</sup>

**Tourism:** Respondents from Ohio (45.0%) reported toxic pollutants are a "big" or "very big" problem with respect to tourism in their area. This result corresponds to the perceived adverse impact of toxic pollutants on recreation in the state. It may be that these two sets of results reflect a general problem with people outside the immediate area are choosing to recreate elsewhere as a consequence of their concern about toxic contamination in Lake Erie.

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<sup>1</sup> Bro, Kenneth M., Sonzogni, William, & Hanson, Mark E.; "Relative Cancer Risks of Chemical Contaminants in the Great Lakes." Paper presented at IAGLR Annual Meeting, Ann Arbor, Michigan, May, 1987.

## CHAPTER 5

### RESOURCE DESTRUCTION AND IMPROVEMENT OF WATER QUALITY

This chapter focuses on factors leading to the impairment of water quality and factors which improve water quality. It contains six parts, with the first five presenting comparative data from the 1971 and 1986 surveys and the sixth covering only 1986 data. In the first part, the relative importance of factors leading to the destruction of natural resources including the impairment of water quality is discussed. In the second part, rankings of potential solutions for improving the inshore water quality are examined. The third part categorizes various public, private, and non-governmental organizations (NGOs) according to their perceived effectiveness in maintaining/improving inshore water quality. In the fourth part, responsibilities of the responding agencies with regard to specific actions to improve water quality and protect shorelines are discussed. The fifth part reports on the respondents' assessments of the effectiveness of different levels of government in their efforts to improve water quality. Finally, the perceived effectiveness of the 1972 and the 1978 Great Lakes Water Quality Agreement between Canada and the United States is examined in the last part of the chapter.

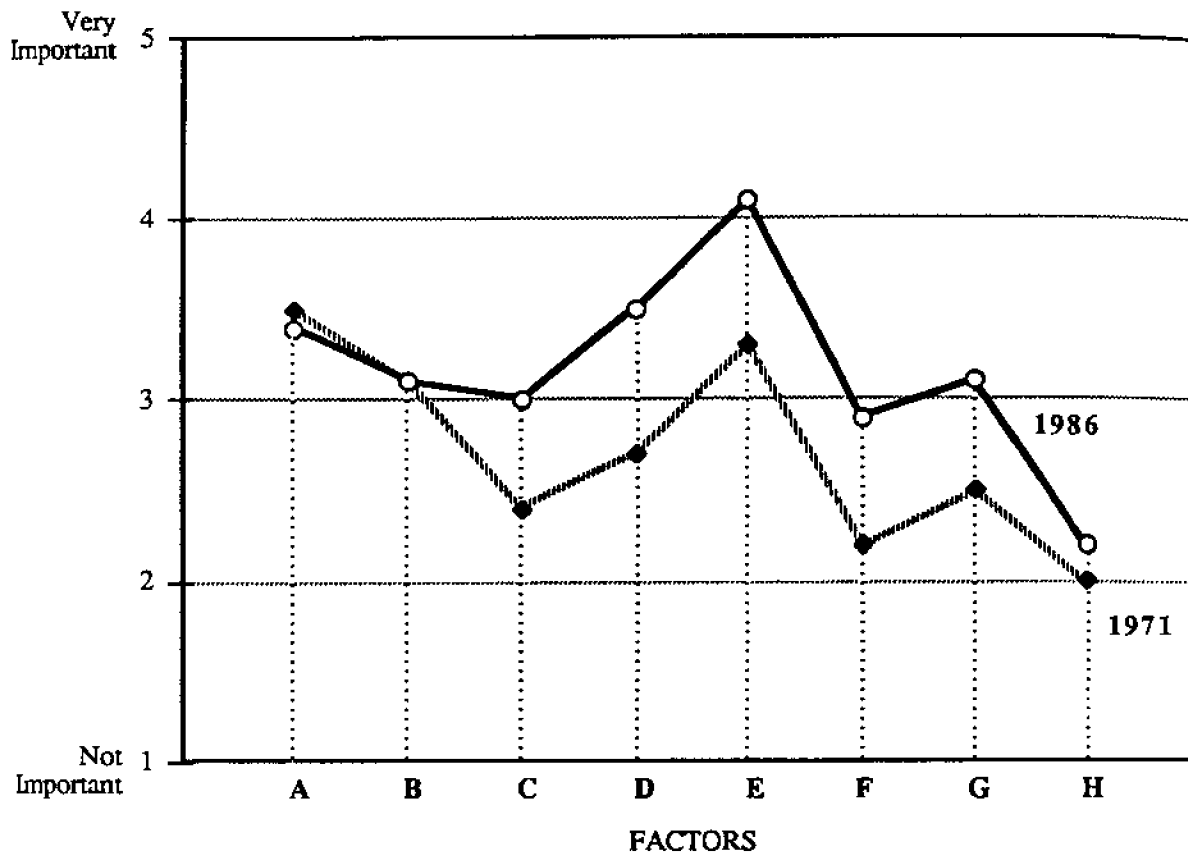
For each part, the results cover the overall response to the issue under consideration. Where appropriate, additional information covering differences in responses by country, by state/province, or by lake are presented.

#### **Resource Destruction/Water Quality Impairment**

Eight factors related to the destruction of resources and the deterioration and impairment of water quality were presented to the respondents who were asked to indicate the importance of each within their jurisdictions. The eight factors were: (1) water pollution due to inadequate municipal sewage facilities; (2) water pollution due to inadequate industrial sewage facilities; (3) water pollution due to agricultural runoff; (4) pollution of both land and water due to disposal of solid waste materials; (5) beach and slope erosion; (6) sedimentation due to poor land use practices; (7) altering of shoreline by filling or dredging; and (8) thermal pollution. Responses ranged from 1 to 5 with 1 being "not important" and 5 being "very important." The analysis considers mean scores for each factor so that comparisons of their relative importance in 1971 and 1986 can be made.

Figure 5-1 summarizes the overall ratings by presenting a profile of mean scores for each factor for 1971 and 1986. The figure shows that five of the eight factors contributing to the destruction of resources significantly increased between 1971 and 1986. The five factors were water pollution from agricultural runoff; pollution of both land and water through disposal of solid waste; beach and slope erosion; sedimentation due to poor land use practices; and alteration of the shoreline by filling and dredging.

Figure 5-1  
 Changes in Importance of Factors Causing the Destruction of Resources - 1971 and 1986  
 (Mean Rating)



- A: Water Pollution - Inadequate Municipal Sewage Facilities
- B: Water Pollution - Inadequate Industrial Sewage Facilities
- C: Water Pollution - Agricultural Runoff
- D: Pollution of Both Land and Water - Disposal of Solid Waste
- E: Beach and Slope Erosion
- F: Sedimentation - Poor Land Use Practices
- G: Alteration of Shoreline by Filling or Dredging
- H: Threat of Thermal Pollution

	A	B	C	D	E	F	G	H
1971	3.5	3.1	2.4	2.7	3.3	2.2	2.5	2.0
1986	3.4	3.1	3.0	3.5	4.1	2.9	3.1	2.2
changes	-0.1	0	+0.6	+0.8	+0.8	+0.7	+0.6	+0.2

In Table 5-1, further information is given on the relative importance of these factors for U.S. and Canadian respondents in 1971 and 1986. According to both groups of respondents, more factors contributed to the destruction of resources in 1986 than in 1971. Whereas three factors in 1971 had a mean of 3.0 or more on the importance scale, six factors were identified as important by this criterion in 1986. In 1986, the Canadians on average ranked water pollution caused by inadequate industrial sewage facilities higher than

Table 5-1

Change in Importance of Factors Causing Destruction of Resources  
(Overall Mean Scores Greater Than or Equal to 3.0)

Factor	USA	Canada	Overall
1971			
A	3.7(208)	3.0(63)	3.5
E	3.4(213)	3.0(57)	3.3
B	3.1(191)	3.1(52)	3.1
1986			
E	4.3(348)	3.3(59)	4.1
D	3.6(316)	3.4(61)	3.5
A	3.4(306)	3.4(63)	3.4
B	3.1(292)	3.3(59)	3.1
G	3.1(327)	2.9(59)	3.1
C	3.0(320)	3.0(59)	3.0

FACTORS:

- A: Water pollution due to inadequate municipal sewage facilities
- B: Water pollution due to inadequate industrial sewage facilities
- C: Water pollution due to agricultural runoff
- D: Pollution of both land and water due to disposal of solid waste materials
- E: Beach and slope erosion
- F: Sedimentation due to poor land use practices
- G: Alteration of shoreline by filling or dredging
- H: The threat of thermal pollution

U.S. respondents. At the same time, U.S. respondents had the same or a slightly higher mean score on all other factors except one. "Beach and soil erosion" was a much greater problem in the U.S. than in Canada. Not surprisingly, the 1986 record high lake levels in Lakes Michigan, Huron, Superior, and Erie, discussed more fully in the next chapter, contributed to the increased importance of this factor in the U.S. The difference in perceptions between the U.S. and Canadian respondents in this factor reflects the fact that many of the latter group are located on Lake Ontario where the lake level is fully regulated.

There is also an increase over the 15-year period in the importance of proper disposal of solid waste materials due to the failure of landfills at toxic waste sites

throughout the Great Lakes Basin. This point is especially important where failures have occurred, such as along the Niagara River. The importance of municipal and industrial waste control facilities is widely shared throughout the Great Lakes Basin.

Alteration of shorelines by filling and dredging has also become more important since 1971 and reflects a general concern among government officials about development pressures on coastal wetlands. Finally, the greater importance of agricultural runoff as a pollution source reflects the recognition that, as point source pollution problems are corrected, nonpoint sources of pollution (including agricultural runoff) become more critical to the quality of surface water.

### **Relative Importance: Perceptions by States/Provinces**

The ranking of importance of the eight factors contributing to resource destruction as reported by respondents from different states/provinces is shown in Table 5-2. In this table, ranking of importance is displayed by the number of states where more than half of the respondents marked a 4 or 5 ("important" or "very important") for each factor.

The table reveals that water pollution from municipal sewage facilities (Factor A) was important in seven states in 1971 and is still important in 1986 when eight states/provinces have more than half of their respondents marking this factor a "4" or "5." Industrial sewage facilities are important as sources of pollution but differences in the locations are seen over the 15-year period. The two Canadian provinces weren't concerned in 1971 but viewed this problem as significant in 1986. At the same time, representatives of four states which ranked industrial sewage facilities as a significant problem in 1971 did not do so in 1986. Presumably this change reflects the effective implementation of the industrial treatment requirements of the federal Clean Water Act of 1972.

Respondents from five states/provinces indicated that pollution from agricultural runoff was of significant importance in 1986, whereas none did so in 1971. Furthermore, the importance of water pollution from solid waste disposal was an issue in only one state in 1971 but, by 1986, eight states viewed the condition as significantly important. Beach and slope erosion was a significant problem in every state or province except Quebec in 1986--in 1971, only five states viewed it as a significant problem. Overall, the total number of states/provinces viewing the eight factors as significantly important increased from 25 in 1971 to 36 in 1986.

### **Relative Importance: Perceptions by Lakes**

In Figure 5-2, the mean scores covering 1971 and 1986 responses are shown for each lake on factors contributing to resource destruction. The relative importance of water pollution as a consequence of inadequate municipal sewage facilities (Factor A) decreased slightly between 1971 and 1986 according to respondents along the Lake Ontario and Lake Michigan shorelines. In contrast, the relative importance of Factor C (water pollution due to agricultural runoff) and Factor D (pollution of land and water due to disposal of solid waste materials) increased for all lakes over the 15-year period. The most dramatic change



occurred for Factor E (beach and slope erosion) where its importance among respondents from each lake except Lake Ontario dramatically increased.

Table 5-2

Number and Identity of Great Lakes States/Provinces  
Identifying the Factors as Significant\*

Factor	1971	1986
A	IN, IL, MN, NY, MI, WI, OH (7)	OH, PA, MN, WI, NY, ON, IN, QU (8)
B	IN, IL, NY, PA, OH, MN (6)	OH, ON, MN, QU (4)
C	-- (-)	QU, WI, PA, MN, IN (5)
D	IN (1)	MN, IN, WI, OH, IL, NY, MI, PA (8)
E	IN, PA, OH, MI, MN (5)	All except QU (9)
F	MN, IL (2)	MN, QU (2)
G	OH, IL, MN (3)	OH, IN (2)
H	IL (1)	IN (1)

FACTORS:

- A: Water pollution due to inadequate municipal sewage facilities
- B: Water pollution due to inadequate industrial sewage facilities
- C: Water pollution due to agricultural runoff
- D: Pollution of both land and water due to disposal of solid waste materials
- E: Beach and slope erosion
- F: Sedimentation due to poor land use practices
- G: Alteration of shoreline by filling or dredging
- H: The threat of thermal pollution

\*Note: To be designated as a significant factor in a specific state/province, more than 50% of the respondents from that state/province ranked the factor as "important" or "very important".

Figure 5-2  
 Changes in Importance of Factors Causing the Destruction of Resources, by Lake - 1971 and 1986  
 (Mean Rating)

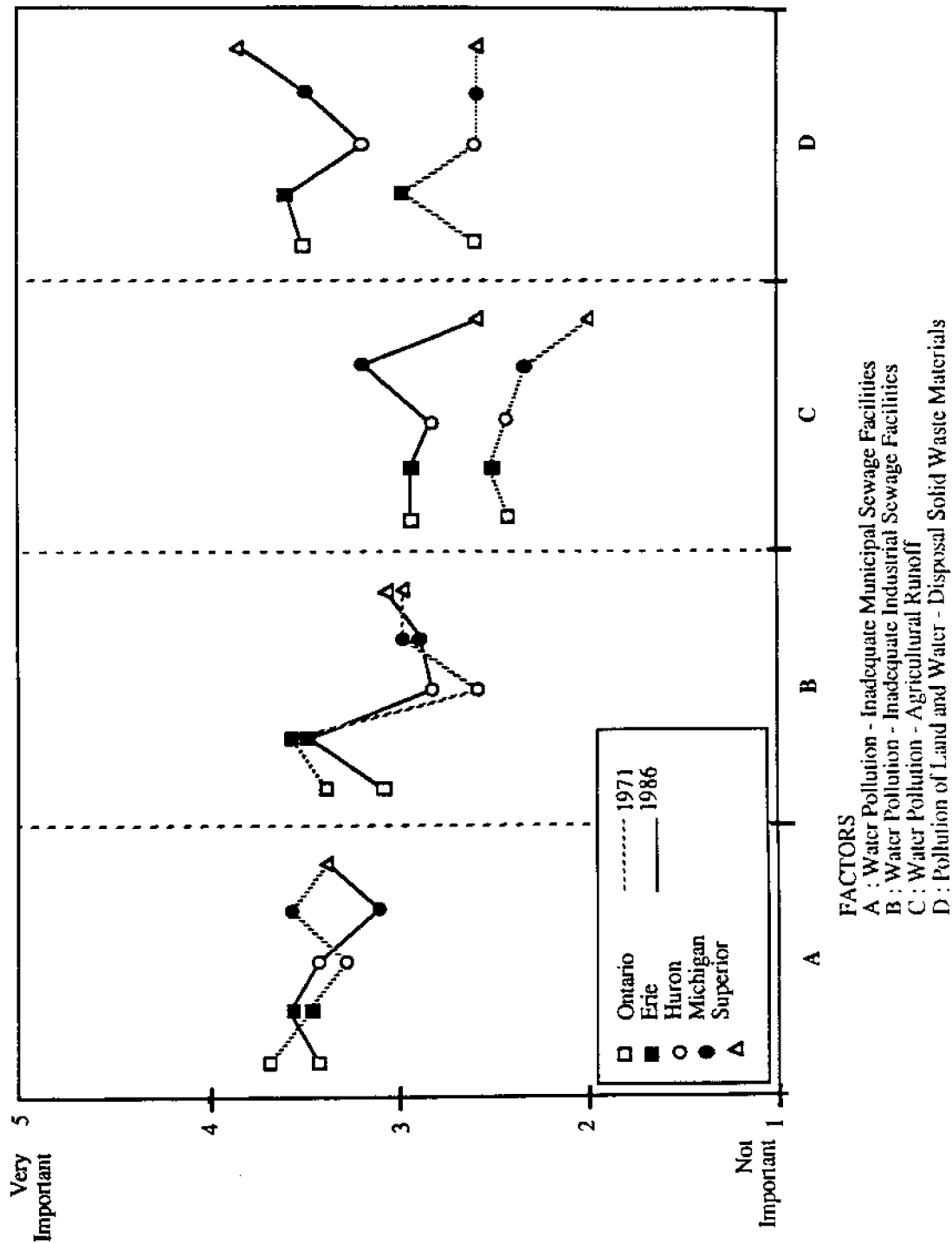


Figure 5-2 (Continued)  
 Changes in Importance of Factors Causing the Destruction of Resources, by Lake - 1971 and 1986 (E-H)  
 (Mean Rating)

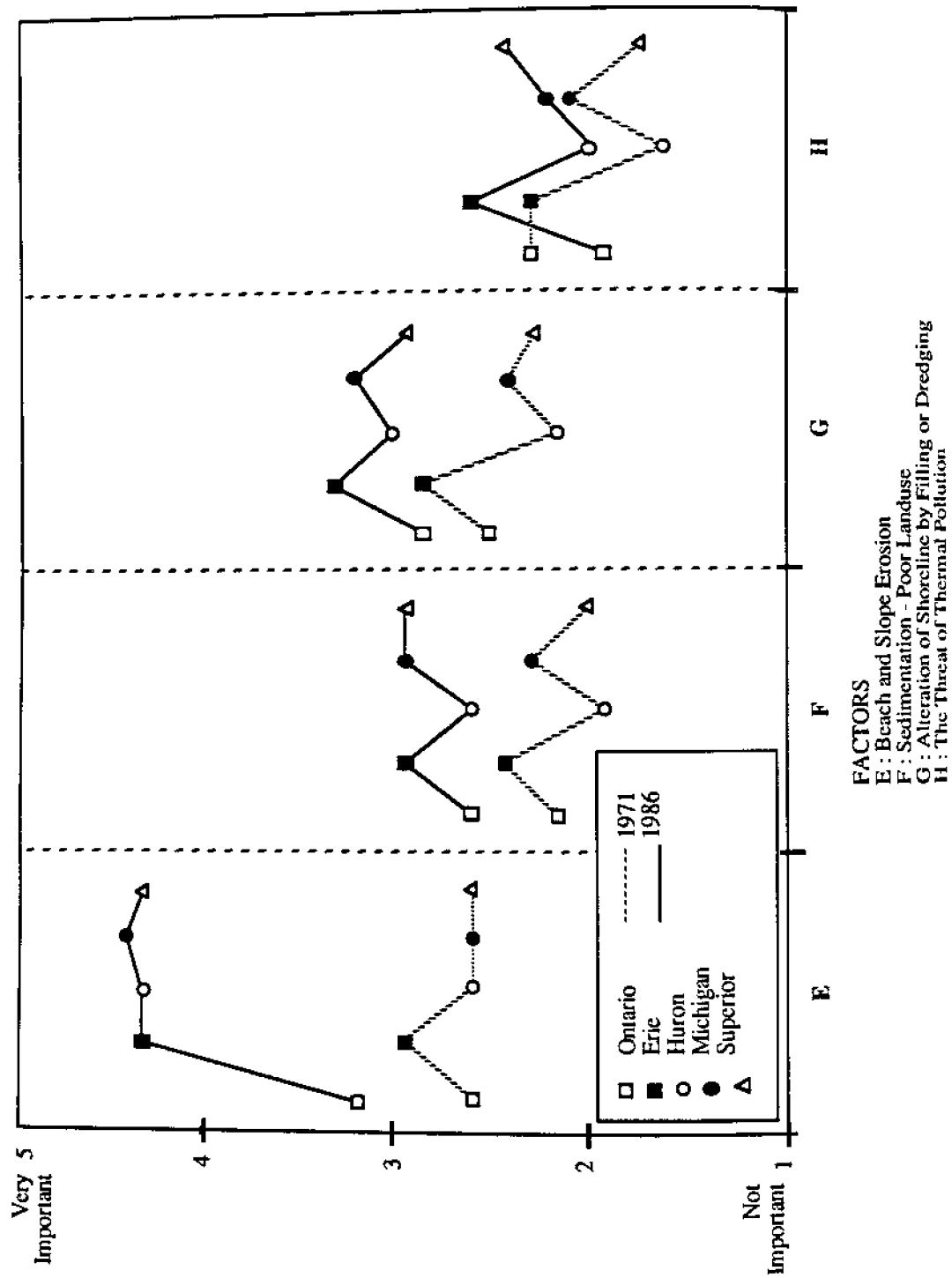


Table 5-3 also displays information on the importance of each factor in contributing to resource destruction in 1971 and 1986, organized by lake. The criteria for a factor to be noted for a particular lake is that more than half of the lake respondents rated the factor as either "important" or "very important." The table shows that the relative importance of both municipal and industrial waste facilities decreased slightly between 1971 and 1986, which no doubt reflects major investments made in these facilities over the 15-year period. During the same period, solid waste disposal became more important in all of the lakes except Lake Huron. Finally, as mentioned earlier, beach and slope erosion was considered a significant problem in 1986 for all lakes except Lake Ontario.

Table 5-3

Respondents Identifying Factors as Significant, by Lake\*

Factor	1971	1986
A	All five Great Lakes	Erie, Ontario, Huron
B	Ontario, Erie	Erie
C	--	--
D	--	Superior, Michigan, Erie, Ontario
E	Michigan, Superior	Michigan, Huron, Superior, Erie
F	--	--
G	--	--
H	--	--

FACTORS:

- A: Water pollution due to inadequate municipal sewage facilities
- B: Water pollution due to inadequate industrial sewage facilities
- C: Water pollution due to agricultural runoff
- D: Pollution of both land and water due to disposal of solid waste materials
- E: Beach and slope erosion
- F: Sedimentation due to poor land use practices
- G: Alteration of shoreline by filling or dredging
- H: The threat of thermal pollution

\*Note: To be significant more than 50% of the respondents from the lake need to score the factor as "important" or "very important".

## Improving Inshore Waters

In order to tap the thoughts of agency representatives about possible ways of improving water quality in their area, both 1971 and 1986 respondents were presented a list of actions that might be taken and asked, "How important is each of the following possible solutions to the problem of deteriorating water quality in your jurisdiction?" The actions or solutions offered were increased funding for expanding treatment plants, increased leadership from public officers, creation of new agencies, new initiatives or redistribution of responsibility, increased coordination across agencies, and stricter enforcement of current regulations. Table 5-4 summarizes the 1971 and 1986 responses to each solution among U.S. and Canadian respondents. It is apparent that there is agreement in both countries that the creation of a new agency and the redistribution of responsibility among existing agencies are the least effective means of improving inshore water quality.

Table 5-4

Ratings for Different Solutions For Solving Water Quality Problem, by Country  
(Percentage Distribution of Respondents Rating the Solution as  
"Important" or "Very Important")\*

Solutions		USA % n	Canada % n	Overall % n
<b>Fund for Waste Water Treatment Plants</b>				
	1971	74.0 (186)	51.0 (56)	68.7 (242)
	1986	58.0 (175)	59.0 (39)	58.4 (214)
<b>Stricter Enforcement</b>				
	1971	69.0 (187)	67.0 (54)	68.5 (241)
	1986	56.0 (178)	72.0 (39)	58.8 (217)
<b>New Regulations</b>				
	1971	55.0 (172)	59.0 (53)	56.0 (225)
	1986	50.0 (174)	68.0 (40)	53.4 (214)
<b>Redistribution of Responsibility</b>				
	1971	38.0 (139)	27.0 (37)	35.7 (176)
	1986	31.0 (166)	24.0 (38)	29.7 (204)
<b>Creation of New Agency</b>				
	1971	18.0 (134)	33.0 (36)	21.2 (170)
	1986	21.0 (166)	9.0 (35)	19.0 (201)
<b>Increased Leadership</b>				
	1971	58.0 (164)	58.0 (45)	58.0 (209)
	1986	58.0 (173)	44.0 (38)	55.5 (211)
<b>Increased Coordination</b>				
	1971	68.6 (178)	63.0 (49)	67.0 (227)
	1986	65.0 (176)	61.0 (38)	64.3 (214)

The response scale ranges from, 1=Not Important, to 5=Very Important

\*Figures represent agencies reporting 4 and 5

Between 1971 and 1986 (See Table 5-4), there was a notable decrease in the proportion of U.S. respondents suggesting that increased funding, stricter enforcement, and new regulations are important solutions. The opposite is true among Canadian responses over the 15-year period. The differences between Canadian and U.S. respondents may be attributable to major federal legislation passed in the U.S. since 1971, particularly the Clean Water Act, which provided funding and regulations to address major water quality problems identified in the 1970s. The change in U.S. responses over the 15-year period demonstrates two points. First, the initiatives of the Clean Water Act were responsive to the needs of state and local governments. Second, having invested significant financial resources, governmental units in the U.S. believe the situation has improved since 1971.

Overall, U.S. respondents believe a framework for addressing water problems is in place. What is needed, however, is increased leadership and coordination. In Canada, there is a general consensus that more funds, stricter enforcement, and new regulations are needed to address the problem of deteriorating water quality in the Great Lakes. The need for increased coordination was supported in both countries in both 1971 and 1986.

### **Perceptions of Group Efforts to Improve Water Quality**

The process of solving water quality problems in the Great Lakes and elsewhere depends in part on the organizational network and the perceived effectiveness of different actors in this network. Accordingly, the 1971 and 1986 surveys contained a question designed to provide insights into how organizations and groups are viewed with regard to maintaining and enhancing inshore water quality. The question attempted to gain information along two dimensions of inquiry. First, it asked the respondent to indicate whether each of 12 different groups aided or hindered the improvement and maintenance of inshore water quality. Second, it asked the respondent to indicate the degree of influence each group has within the respondent's area of jurisdiction.

Figures 5-3 and 5-4 show the overall normalized results for 1971 and 1986. These results combine the AID/INFLUENCE ratings of respondents for each group as well as their HINDER/INFLUENCE ratings.

With the normalized results, any score over .50 is considered as more important on either the AID or HINDER axis. Conversely, any score of less than .50 on either the AID or HINDER axis is considered as less important.

In 1971, state/provincial agencies and regulations, conservation groups, professional planners, and federal agencies and regulations were the most important groups aiding the maintenance and enhancement of water quality (See Figure 5-3).

In 1986, state/provincial agencies and regulations, other civic associations, conservation groups, and federal agencies and regulations were the most important groups aiding the maintenance and enhancement of water quality (See Figure 5-4).

Figure 5-3

Perceived Effects of Various Groups on the Maintenance of the Quality of the Inshore Water (1971)

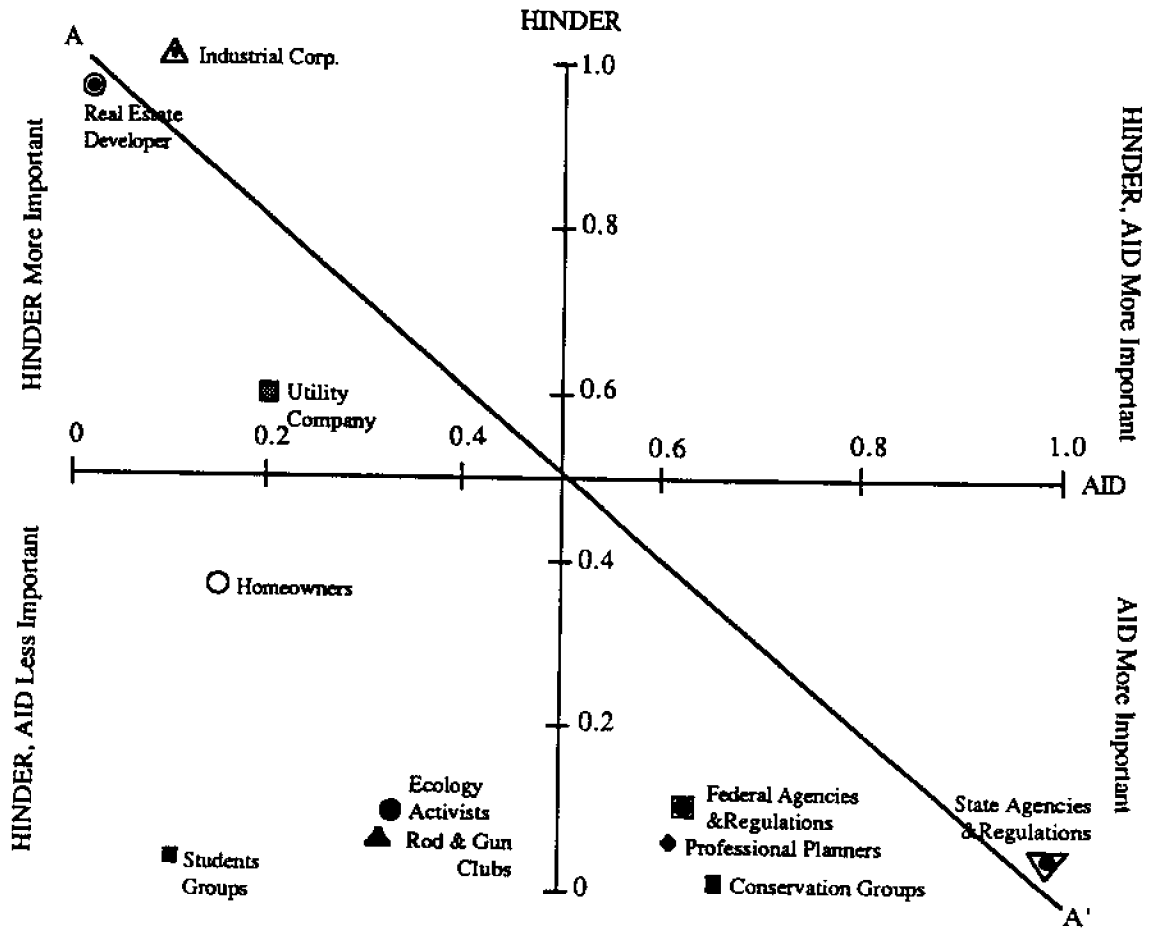
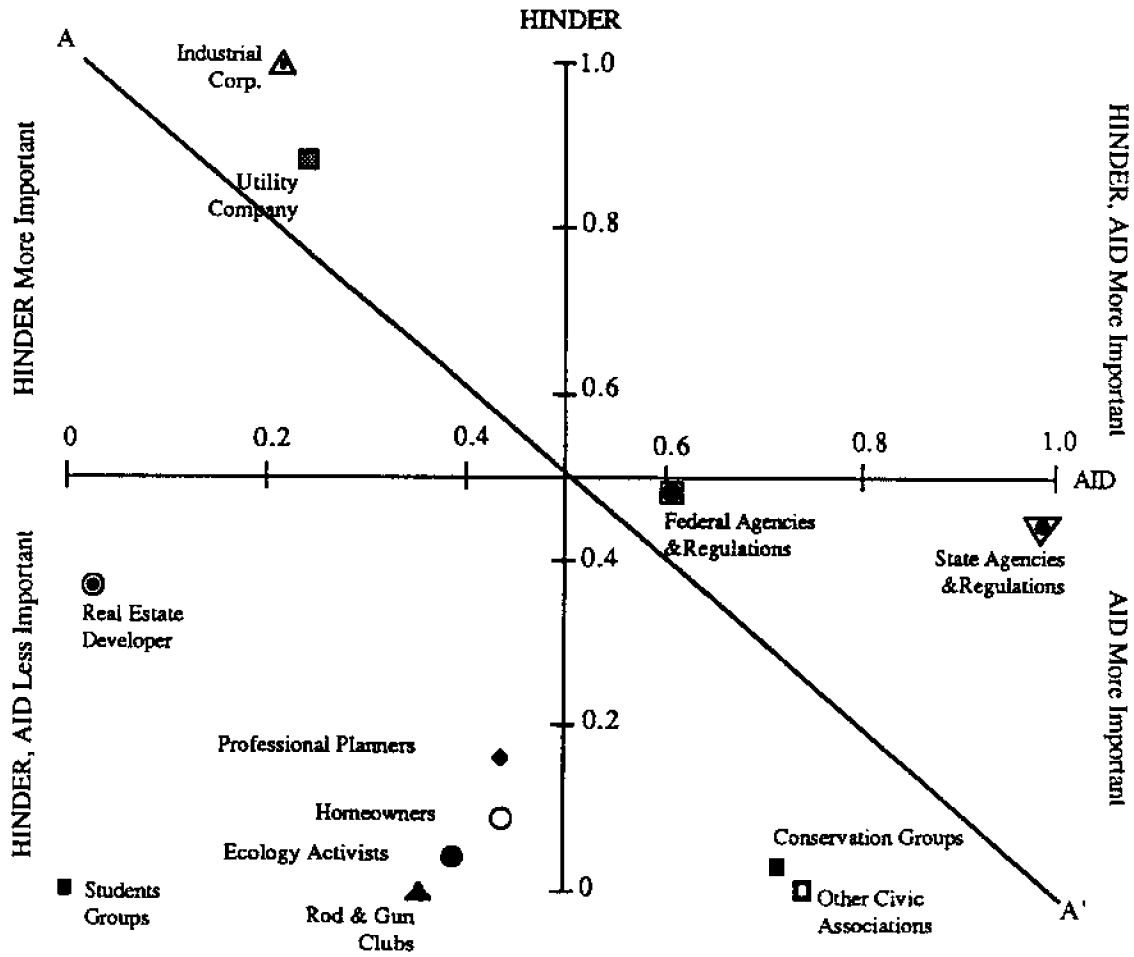


Figure 5-4

Perceived Effects of Various Groups on the Maintenance of the Quality of the Inshore Water (1986)





In 1971, industrial corporations, real estate developers, and utility companies were rated as the most important groups hindering water quality improvement. In 1986, only the industrial corporations and utility companies were perceived as hindering water quality improvement.

A comparison of the two figures indicates that both state/provincial and federal agencies were considered to be a greater impediment to enhanced water quality in 1986. One possible explanation for this change is that, as state/provincial and federal governments have established more rules and regulations, resistance to the bureaucratic requirements has developed. The particular position of the federal agencies may also reflect the cutback of U.S. governmental support for water quality improvements. The 1986 data also show that civic groups have joined with other conservation groups as positive forces in improving and maintaining water quality. This observation underscores the increased importance of non-governmental organizations (NGOs) which serve as watch dogs in keeping established agencies accountable to their prescribed tasks. Furthermore, NGOs also alert the public as to the importance of key issues in the enhancing and maintaining of water quality.

Finally, it is important to note that industry and the utility companies have maintained their clear identity as forces hindering the improvement and maintenance of water quality. In fact, the utility companies have displaced real estate developers as the greatest impediment to improving water quality.

### Perceptions of Agency Responsibilities

In 1971 and 1986, respondents were asked about their agency's responsibility for each of several planning and management activities designed to help protect the quality of their inshore waters and the quality of their Great Lakes shoreline. These activities were: (1) financing sewer construction; (2) financing storm drain construction; (3) industrial pollution control; (4) solid waste disposal; (5) thermal pollution control; (6) boat sewage discharge; (7) erosion control; (8) industrial development; (9) marshland development; (10) cluster development; (11) construction of recreational facilities; (12) zoning; (13) preservation of natural shoreline; (14) land use planning; and (15) regional planning.

The results, covering agencies in the United States responding in 1971 and 1986, are shown in Table 5-5. The table shows a decrease in the level of responsibility for virtually all activities between 1971 and 1986, which reflects a more prominent role for the U.S. government during this period. In the case of land use planning, the responsibilities of respondents in the U.S. decreased only slightly.

Table 5-5

Level of Responsibility of Agencies in the United States for Selected Activities  
to Protect Water Quality and Shorelines in the Great Lakes  
(Mean Score)\*

Activity	1971	1986
Financing Sewer Construction	3.3 (111)	2.7 (340)
Financing Storm Drain Construction	2.8 (58)	2.6 (336)
Industrial Pollution Control	2.6 (65)	2.0 (329)
Solid Waste Disposal	3.1 (75)	2.7 (340)
Thermal Pollution Control	2.0 (36)	1.5 (315)
Boat Sewage Discharge	2.2 (47)	1.7 (333)
Erosion Control	2.7 (64)	2.5 (345)
Industrial Development	3.1 (60)	2.8 (334)
Marshland Development	3.0 (46)	2.1 (322)
Cluster Development	3.3 (47)	2.5 (318)
Construction of Recreational Facilities	3.3 (80)	3.1 (340)
Zoning	3.9 (95)	3.6 (348)
Perservation of Natural Shoreline	3.0 (71)	2.7 (339)
Landuse Planning	3.8 (77)	3.7 (345)
Regional Planning	3.2 (66)	2.5 (335)

\* The response scale ranges from 1= Not Responsible to 5=Very Responsible.  
Numbers in parentheses are the total number of respondents answering the question.

In contrast, the pattern of change in responsibilities among Canadian agencies is mixed (See Table 5-6). For example, the responsibilities for financing construction of sewers and storm drains among Canadians was unchanged, while U.S. agencies had less responsibility for these activities in 1986. Also, U.S. responsibilities for industrial development diminished somewhat while Canadian responsibilities for this activity grew.

### Perceptions of Agency Effectiveness

Respondents were also asked to indicate how effective agencies representing the federal, state/provincial, regional, and local governmental units have been in protecting the water quality in their jurisdiction. Effectiveness was rated on a 5 point scale with 5 being "very effective" and 1 being "not effective."

As seen in Table 5-7, U.S. respondents, more so than their Canadian counterparts, indicated that the federal agencies were effective (3.0 vs. 2.4). The relatively low Canadian rating of federal effectiveness reflects a reduced role played by the federal government of Canada in current Great Lakes policy. Differences in the perceived effectiveness among the U.S. and Canadian respondents for other levels of government is less pronounced, as shown in Figure 5-5.

Table 5-6

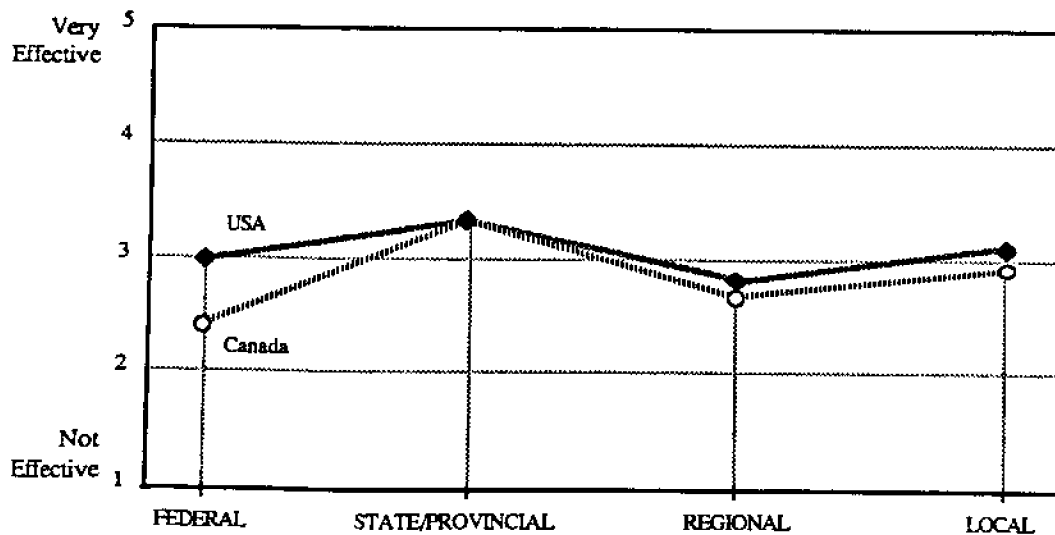
Level of Responsibility of Agencies in Canada for Activities to Protect Water Quality and Shorelines in the Great Lakes (Mean Score)\*

Activity	1971	1986
Financing Sewer Construction	3.1 (22)	3.0 (61)
Financing Storm Drain Construction	3.0 (13)	3.0 (61)
Industrial Pollution Control	2.0 (14)	2.2 (58)
Solid Waste Disposal	3.7 (15)	3.0 (58)
Thermal Pollution Control	1.5 (4)	1.3 (58)
Boat Sewage Discharge	1.8 (6)	1.7 (60)
Erosion Control	2.5 (13)	2.4 (60)
Industrial Development	2.9 (14)	3.1 (57)
Marshland Development	3.6 (10)	2.2 (56)
Cluster Development	3.7 (12)	2.4 (49)
Construction of Recreational Facilities	3.5 (22)	3.0 (60)
Zoning	3.9 (23)	3.8 (60)
Perservation of Natural Shoreline	2.5 (22)	3.0 (60)
Landuse Planning	4.0 (24)	4.0 (60)
Regional Planning	3.5 (18)	2.8 (54)

\* The response scale ranges from 1= Not Responsible to 5=Very Responsible  
Numbers in parentheses are the total number of respondents answering the question.

Figure 5-5

Average Ratings of Effectiveness of Different Levels of Government, by Country (Mean Rating)



It can also be seen that the Canadians ranked the effectiveness of their provincial governments notably higher than their federal government (3.3 vs. 2.4). The Canadian provinces of Ontario and Quebec have primary responsibility for Great Lakes water policy, and therefore, they are considered to be the most effective unit of government. Similarly, the states are generally viewed as being the most effective units for protecting water quality in the U.S.

Table 5-7

Ratings of Effectiveness of Different Levels of Government, by Country  
(Percentage Distribution)

Level		Not Effective (1)	(2)	(3)	(4)	Very Effective (5)	Total (n)	Mean Score
Federal	USA	11.7	16.2	41.6	22.7	7.8	100.0(308)	3.0
	Canada	14.3	34.7	44.9	4.1	2.0	100.0(49)	2.4
	Overall	12.0	18.8	42.0	20.2	7.0	100.0(357)	2.9
State/Provincial	USA	7.3	13.1	36.9	30.2	12.5	100.0(328)	3.3
	Canada	3.4	6.9	44.8	43.1	1.7	100.0(58)	3.3
	Overall	6.7	12.2	38.1	32.1	10.9	100.0(386)	3.3
Regional	USA	20.7	17.8	33.1	20.4	8.0	100.0(275)	2.8
	Canada	23.7	18.4	26.3	26.3	5.3	100.0(38)	2.7
	Overall	21.1	17.9	32.3	21.1	7.7	100.0(313)	2.8
Local	USA	10.9	17.1	34.2	26.3	11.5	100.0(304)	3.1
	Canada	11.1	16.7	44.4	22.2	5.6	100.0(54)	2.9
	Overall	10.9	17.0	35.8	25.7	10.6	100.0(358)	3.1

### Effectiveness of Water Quality Agreements

Perceptions of the effectiveness of the two Water Quality Agreements signed by the Governments of Canada and the United States were also identified as part of the 1986 survey. While the 1972 Water Quality Agreement focused on the reduction of nutrient loadings to the Great Lakes, primarily through control of phosphorus discharges, the 1978 Water Quality Agreement focused on the means of reducing the level of toxics in the Great Lakes.

The effectiveness of the two agreements, as reported by the respondents in both countries, is shown in Table 5-8 and Table 5-9. It should be noted that nearly half of the respondents who returned the questionnaires indicated they didn't know how to respond to the two questions. These high proportions suggest that the two agreements are not well understood or known.

Table 5-8

Effectiveness of 1972 Water Quality Agreement\*  
(Percentage Distribution)

Country	Not at all True (0)	Not very True (1)	Somewhat True (2)	Very True (3)	Total	Mean Score	Number of Respondents	Number of Respondents Who Don't know
US	8.5	19.0	62.4	10.1	100.0	1.7	189	178
Canada	14.3	22.9	57.1	2.9	100.0	1.5	35	31
Overall	9.4	19.6	61.6	8.9	100.0	1.7	224	209

\*The question is : My agency thinks the 1972 Water Quality Agreement Between Canada and the United States has been effective. The responses range from 0=Not at all true to 3=Very true. 'Don't Know' responses were not scored.

Table 5-9

Effectiveness of 1978 Water Quality Agreement\*  
(Percentage Distribution)

Country	Not at all True (0)	Not very True (1)	Somewhat True (2)	Very True (3)	Total	Mean Score	Number of Respondents	Number of Respondents Who Don't know
US	7.3	18.8	64.9	8.9	100.0	1.8	191	176
Canada	11.1	27.8	61.1	-	100.0	1.5	36	30
Overall	7.9	20.0	64.6	7.5	100.0	1.7	228	206

\*The question is : My agency thinks the 1978 Water Quality Agreement Between Canada and the United States has been effective. The responses range from 0=Not at all true to 3=Very true. 'Don't Know' responses were not scored.

The information presented in the two tables indicates that, among those who could respond, the Canadians thought both the 1972 and the 1978 Water Quality Agreements were less effective than the respondents from the United States. The Canadian view that these agreements are relatively ineffective may result from the long history of the failure of the two countries to work out a satisfactory arrangement to reduce acid rain. It can also be noted that no Canadian marked "very true" to the effectiveness question covering the 1978 Water Quality Agreement dealing with toxic pollution. This may result from the adverse impact on Lake Ontario of toxic pollutants entering from the United States via the Niagara River.

**CHAPTER 6**  
**WATER LEVEL FLUCTUATIONS**

In 1986, the water levels in Lake Superior, Lake Michigan, Lake Huron, Lake St. Clair, and Lake Erie reached their highest marks since 1860, when monthly records on lake levels were first recorded and maintained. In the case of Lake Superior, high levels were recorded from January 1986 through August 1986 even though the lake level is regulated at its outlet into the St. Marys River. The levels for the months of September through December 1986 reverted to 1985 record high levels. At the same time, Lakes Michigan, Huron, St. Clair, and Erie established new record high levels for each month during 1986. Only Lake Ontario, whose levels have been fully controlled since the completion of the St. Lawrence Seaway, failed to record all time high levels. However, the 1986 level of Lake Ontario was more than one foot above its long-term average.

**Assessing the Problem of High Water Levels**

As part of the 1986 questionnaire, agency representatives were asked, "How much of a problem are high lake water levels adjacent to your jurisdiction?" The response categories ranged from "not a problem" to "very big problem" on a 5-point scale where 5 represented the most problematic or negative response. As seen in Table 6-1, a significant portion of the respondents in both the United States and Canada indicated that high lake levels are a big problem within their jurisdiction. Overall, the ratings reflect the lake level situation as it existed in 1986; more than four in five respondents (82.5%) marked a "4" or "5." At the same time, less than one in ten (8.7%) responded to the question with either "1" or "2".

Table 6-1  
Ratings of High Lake Water Levels, by Country  
(Percentage Distribution)

Country	High Lake Water Levels					Total (n)	Mean Score
	Not A Problem(1)	(2)	(3)	(4)	Very Big Problem(5)		
USA	3.1	3.1	6.8	16.3	70.7	100.0(355)	4.5
Canada	12.9	9.7	21.0	21.0	35.5	100.0(62)	3.6
Total	4.6	4.1	8.9	17.0	65.5	100.0(417)	4.3

Looking at the responses from each country, 87% of the respondents from the United States answered the question with either "4" or "5". In contrast, 56.5% of the Canadians responded in this manner. Differences in ratings between the two countries are

also reflected in the mean scores (4.5 vs. 3.6), where the higher values indicate perceptions of a more problematic condition. The differences can be explained in part by the fact that most survey respondents from Canada live and work adjacent to Lake Ontario. Unlike other lakes, Ontario has been regulated and thus did not set record levels in 1986. Even so, flooding occurred downstream from the outlet of Lake Ontario along the St. Lawrence River as a consequence of the high flow being released from Lake Ontario.

### Water Level Fluctuations: Assessments by States/Provinces

As seen in Table 6-2, respondents representing Ohio and Michigan agencies were most likely to view the high lake water levels as problematic; more than nine in ten marked a "4" or "5" in response to the question. Similarly, three-quarters of the Indiana respondents saw high water levels as a problem. Ontario and Quebec respondents on average were least likely to report fluctuations as a problem although half from each province scored a "4" or "5."

Table 6-2  
Ratings of High Lake Levels as a Problem, by State/Province  
(Percentage Distribution)

State/Province	High Lake Water Levels					Total (n)	Mean Score
	Not a Problem (1)	(2)	(3)	(4)Problem	Very Big (5)		
Illinois	5.3	-	5.3	36.8	52.6	100.0 (19)	4.3
Indiana	16.7	8.3	-	25.0	50.0	100.0 (12)	3.8
Michigan	1.3	0.6	6.3	10.6	81.3	100.0 (160)	4.7
Minnesota	-	-	15.4	38.5	46.2	100.0 (13)	4.3
New York	6.4	8.5	8.5	23.4	53.2	100.0 (47)	4.1
Ohio	-	2.7	2.7	8.1	86.5	100.0 (37)	4.8
Ontario	8.8	10.5	22.8	22.8	35.1	100.0 (57)	3.6
Quebec	50.0	-	-	16.7	33.3	100.0 (6)	2.8
Pennsylvania	11.1	-	-	11.1	77.8	100.0 (9)	4.4
Wisconsin	3.4	6.9	10.3	19.0	60.3	100.0 (58)	4.3

### Water Level Fluctuations: Assessments by Lakes

Since Lake Michigan and Lake Huron are often considered a single lake from a water level and hydraulic point of view, it is not surprising that the mean scores for the two lakes are about the same (4.5 and 4.8). In fact, 95% of the Lake Huron respondents and 87.4% of the Lake Michigan respondents ranked high lake levels as either "4" or "5" on the problem scale (See Table 6-3). For Lake Huron, only one respondent (1.7%) scored the lake level question as a "2" and no one marked a "1" or "not a problem." In contrast, 7% of the Lake Michigan respondents ranked high lake level as "1" or "2" or "not a problem."

Table 6-3

Ratings of High Lake Levels as a Problem, by Lake  
(Percentage Distribution)

Lake	High Lake Water Levels					Total (n)	Mean Score
	Not a Problem (1)	(2)	(3)	(4)	Very Big Problem (5)		
Ontario	15.7	11.8	19.6	25.5	27.5	100.0 (51)	3.4
Eric	1.3	2.6	7.9	13.2	75.0	100.0 (76)	4.6
Huron	-	1.7	3.3	13.3	81.7	100.0 (60)	4.8
Michigan	4.2	2.8	5.6	16.1	71.3	100.0 (143)	4.5
Superior	1.9	1.9	14.8	20.4	61.1	100.0 (54)	4.4

### Water Level Fluctuations: Agency Assessments

Looking at the issue of high lake levels from the perspective of various governmental units, all respondents representing states/provinces viewed high lake levels as a major problem in their areas of jurisdiction (See Table 6-4). Township representatives were the second largest group to report high lake levels as problematic; 88.1% of the 151 township representatives categorized the problem as either a "4" or a "5". The third group consists of city/municipality representatives, where more than three-quarters (78.2%) thought high lake levels were a big problem in their jurisdiction. Despite differences in assessments, it is important to note that there is generally a consensus among respondents from all governmental units regarding the magnitude of the high lake level problem. It is also worth noting that the problem is seen as being less acute by representatives of interest groups.



**Table 6-4**  
**Ratings of High Lake Levels as a Problem, by Agency/Organization**  
**(Percentage Distribution)**

Agency/ Organization	High Lake Water Levels					Total (n)	Mean Score
	Not a Problem (1)	(2)	(3)	(4)	Very Big Problem (5)		
Township	4.6	2.0	5.3	12.6	75.5	100.0 (151)	4.5
County	4.8	6.5	8.1	12.9	67.7	100.0 (62)	4.3
City/Municipality	4.5	4.5	12.7	17.3	60.9	100.0 (110)	4.3
State/Province	-	-	-	41.4	58.6	100.0 (29)	4.6
Regional	5.0	5.0	20.0	30.0	40.0	100.0 (20)	4.0
Interest Group	4.5	13.6	18.2	22.7	40.9	100.0 (22)	3.8

### Impacts of High Water Levels

In addition to determining the magnitude of the problem of changing water levels, the questionnaire was designed to tap views on the significance of the impact of high lake water levels on several conditions that often exist along shorelines. These conditions include flooding, erosion, loss of beach frontage (public and private), decreasing tourism, and wetland damage. As shown in Table 6-5, respondents considered high lake water levels as having the greatest impact on shoreline erosion; nearly three-quarters of the respondents marked a "4" or "5." Least likely to be affected was tourism; where half rated "decreasing tourism" as "not significant" and only a quarter rated the condition as "4" or "5." Figure 6-1 presents a graphic summary of the perceived severity of high water levels on the six conditions.

Table 6-5

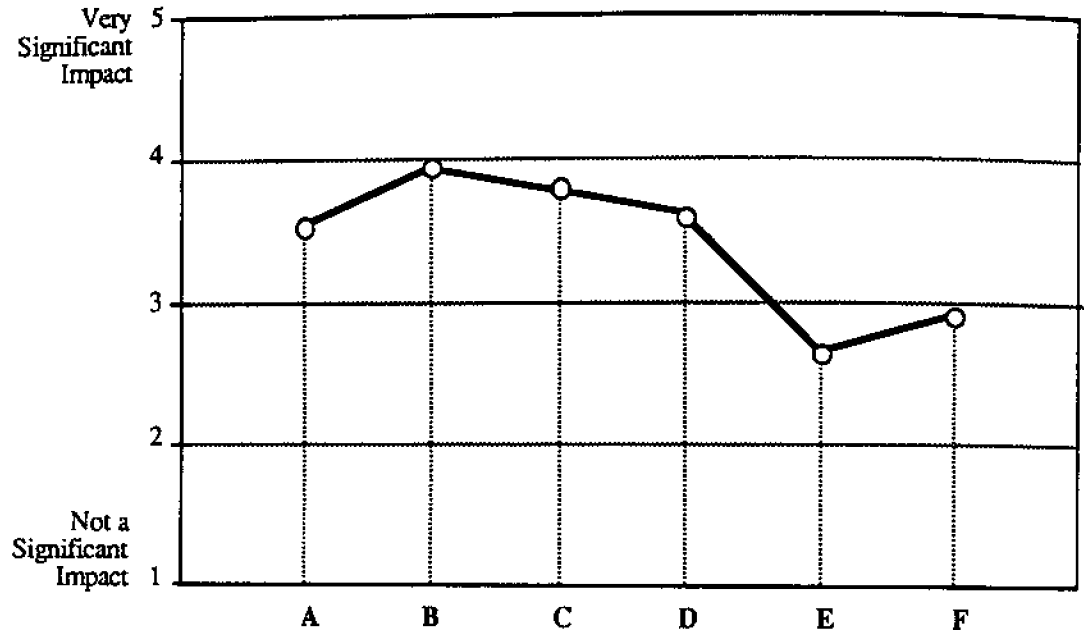
Significance of Impacts of High Lake Water Levels on Selected Conditions  
(Percentage Distribution)

Condition	Impact of High Lake Water Levels					Total (n)	Mean Score
	Not Significant (1)	(2)	(3)	(4)	Very Significant (5)		
Shoreline erosion	16.3	4.8	6.5	13.2	59.1	100.0 (416)	3.9
Loss of private beachfront	19.2	6.3	7.8	12.7	54.0	100.0 (411)	3.8
Loss of public beachfront	19.4	10.3	9.3	13.5	47.5	100.0 (407)	3.6
Flooding	15.5	12.5	16.5	13.5	42.0	100.0 (401)	3.5
Wetlands	27.5	15.1	20.5	13.0	23.9	100.0 (385)	2.9
Decreasing tourism	29.4	21.6	21.8	10.8	16.4	100.0 (385)	2.6

Information on the perceived significance of high lake levels as they affect flooding, erosion, public and private beachfronts, tourism, and wetlands is also displayed by mean scores for both state/province respondents and lake respondents. For example, shoreline high lake water levels was most likely to be seen as affecting on erosion among Michigan respondents (3.9) while erosion was not as much of a concern for residents of Minnesota (2.5) and Indiana (2.3). Indiana respondents felt that the high lake water levels were most likely to result in the loss of private beach frontage and least likely to affect wetlands. Respondents from other places except Minnesota and the Province of Quebec were also inclined to see significant impacts on private beach frontage from high water levels (See Table 6-6). Indeed, the high lake water levels result in a significant loss of private and public shorelines along all lakes according to respondents (See Table 6-7).

Figure 6-1

Impact of High Water Levels on Selected Conditions in 1986  
(Mean Rating)



CONDITIONS

- A : Flooding
- B : Shoreline Erosion
- C : Loss of Private Beachfronts
- D : Loss of Public Beachfront
- E : Decreasing Tourism
- F : Wetlands

Table 6-6

Significance of Impacts of High Lake Water Levels on Selected Conditions,  
by State/Province  
(Mean Score)\*

State/Province	Condition					
	(A)	(B)	(C)	(D)	(E)	(F)
Illinois	3.3	3.8	3.4	3.3	2.4	1.9
Indiana	2.3	2.9	2.4	2.6	2.1	2.2
Michigan	3.9	4.2	4.0	3.8	2.9	3.2
Minnesota	2.5	3.2	3.7	3.0	2.0	2.5
New York	3.6	4.0	3.9	3.5	2.5	2.7
Ohio	3.8	4.3	4.1	3.8	2.8	2.9
Ontario	3.4	3.6	3.4	3.5	2.7	2.9
Quebec	2.8	2.0	1.8	1.8	1.7	2.2
Pennsylvania	2.7	4.1	4.0	4.0	3.2	2.7
Wisconsin	3.2	3.9	3.7	3.6	2.4	3.0

Condition:

- A: Shoreline erosion
- B: Loss of private beachfront
- C: Loss of public beachfront
- D: Flooding
- E: Wetlands
- F: Decreasing tourism

\*The higher the score, the greater the significance of the impact of high lake water levels on the condition.

Table 6-7

Significance of Impacts of High Lake Water Levels on Selected Conditions, by Lake  
(Mean Score)\*

Lake	Condition					
	(A)	(B)	(C)	(D)	(E)	(F)
Ontario	3.0	3.5	3.2	3.0	2.5	2.8
Erie	3.7	4.1	3.9	3.6	2.6	2.7
Huron	3.9	3.8	3.7	3.8	2.8	3.0
Michigan	3.5	4.1	3.9	3.7	2.7	2.9
Superior	3.2	3.9	3.9	3.6	2.6	2.7

Condition:

A: Shoreline erosion

B: Loss of private beachfront

C: Loss of public beachfront

D: Flooding

E: Wetlands

F: Decreasing tourism

\*The higher the score, the greater the significance of the impact of high lake water levels on the condition.

### Controlling High Water Levels

The issue of controlling water levels in the Great Lakes took on special significance in 1986 when very high lake levels were being experienced. As part of the 1986 survey, respondents were asked whether or not government action should be taken to minimize the variability of lake levels in the future. Overall, four out of five (79.1%) respondents reported that government action should be taken to control lake levels in the future (see Table 6-8). The table shows that the strongest support for this proposition came from the governmental units closest to the problem, namely, the townships, counties, cities, and municipalities. An examination of the responses from representatives of regional, state/provincial, and federal governmental units indicates that these respondents did not express the same level of support for government action. In fact, there is a tendency for support for government action to control lake levels to decrease as the hierarchy of governmental units increases.

Table 6-8  
Support for Government Action to Control Variability in Lake Levels,  
by Agency/Organization

Agency/Organization	Proportion Responding Affirmatively	Number of Respondents
Township	87.4	125
County	76.4	42
City/Municipality	85.6	101
State/Provincial	57.1	12
Regional	38.9	7
Federal	33.3	1
All	79.1	288

Another question asked whether or not additional diversions from the Great Lakes were recommended by the respondent's agency/organization as a means of decreasing high lake levels. For respondents answering affirmatively, they were then asked to suggest the amount of reduction in the water level resulting from the increased diversion. Finally, they were asked which lakes should be tapped for the diversion.

Respondents were equally divided over whether or not additional diversion from the Great Lakes should occur; half said there should be increased diversion and half said additional diversions should not occur. Canadians were less willing to recommend diversion than their American counterparts. Whereas 55% of the U.S. respondents favored increased diversion, only 23.1% of the Canadian respondents supported this action. This difference may be explained in part by the concentration of Canadian respondents associated with Lake Ontario. Currently, this lake is fully regulated and would not necessarily benefit from increased diversions as a lake level control measure.

There appears to be a relationship between respondents who have experienced severe erosion problems in their area of jurisdiction (i.e. Ohio, Michigan, Illinois, New York, and Wisconsin) as a consequence of high lake levels and their desire to have lake levels reduced by more than one foot by diversion. Whereas six in ten respondents, overall, favored reducing the lake levels more than one foot, virtually all of these diversion advocates were from the severely affected states (See Table 6-9).

Table 6-9

Support for Additional Diversions to Reduce Lake Levels by More Than One Foot,  
by State

State/Province	Proportion Responding Affirmatively	Number of Respondents
Illinois	66.7	9
Indiana	66.7	6
Michigan	61.4	88
Minnesota	- *	1
New York	53.8	13
Ohio	75.0	16
Ontario	55.6	9
Quebec	- *	1
Pennsylvania	25.0	4
Wisconsin	60.0	20
All	60.5	167

\* Less than one half of one percent

For the respondents who supported additional diversion to reduce high lake levels, a question about where the diversion should come from was asked. The opportunity to suggest diversion from more than one lake was offered. Lake Michigan was given the largest number of votes with 28% of the respondents recommending diversions from the lake. In contrast, only 12.8% thought that diversions should come from Lake Ontario.

Table 6-10 shows the proportion of respondents from each lake suggesting diversion from the different sources. It is interesting to note that, with the exception of Lake Ontario respondents, those from each lake were most likely to select their own lake as the place from which diversions should occur. For instance, 44.9% of Lake Michigan respondents selected that lake as the main source of water diversion.

Table 6-10

Support for Additional Diversions from Specific Lakes, by Respondent's Lake  
(Proportion of Respondents Wanting Diversion)

Lake of Respondent	Lake Where Diversion Should Come From					Number of Respondents
	Erie	Huron	Michigan	Ontario	Superior	
Erie	32.0	17.3	17.3	16.0	17.3	75
Huron	29.2	33.8	29.2	16.9	23.1	65
Michigan	15.0	23.1	44.9	12.2	22.4	147
Ontario	17.6	17.6	17.6	13.7	17.6	51
Superior	5.4	10.7	23.2	5.4	39.3	56

We note parenthetically that public interest in lake levels tends to be associated with the magnitude of the difference between the present lake level and the long-term average lake level. As the actual lake levels deviate from the long-term average either as high lake levels (1986) or low lake levels (1964), the public becomes more concerned about the issue. At the end of July, 1988, Lakes Superior, Michigan, Huron, and Ontario recorded levels below their long-term average. Furthermore, projections by the U.S. Army Corps of Engineers<sup>1</sup> indicate that these lakes could be more than one foot below their long-term average levels by January, 1989. Lake Erie, while still above its long-term average level at the end of July, 1988, is projected to be as much as eight-tenths of a foot below its long-term average. These projections for the next six months have confidence limits of at least one foot for each of the Great Lakes. If the downward trend on lake levels continues in the near future, the deviation below the long term average could cause lake levels to emerge as a low lake level problem in contrast to the high lake level problem of 1986.

<sup>1</sup>"Monthly Bulletin on Lake Levels for the Great Lakes," Detroit District, U.S. Army Corps of Engineers, July, 1988.



## CHAPTER 7

### RESOURCE UTILIZATION AND RESOURCE PLANNING ISSUES

Additional insights into the changing perceptions of Great Lakes resource management were gained through two sets of questions covering resource utilization and resource planning. Both sets of questions were included in the 1971 survey as well as in the 1986 survey, with each set addressing specific issues of importance to policy makers and planners.

#### Resource Use

The first set of questions addressed eight issues which bear directly upon the effective use of natural resources within the Great Lakes region. Respondents were asked to indicate the importance of each issue within their jurisdiction using a 5-point scale with 1 being "not important," and 5 being "very important." The resource use issues were: (1) Inadequate access to the water's edge; (2) Conflicts over land use by competing uses; (3) Poor quality development adjacent to the shoreline; (4) Decreasing availability of land for public use; (5) Congested and inferior facilities for recreation; (6) Reduced enjoyment of shore areas due to erosion prevention structures; (7) Lack of proper marina facilities; and (8) Lack of proper port facilities.

In order to compare the relative importance of issues in 1971 and 1986, average ratings or mean scores are presented. Further, only mean scores of 3.0 or greater are discussed in order to highlight the most important issues. Finally, the discussion focuses on issues deemed important by identifying each issue (where half or more) of the respondents from any state/province or lake scored it as either a "4" or "5."

Table 7-1 presents the rankings of mean scores of the important resource use issues in 1971 and 1986 for respondents from each country. The table reveals that "decreasing land available for public use" was the highest ranked issue in 1971, but in 1986, while still being important, several other issues are equally important. Most notable are "conflicts over land use" and "lack of proper marina facilities." Furthermore, while five of the eight resource issues were considered important in 1971, seven of the eight were important in 1986. Joining the five issues mentioned in 1971 were "conflicts over land use" and "reduced enjoyment of shore areas due to erosion prevention structures." The latter issue reflected the extreme high lake levels which were being experienced in 1986.

It is interesting to note the greater importance attached to "lack of proper marina facilities" among Canadians between 1971 and 1986. Although the Canadians considered it to be moderately important in 1971, U.S. respondents viewed marina facilities as being more important (3.2 vs. 2.7). The issue was more important in 1986 among U.S. respondents as well.

Table 7-1

Change in Importance of Resource Use Issues  
(Overall Mean Scores Greater Than or Equal to 3.0)

Issue	USA	Canada	Overall
1971			
D	3.5(221)	3.6(66)	3.5
A	3.2(211)	3.1(62)	3.1
G	3.2(211)	2.7(60)	3.1
E	3.2(213)	2.6(62)	3.0
C	3.1(209)	2.7(61)	3.1
1986			
B	3.3(326)	3.4(60)	3.3
G	3.3(317)	3.1(60)	3.3
A	3.3(324)	3.1(56)	3.2
D	3.3(339)	3.0(61)	3.2
C	3.3(321)	2.8(61)	3.2
E	3.1(322)	2.7(59)	3.1
F	3.1(319)	2.3(56)	3.0

## ISSUES:

- A: Inadequate accessibility to the water edge
- B: Conflicts over land uses by competing users
- C: Poor quality development adjacent to shoreline
- D: Decreasing land available to public use
- E: Congestion and inferior facilities in recreation developments
- F: Reduced enjoyment of shore areas due to erosion prevention structures
- G: Lack of proper marina facilities
- H: Lack of proper port facilities

Erosion control structures were less of an issue in Canada in 1986 than in the United States indicating that the Canadian responses reflect the Lake Ontario situation where high lake levels were not reached in 1986. Overall, the increasing number and importance of resource use issues suggests a need for enhanced planning in the future. This observation is confirmed later in this chapter.

### Relative Importance: Perceptions by States/Provinces

Another perspective on the importance of issues related to resource use can be seen by examining responses of representatives from different states and provinces. Table 7-2 shows the number and identity of the Great Lakes states/provinces where more than half of the respondents indicated the resource use issue was significant. The criteria for significance is the percentage of the respondents who marked the issue as either important (4) or very important (5). The maximum number of states and provinces identifying an

issue as being significant is ten. Change in significance is reflected in Table 7-2 by the number of states noted for each resource issue in both 1971 and 1986.

Table 7-2  
Number and Identity of Great Lakes States/Provinces  
Identifying Resource Use Issues as Significant\*

Issue	1971	1986
A	IN, IL (2)	NY, PA, IN, OH (4)
B	IN, IL, NY, OH (4)	QU, MN, IN, NY (4)
C	PA, IN, NY, OH (4)	OH, WI, IL, IN (4)
D	MN, IN, IL, ON, OH, MI, NY (7)	PA, OH, NY (3)
E	MN, OH, IL, IN (4)	IN, PA, OH (3)
F	-- (-)	IN, PA, OH (3)
G	PA, MN, NY, IN (4)	NY, PA, MN (3)
H	-- (-)	-- (-)

ISSUES:

- A: Inadequate accessibility to the water edge
- B: Conflicts over land uses by competing users
- C: Poor quality development adjacent to shoreline
- D: Decreasing land available to public use
- E: Congestion and inferior facilities in recreation developments
- F: Reduced enjoyment of shore areas due to erosion prevention structures
- G: Lack of proper marina facilities
- H: Lack of proper port facilities

\*Note: To be significant, more than 50% of the respondents from a state/province scored the issue as "important" or "very important".

The table shows that resource issues significant in 1971 were still important in 1986. The decreasing availability of land for public use (Issue D) appears to have been somewhat mitigated. In 1971, respondents from seven states/provinces ranked this issue as significant; in 1986, respondents from only three states viewed the issue as significant. In both 1971 and 1986, lack of port facilities for commercial vessels was the only resource issue not rated as significant.

### Relative Importance: Perceptions by Lake

Table 7-3 shows the lakes where the respondents regard the eight resource use issues as significantly important. That is, half or more of the respondents from any lake had to mark the issue as either "important" or "very important."

Table 7-3  
Respondents Identifying the Resource Use Issues as Significant, by Lake\*

Issue	1971	1986
A	Ontario	Erie, Ontario, Huron
B	Ontario	--
C	Erie, Ontario	Erie
D	Huron, Erie, Ontario, Michigan	Erie
E	--	--
F	--	Erie, Huron, Michigan
G	Superior	Huron, Ontario
H	--	--

#### ISSUES:

- A: Inadequate accessibility to the water edge
- B: Conflicts over land uses by competing users
- C: Poor quality development adjacent to shoreline
- D: Decreasing land available to public use
- E: Congestion and inferior facilities in recreation developments
- F: Reduced enjoyment of shore areas due to erosion prevention structures
- G: Lack of proper marina facilities
- H: Lack of proper port facilities

\*Note: To be significant more than 50% of the respondents from a lake scored the issue as "important" or "very important".

The table reveals that, in general, the importance of these resource use issues changed over time. For example, in 1971, reduced enjoyment of shorelines due to erosion prevention structure (Issue F) was not considered significant by respondents from any of the lakes. In 1986, this issue was a significant one for respondents associated with Lakes Michigan, Huron, and Erie. Port facilities was not a significant issue on any lake at either date, nor was congestion and poor recreational development. One should be mindful that

perceptions of these resource issues could be considered as significant in specific geographic locations on any lake.

### Resource Planning

Seven issues which directly focus upon resource planning in connection with the Great Lakes shoreline were presented to the respondents, who were asked to indicate the importance of each within their jurisdiction. The planning issues were the following: (1) Inadequate emphasis on water oriented environmental planning by all levels of government; (2) Lack of inter-agency cooperation with regard to this matter; (3) Piecemeal approach to planning and solving of immediate problems; (4) Need for state- or province-wide zoning of shorelines; (5) Lack of resource information; (6) Inadequate zoning and building regulations; and (7) Lack of planning methods, goals, policies and identification of use values.

As in the case of resource use, the importance of planning issues was to be determined by the respondents using a 5-point scale where 1 was "not important," and 5 was "very important." On the basis of the average or mean score for each issue and using the criteria that a mean score of 3.0 or greater represented a significant issue, it is possible to compare the relative importance of these planning issues in 1971 and 1986. In a manner similar to the previous section of this chapter, planning issues are first discussed for each country and then by respondents representing different states/provinces and lakes.

Figure 7-1 plots the mean scores covering responses to each planning issue for both 1971 and 1986. It indicates the greater importance in 1986 of three issues--the inadequate emphasis on water oriented planning by all levels of government (Issue A); the lack of inter-agency cooperation in this type of planning (Issue B); and the piecemeal approach to planning emphasizing solutions to immediate problems (Issue C).

Several elements may be contributing to the changes in the perceived importance of planning with regard to these issues. First, in the United States, the Water Pollution Control Act Amendments of 1972 and subsequent legislation, now designated as the Clean Water Act, mandated and required planning for wastewater treatment facilities at the community level, the regional level, and the river basin level. Second, the Great Lakes Basin Commission terminated its operations in 1981 along with the other federal river basin planning commissions that were established in accordance with the Water Resources Planning Act of 1965. Third, new initiatives at the state/provincial level, including the creation of the Great Lakes Charter and the Toxic Substances Control Agreement, have placed new emphasis on planning in the Great Lakes.

The same overall mean scores shown in Figure 7-1 are presented in Table 7-4. This table also shows the relative importance of the issues by country. It is interesting to note that in 1971, the Canadians tended to view planning issues as more significant than the respondents from the United States. In contrast, the Americans in 1986 gave greater significance to the same planning issues. The responses from both countries indicates that a piecemeal approach to planning is of significant concern. The issue was ranked very high by both Canadian and U. S. respondents in 1986 but only the former viewed it as an

important planning issue in 1971. A contributing factor to this change among U.S. respondents may be the signing of two Water Quality Agreements by the two countries in 1972 and 1978.

Table 7-4

Change in Importance of Resource Planning Issues  
(Overall Mean Scores Greater Than or Equal to 3.0)

	Issue	USA	Canada	Overall
1971	A	3.2(216)	3.4(62)	3.2
	C	3.1(215)	3.6(59)	3.2
	B	3.0(211)	3.0(57)	3.0
	F	2.9(214)	3.3(63)	3.0
	G	2.9(212)	3.2(61)	3.0
	D	2.8(200)	3.6(59)	3.0
	1986	C	3.7(332)	3.6(59)
A		3.6(340)	3.4(62)	3.5
B		3.5(332)	3.3(59)	3.5
G		3.1(332)	3.0(57)	3.1
E		3.0(328)	2.7(60)	3.0
<b>ISSUES:</b>				
	A:	Inadequate emphasis on water oriented environmental planning		
	B:	Lack of inter-agency cooperation with regard to this matter		
	C:	A piecemeal approach to planning-solving of immediate problems		
	D:	Need for state or province wide zoning of shorelines		
	E:	Lack of resource information		
	F:	Inadequate zoning and building regulations		
	G:	Lack of planning methods, goals, policies and identification of user values		

**Relative Importance: Perceptions by States/Provinces**

Table 7-5 presents a listing of states/provinces whose respondents considered the planning issues to be significant in both 1971 and 1986. The data confirm the greater importance of the first three issues throughout the Great Lakes region. For example, in 1971 a significant number of respondents from one state, Indiana, thought that there was "inadequate emphasis on water oriented environmental planning." In 1986, respondents from seven states/provinces (Indiana, Ohio, Michigan, Illinois, Wisconsin, Pennsylvania, and Quebec) reported this planning issue as being significant.

Table 7-5

Number and Identity of Great Lakes States/Provinces  
Identifying Planning Issues as Significant\*

Issue	1971	1986
A	IN (1)	IN, OH, MI, IL, WI, PA, QU (7)
B	IL, IN (2)	IN, PA, OH, MI, MN, QU (6)
C	MN, IL, ON, PA, IN (5)	IN, IL, MI, NY, OH, ON, QU, PA, WI (9)
D	IL, ON, OH (3)	QU, IN, OH (3)
E	IN (1)	QU, IN (2)
F	NY, PA, MN, IN (4)	IN, QU (2)
G	MN, IN (2)	IN, OH, QU (3)

## ISSUES:

- A: Inadequate emphasis on water oriented environmental planning
- B: Lack of inter-agency cooperation with regard to this matter
- C: A piecemeal approach to planning-solving of immediate problems
- D: Need for state or province wide zoning of shorelines
- E: Lack of resource information
- F: Inadequate zoning and building regulations
- G: Lack of planning methods, goals, policies and identification of user values

\*Note: To be designated as significant, more than 50% of the respondents from a state/province scored the issue as "important" or "very important".

### Relative Importance: Perceptions by Lakes

Finally, Table 7-6 shows significant planning issues where the respondents are grouped according to the lake with which they are associated. Once again, the table demonstrates the growing importance of several planning issues over the 15-year period. In 1971 only one issue (shoreline zoning) was considered significant by respondents located around one lake--Lake Ontario. In contrast, four issues were considered significantly important by respondents in 1986. Interestingly, this occurred along all lakes except Ontario. However, it can be noted that Lake Ontario respondents just missed the 50% cutoff--48% of them said "a piecemeal approach to planning" was important or very important in 1986.

Table 7-6

Respondents Identifying the Resource Planning Issues as Significant, by Lake\*

Issue	1971	1986
A	--	Superior, Erie
B	--	Erie, Superior, Huron
C	--	Erie, Huron, Michigan
D	Ontario	--
E	--	--
F	--	--
G	--	Erie

**ISSUES:**

- A: Inadequate emphasis on water oriented environmental planning
- B: Lack of inter-agency cooperation with regard to this matter
- C: A piecemeal approach to planning-solving of immediate problems
- D: Need for state or province wide zoning of shorelines
- E: Lack of resource information
- F: Inadequate zoning and building regulations
- G: Lack of planning methods, goals, policies and identification of user values

\*Note: To be significant more than 50% of the respondents from a lake scored the issue as "important" or "very important".



## CHAPTER 8

### PROSPECTS FOR THE FUTURE

To gain insights about how governmental officials and organizational representatives view the future of the Great Lakes region, two questions, not included in 1971, were added to the 1986 questionnaire. First, 12 conditions which could potentially threaten water quality were presented to the respondents, who were asked "How big a threat will each of the following pose to the inshore water within your jurisdiction in the next 15 years?" A five (5) point response scale ranging from 1 "Not a Threat" to 5 "Major Threat" was used for each condition. Second, the 12 conditions and response categories were repeated except the respondents were asked about threats posed to the entire Great Lakes system. Responses to these two sets of questions were compared for respondents associated with each lake, each level of government, and each geographic location.

#### Extent of Threats

Table 8-1 presents the distributions of ratings on threats of each condition to inshore waters of the respondents' jurisdictions. The conditions are ordered according to the perceived severity of the threat. High lake levels, pollution (other than toxics), and toxic pollution were viewed as the greatest threats to inshore waters in the jurisdictions of the respondents. More specifically, the greatest threat was considered to be high lake

Table 8-1  
Extent of Threat of Selected Conditions to Water in Respondents' Jurisdictions  
(Percentage Distribution)

Conditon	Not A Threat (1)	(2)	(3)	(4)	Major Threat (5)	Total	Mean Score
High lake levels	10.8	5.8	14.1	21.6	47.7	100.0(398)	3.9
Pollution (other than toxics)	10.3	17.7	36.9	22.4	12.7	100.0(379)	3.1
Toxic pollution	16.6	23.2	24.2	15.8	20.2	100.0(392)	3.0
Ecosystem destruction	15.9	23.2	34.6	14.7	11.6	100.0(353)	2.8
Recreation growth	26.1	24.8	25.3	15.2	8.6	100.0(395)	2.6
Urban growth	25.8	29.0	25.3	14.3	5.6	100.0(391)	2.5
Industrial development	33.2	27.0	27.2	7.7	4.9	100.0(389)	2.2
Agricultural development	42.1	21.8	20.0	11.3	4.9	100.0(390)	2.2
Diversion/consumptive uses	48.3	18.5	17.7	7.5	8.0	100.0(362)	2.1
Nuclear plant construction	64.6	12.3	8.9	5.0	9.2	100.0(381)	1.8
Fossil fuel plant	54.5	23.3	12.7	5.3	4.2	100.0(377)	1.8
Mining operation	68.9	14.5	8.2	4.7	3.7	100.0(379)	1.6

levels, where more than 69% of the respondents checked categories 4 or 5, compared to 35% that marked pollution (other than toxics) and 36% that marked toxic pollution in these categories. Mining operations, fossil fuel plant construction, and nuclear power plant

construction were least likely to be viewed as threats to the local water quality in the next 15 years (the proportions of respondents rated 4 and 5 were 8.4%, 9.5% and 14.2% respectively).

The perceptions of the extent of threat to the entire Great Lakes system for the same conditions are presented in Table 8-2. Again, high lake levels were viewed as the greatest threat to the region. This response is clearly related to the fact that, at the time the questionnaires were distributed in 1986, many areas of the Great Lakes were facing unusually high lake levels.

Toxic pollution was considered the second greatest threat to the region and pollution (other than toxics) ranked third; about 72% and 60% respectively marked these conditions in the 4 or 5 categories. At the same time, mining operations and fossil fuel plant construction were viewed as the least threatening activities to the entire Great Lakes system over the next 15 years.

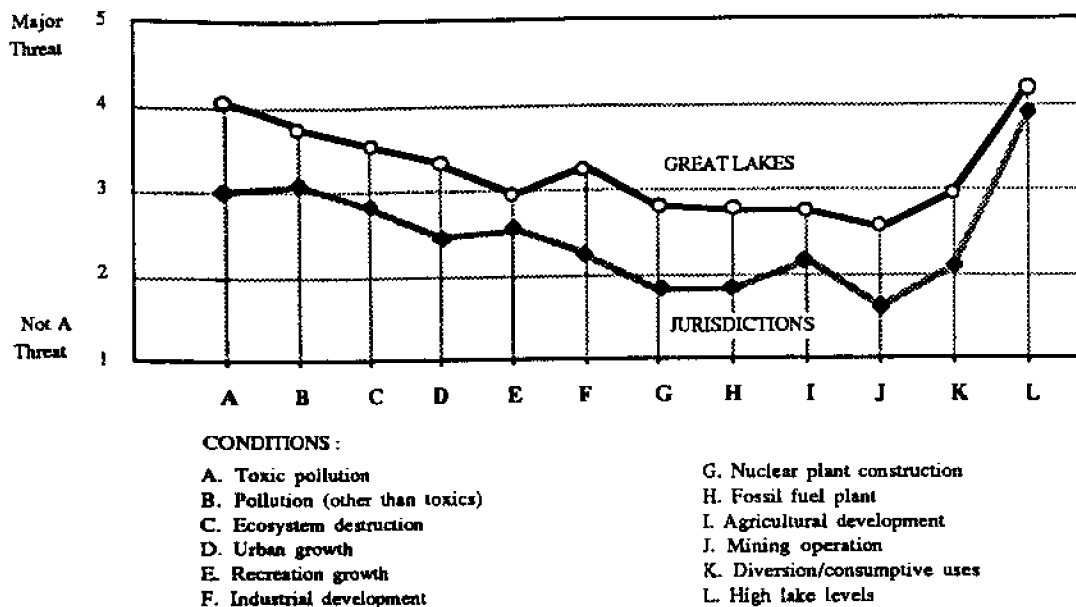
Table 8-2  
Extent of Threat of Selected Conditions to the Great Lakes System  
(Percentage Distribution)

Conditon	Not A Threat (1)	(2)	(3)	(4)	Major Threat (5)	Total	Mean Score
High lake levels	3.2	5.6	12.8	21.4	57.0	100.0(374)	4.2
Toxic pollution	2.1	6.1	20.3	27.3	44.2	100.0(374)	4.1
Pollution (other than toxics)	2.5	8.2	29.6	31.8	27.9	100.0(365)	3.7
Ecosystem destruction	4.7	9.5	35.3	27.9	22.6	100.0(337)	3.5
Urban growth	6.5	15.1	33.2	28.8	16.4	100.0(365)	3.3
Industrial development	7.1	15.5	36.3	24.5	16.6	100.0(367)	3.3
Diversion/consumptive uses	18.4	18.4	30.5	15.2	17.5	100.0(342)	3.0
Recreation growth	11.1	23.0	37.2	17.6	11.1	100.0(369)	2.9
Nuclear plant construction	22.4	23.3	23.3	12.2	18.8	100.0(352)	2.8
Agricultural development	15.0	25.4	35.3	16.4	7.9	100.0(366)	2.8
Fossil fuel plant	18.4	24.5	31.4	15.3	10.4	100.0(347)	2.7
Mining operation	22.4	29.9	25.6	14.5	7.6	100.0(344)	2.5

A comparison of data in Tables 8-1 and 8-2 shows that, in general, the respondents believed the 12 conditions were more serious threats to the entire Great Lakes system than to the inshore waters within their own jurisdictions. Although the ordering of the severity of threats in the two tables shows a similar pattern, there are exceptions worthy of mention. For example, respondents thought pollution (other than toxics) would be a greater threat than toxics to the inshore waters of their jurisdictions; in the case of threats to the entire Great Lakes system, the opposite is true (see also slopes between A and B in Figure 8-1).

Figure 8-1

Extent of Threat of Selected Conditions to Inshore Water in Local Jurisdictions and to Entire Great Lakes System  
(Mean Score)



### Threats: Perception by States/Provinces

When the views of respondents associated with different states/provinces were examined, the perceived threats to inshore water for any given condition were similar (see Table 8-3). High lake levels was seen as the greatest threat in all places except in the Province of Quebec where the respondents indicated that ecosystem destruction and agricultural development posed the greatest threats in their areas. Not surprisingly, high lake levels was not seen as a major threat to the five Quebec respondents who were located along the St. Lawrence River.

There are a number of other findings from Table 8-3 worth noting. For instance, the Minnesota respondents viewed mining operations as a much greater threat than respondents from any of the other states (2.7 vs. 1.6). This difference may reflect the shut-down of the Duluth water supply as a consequence of the discharge of mining tailings from the Reserve Mining Company into Lake Superior. Also, the Ohio respondents, more than others, were likely to see toxic pollution, pollution (other than toxics), and nuclear plant construction as major threats to their inshore waters.

Table 8-3

Extent of Threat of Selected Conditions to Water in Respondent Jurisdiction,  
by State/Province  
(Mean Score)\*

Condition	AL	IL	IND	MI	MN	NY	OH	ONT	QUE	PA	WI
High lake levels	3.9	4.1	3.3	4.2	3.3	3.7	4.4	3.2	2.0	4.3	3.8
Pollution (other than toxics)	3.1	2.9	3.1	3.0	3.2	3.1	3.8	3.2	2.7	3.1	2.9
Toxic pollution	3.0	2.7	3.3	2.9	3.0	3.2	3.7	3.1	3.2	2.8	2.7
Ecosystem destruction	2.8	2.5	2.8	2.8	2.9	2.8	3.4	2.8	3.0	2.6	2.7
Recreation growth	2.6	2.5	2.2	2.5	2.6	2.7	2.8	2.4	3.2	2.1	2.6
Urban growth	2.5	2.2	2.5	2.4	2.1	2.8	2.7	2.4	3.0	2.3	2.4
Industrial development	2.2	2.3	2.8	2.1	2.5	2.3	2.7	2.2	3.3	1.9	2.1
Agricultural development	2.2	1.4	2.2	2.1	1.6	2.2	2.4	2.0	3.5	1.5	2.4
Diversion/consumptive uses	2.1	2.1	1.9	2.0	2.2	2.3	2.7	1.8	2.4	1.6	2.0
Nuclear plant construction	1.8	1.9	1.8	1.7	1.5	1.9	3.7	1.5	1.4	2.3	1.7
Fossil fuel plant	1.8	1.9	1.7	1.7	1.8	1.8	2.4	1.9	1.4	1.6	1.8
Mining operation	1.6	1.2	1.3	1.6	2.7	1.6	1.6	1.3	1.6	1.6	1.7
approx. n=	398	18	12	156	13	46	31	52	5	8	57

\* The response scale ranges from 1=Not a threat, to 5=Major threat.  
  Mean score with the difference of 0.7 or greater from overall mean.

With regard to threats to the entire Great Lakes system, respondents from different states/provinces were somewhat divided in their opinions (see Table 8-4). While Indiana, Minnesota, New York, Ontario, and Quebec respondents indicated that toxic pollution is the greatest threat, those from Illinois, Michigan, Ohio, Pennsylvania, and Wisconsin noted that high lake levels would be the greatest threat for the Great Lakes in the future. Moreover, respondents from New York (3.6) and Quebec (4.0) were much more likely to think that diversion/consumptive uses would be a threat to the region than respondents from other states/provinces (2.9). Finally, Ohio respondents appear to be much more concerned than others over nuclear plant construction. These views by state/province clearly reflect the present realities of specific geographical areas of the Great Lakes region.

### Threats: Perceptions by Lakes

Table 8-5 shows that, for respondents associated with each lake, the severity of threat for most conditions is viewed similarly. However, there are exceptions. First, Lake Erie respondents tended to view several conditions (i.e. high lake levels, recreation growth, diversion/consumption, nuclear plant construction), as a greater threat than respondents from the other lakes. Second, Lake Ontario respondents were the least likely to see high lake levels as their greatest threat; 40% of them marked a 4 or 5 for high lake levels compared to 70% or more from each of the other lakes. The reader is again reminded that Lake Ontario's water level has been fully controlled since the completion of the St. Lawrence Seaway. Accordingly, while Lake Ontario's water level in 1986 was above its long-term average, it had not set record levels at the time of the survey. Pollution (other

Table 8-4

Extent of Threat of Selected Conditions to the Great Lakes System, by State/Province  
(Mean Score)\*

Condition	ALL	IL	IND	MI	MN	NY	OH	ONT	QUE	PA	WI
High lake levels	4.2	4.6	3.5	4.5	3.8	4.2	4.5	3.5	4.3	4.8	4.2
Toxic pollution	4.1	3.5	4.2	4.0	4.3	4.3	4.0	4.3	5.0	4.0	3.9
Pollution (other than toxics)	3.7	3.2	3.8	3.7	3.8	3.9	3.9	3.8	4.0	3.4	3.7
Ecosystem destruction	3.5	3.4	3.5	3.5	3.6	3.6	3.9	3.5	4.3	3.0	3.5
Urban growth	3.3	3.3	3.0	3.4	3.5	3.4	3.5	3.3	3.8	2.9	3.2
Industrial development	3.3	3.3	2.9	3.2	3.5	3.4	3.3	3.4	4.3	3.0	3.2
Recreation growth	2.9	3.2	2.8	3.0	3.3	3.1	3.1	2.6	3.3	3.3	2.8
Diversive/consumptive uses	2.9	2.6	2.1	2.8	3.5	3.6	3.4	2.8	4.0	2.8	2.7
Nuclear plant construction	2.8	2.6	2.3	2.7	2.9	2.9	3.5	2.8	2.3	3.0	2.8
Agricultural development	2.8	2.9	2.3	2.8	3.3	2.6	3.0	2.5	3.8	2.8	2.9
Fossil fuel plant	2.7	2.8	2.0	2.6	3.2	2.8	2.9	2.9	2.3	2.6	2.8
Mining operation	2.5	2.6	1.7	2.5	3.0	2.9	2.8	2.3	2.5	2.4	2.5
approx. n=	375	17	10	143	13	39	31	55	4	8	55

\* The response scale ranges from 1=Not a threat, to 5=Major threat.

Mean score with the difference of 0.7 or greater from overall mean.

Table 8-5

Extent of Threat from Selected Conditions to Water in Jurisdiction, by Lake  
(Mean Score)\*

Condition	All					
	Lakes	Ontario	Erie	Huron	Michigan	Superior
High lake levels	3.9	2.8	4.2	4.3	4.1	3.6
Pollution (other than toxics)	3.1	3.3	3.3	3.1	3.0	2.7
Toxic pollution	3.0	3.1	3.2	2.9	2.7	2.6
Ecosystem destruction	2.8	2.7	2.9	2.8	2.7	2.5
Recreation growth	2.6	2.5	2.7	2.3	2.6	2.3
Urban growth	2.5	2.7	2.6	2.2	2.4	1.9
Industrial development	2.2	2.2	2.3	2.0	2.1	1.9
Agricultural development	2.2	2.1	2.1	2.1	2.2	1.6
Diversion/consumptive uses	2.1	1.8	2.4	1.9	1.9	1.9
Nuclear plant construction	1.8	1.5	2.7	1.8	1.5	1.6
Fossil fuel plant	1.8	1.6	2.2	1.9	1.7	1.6
Mining operation	1.6	1.4	1.6	1.6	1.5	1.9
approx. n=	362	46	63	60	135	51

\*The response scale ranges from, 1=Not a threat, to 5=Major threat

than toxics) and toxic pollution were viewed by the Lake Ontario respondents as the two conditions most likely to threaten their inshore waters in the future; about half scored the two conditions as 4 or 5. Third, the severity of threat from high lake levels among Lake Superior respondents was much lower than it was for Lakes Erie, Huron, and Michigan respondents; more than half of the Lake Superior respondents (56%) rated this condition as 4 or 5, compared to about 80% for the Lakes Huron and Erie respondents, and 74% for the Lake Michigan respondents. Again, as in the case of Lake Ontario, the lake level of Superior is controlled through the operation of the compensation works at the Soo Locks.

Table 8-6 shows the mean ratings for the perceived severity of threats to the entire Great Lakes system for respondents associated with different lakes. In general, the data indicate that each of the threats are viewed similarly across lakes. High lake levels, toxic pollution and pollutants (other than toxics) are still the three conditions seen as the greatest threat to the region in the next 15 years. In the case of Lake Ontario and Lake Superior, respondents indicated toxic pollution posed the greatest threat to the system, whereas those from Lakes Erie, Huron, and Michigan thought that high lake levels would be a major threat to the system; nine out of every ten respondents associated with these lakes marked high lake levels with a 4 or 5). It should be noted that, while roughly one third (31%) of all respondents thought nuclear power plant construction posed a high level of threat (4 or 5), Lake Erie and Superior respondents tended to view nuclear power plant construction more seriously as a threat to the entire Great Lakes system; 50% from Lake Erie and 40% from Lake Superior marked this condition as 4 or 5.

Table 8-6

Extent of Threat of Selected Conditions to the Great Lakes System, by Lake  
(Mean Score)\*

Condition	All Lakes	Ontario	Erie	Huron	Michigan	Superior
High lake levels	4.2	3.4	4.5	4.3	4.4	4.1
Toxic pollution	4.1	4.4	3.9	4.1	3.8	4.3
Pollution (other than toxics)	3.7	3.9	3.7	3.8	3.6	3.9
Ecosystem destruction	3.5	3.6	3.5	3.4	3.4	3.7
Urban growth	3.3	3.3	3.3	3.3	3.3	3.5
Industrial development	3.3	3.4	3.2	3.4	3.2	3.3
Diversion/consumptive uses	2.9	3.0	3.3	2.9	2.6	3.0
Recreation growth	2.9	2.8	3.1	2.8	2.9	3.0
Nuclear plant construction	2.8	2.6	3.4	2.8	2.5	3.2
Agricultural development	2.8	2.4	2.8	2.8	2.7	2.9
Fossil fuel plant	2.7	2.6	2.9	2.8	2.6	2.9
Mining operation	2.5	2.5	2.8	2.6	2.4	2.8
approx. n=	362	46	63	60	135	51

\* The response scale ranges from 1=Not a threat, to 5=Major threat

### Threats: Agency Perceptions

In general, there are no significant differences in the responses to the two sets of questions for representatives of different governmental agencies (see Tables 8-7 and 8-8). However, a detailed examination of the two tables reveals a number of interesting variations. Whereas interest groups tended to be more concerned than others about most conditions, they expressed roughly the same level of concern about the high lake level problem. At the same time, interest groups viewed toxic pollution and ecosystem destruction as the two greatest threats to inshore water both for their local area and for the Great Lakes system as a whole.

Table 8-7

Extent of Threat of Selected Conditions to Water in Respondent Jurisdiction,  
by Agency/Organization  
(Mean Score)\*

Condition	All	Tnshp.	County	State/ Prov.	Regnl.	Fed.	City/ Munic.	Village	Interest Group
High lake levels	3.9	4.0	3.7	3.9	3.8	3.7	3.9	3.9	3.7
Pollution (other than toxics)	3.1	2.9	3.0	3.2	3.6	3.7	3.0	3.4	4.0
Toxic pollution	3.0	2.7	2.8	3.8	3.3	5.0	2.9	2.7	4.5
Ecosystem destruction	2.8	2.5	2.9	3.6	3.2	3.0	2.5	3.0	4.2
Recreation growth	2.6	2.4	2.6	2.8	3.0	2.3	2.3	2.4	3.7
Urban growth	2.5	2.2	2.5	2.8	2.9	2.7	2.3	2.3	3.6
Industrial development	2.2	1.8	2.3	3.0	2.5	3.3	2.2	2.0	3.6
Agricultural development	2.2	1.9	2.4	2.3	2.4	2.3	2.1	2.3	3.0
Diversion/consumptive uses	2.1	1.8	1.9	3.0	1.8	3.7	2.0	2.3	3.0
Nuclear plant construction	1.8	1.7	1.7	1.7	1.7	1.0	1.7	2.6	2.7
Fossil fuel plant	1.8	1.7	1.7	1.8	1.9	1.3	1.7	2.5	2.6
Mining operation	1.6	1.6	1.5	2.0	1.6	1.3	1.5	1.5	2.2
approx. n=	398	141	56	27	19	3	108	20	22

\* The response scale ranges from 1=Not a threat, to 5=Major threat.

Mean score with the difference of 0.7 or greater from overall mean.

When the severity of threats for the same conditions was considered for the entire Great Lakes system, high lake levels and toxic pollution were once again seen as major threats among representatives of various governmental units and among interest groups (see Table 8-8). Additionally, the three federal agency representatives were more likely than others to see urban growth and diversion/consumptive uses as major threats to the entire Great Lakes system while interest groups were much more concerned than others about ecosystem destruction, toxic pollution, recreation growth, diversion/consumptive uses, and mining operations.

Table 8-8

Extent of Threat of Selected Conditions to the Great Lakes System,  
by Agency/Organization  
(Mean Score)\*

Condition	All	Tnshp.	County	State/ Prov.	Regnl.	Fed.	City/ Munic.	Village	Interest Group
High lake levels	4.2	4.3	4.2	4.0	3.9	4.3	4.3	4.2	4.0
Toxic pollution	4.1	4.1	3.9	4.2	4.3	4.3	3.9	4.1	4.6
Pollution (other than toxics)	3.7	3.9	3.7	3.5	3.7	4.0	3.6	4.0	4.0
Ecosystem destruction	3.5	3.5	3.5	3.5	3.8	3.3	3.3	3.8	4.2
Urban growth	3.3	3.3	3.4	3.3	3.5	4.0	3.3	3.3	3.8
Industrial development	3.3	3.2	3.2	3.5	3.3	3.7	3.2	3.6	3.8
Recreation growth	2.9	3.0	2.9	2.9	3.0	3.3	2.7	2.8	3.7
Diversion/consumptive uses	2.9	2.7	2.8	3.5	3.1	4.3	2.9	3.4	3.7
Nuclear plant construction	2.8	2.9	2.5	2.4	2.8	2.7	2.7	3.5	3.1
Agricultural development	2.8	2.6	2.8	3.0	3.1	2.7	2.7	2.9	3.3
Fossil fuel plant	2.7	2.8	2.6	2.5	2.8	3.0	2.7	3.3	3.1
Mining operation	2.5	2.6	2.4	2.3	2.7	1.7	2.4	3.1	3.3
approx. n=	375	130	51	26	19	3	102	21	21

\* The response scale ranges from 1=Not a threat, to 5=Major threat.

Mean score with the difference of 0.7 or greater from overall mean.

Finally, it can be seen that when conditions were considered as threats to the inshore waters of particular jurisdictions, most units (except state/provincial and federal agencies and interest groups) thought pollution (other than toxics) would be a greater threat than toxic pollution. When threats to the entire Great Lakes system are considered, toxic pollution was more critical than other types of pollution. It is clear that the pollution threat, irrespective of its source, is seen as critical to the future of the Great Lakes.



## **CHAPTER 9**

### **SUMMARY AND RECOMMENDATIONS**

The previous chapters present findings concerning water quality and other environmental issues as reported by selected individuals throughout the Great Lakes Basin in the United States and Canada. The findings are based on a 1986 survey of over 400 governmental units and environmental organizations. The survey utilized a mail questionnaire similar in design to a questionnaire sent to a smaller number of these same units in 1971. Data from the 1971 survey constitute a benchmark against which the 1986 findings can be compared. Accordingly, trends can be observed while new issues, not considered in the 1971 survey, can be discussed. Key issues addressed in the 1986 survey were resource utilization, threats to water quality, high lake levels, institutional arrangements, and future threats to the Great Lakes. A summary of the major findings follows.

#### **Overview of Findings**

##### **Resource Utilization**

The pattern of land use in the Great Lakes basin has changed substantially since 1971. According to the 1986 respondents, industrial and residential land use along the Great Lakes shoreline has increased while recreational or wild land areas have been reduced.

In both 1971 and 1986, the degree of urbanization in the Great Lakes Basin was associated with perceptions of inshore water quality. Governmental representatives in places classified as highly urban rated inshore water quality as poor while representatives of the least urbanized areas gave the highest marks to inshore water quality.

Compared to 1971, the 1986 respondents placed greater importance on agricultural runoff, solid waste disposal, beach and slope erosion, sedimentation, and alteration of shoreline by filling and dredging as factors contributing to impairment of water quality. Municipal wastewater facilities and industrial wastewater facilities were considered equally important in both 1971 and in 1986.

In 1986, conflicts over land use and a lack of appropriate marina facilities were identified as the most important resource use issues facing governmental units contiguous to the Great Lakes.

##### **Threats to Water Quality**

For each of the Great Lakes, water quality was viewed as having improved since 1971. The greatest improvement was reported by Lake Erie representatives.

The quality of inshore water in 1986 was considered lower among Canadian representatives than among their counterparts from the United States.

Toxic pollution was the most serious threat to water quality according to international and federal agencies and interest groups.

In 1986, respondents from Lake Erie and Lake Ontario were more likely to say their lakes had a toxic problem than representatives of the other Great Lakes. Throughout the entire region, toxic pollution was viewed as a localized, site-specific problem.

Canadians were more likely than their U.S. colleagues to report point source discharges as a major source of toxic pollutants.

### **High Lake Levels**

Governmental concern about high lake levels reflects the condition at a particular point in time and does not take into account naturally occurring long-term fluctuations.

Representatives from the United States were more likely to see high lake levels as a significant problem than representatives from Canada. Virtually everyone reported that shoreline erosion, loss of private and public beachfront, and flooding were major consequences of high lake levels.

Four in five respondents said they would support further government action to control lake levels. The strongest support came from representatives of local government.

Respondents were equally divided over whether or not additional diversions from the Great Lakes should be used to reduce high lake levels. However, Canadians were significantly less supportive of increased diversions than respondents from the United States.

Among respondents favoring diversions to reduce lake levels, nearly all preferred diversion from the lake associated with their jurisdiction; respondents associated with Lake Ontario were the exception.

### **Institutional Arrangements**

Since 1971, responsibilities for dealing with water quality issues have shifted between different levels of government. Responsibilities for maintaining water quality have diminished among townships whereas municipalities have increased their responsibilities. Overall, municipalities, counties, and regional agencies have assumed greater responsibility for activities related to water quality over the past 15 years.

In both the United States and Canada, states and provinces were considered to be the most effective governmental units at improving water quality. In Canada,

federal agencies were viewed as least effective among the several units of government. In the United States, regional governmental units were considered as least effective.

According to respondents from the United States, an institutional framework is currently in place to bring about improved water quality in the inshore waters of the Great Lakes. The consensus in Canada was that more funds, stricter enforcement, and new regulations are needed to address the problem.

Canadians, more so than Americans, were likely to believe that the 1972 and 1978 Water Quality Agreements between Canada and the United States were ineffective. With regard to the 1978 Agreement, Canadians were particularly sensitive to the toxic contamination of Lake Ontario and the Niagara River caused by waste disposal sites in the United States.

According to respondents, non-governmental organizations play an important role in aiding water quality maintenance in the inshore waters of the Great Lakes.

Inadequate emphasis on water-oriented planning by all levels of government, the lack of inter-agency cooperation, and a piecemeal approach to planning with emphasis on solving short-term problems were identified as important planning issues throughout the Great Lakes.

### **Future Threats to the Great Lakes**

Lake levels, toxic contamination, and other pollution sources were considered as the greatest threats to both individual lakes and the Great Lakes system as a whole. Additionally, respondents felt that ecosystem destruction, urban growth, and industrial development would threaten the entire Great Lakes system.

During the next fifteen years, toxic and conventional pollutants are expected to be critical problems that must be addressed by policy makers in the Great Lakes region.

### **Recommendations**

The preceding chapters identify a number of issues facing the Great Lakes which require careful attention from policy makers in the future. In broad terms, the key policy issues are:

- o the changing nature of Great Lakes water and related resources;
- o water quality and the threat of toxic pollutants;
- o variability in institutional perceptions of environmental problems; and
- o the desirability of proactive and ecosystem-based water resource planning.

## **The Changing Nature of Great Lakes Water and Related Resources**

Dynamic land use changes are occurring within the Great Lakes shoreline regions. For example, conversion of land from agriculture to residential/industrial uses is occurring throughout the region. Nearly 60% of the 1986 respondents reported a substantial degree of urbanization; an increase from the 44% that reported the same degree of urbanization in 1971.

**Because changes in land use are widespread and are most likely irreversible, regional and local policy makers should monitor and regulate land conversion, especially when it involves sensitive wetlands and wildlife habitats.**

The high lake levels of 1986 are history. Although this historical event was a critical issue for the governmental representatives who were queried, it is clear that high lake levels are a temporary feature of a natural cyclical process. If lake levels continue to significantly rise and fall, it is likely that public pressure to further regulate individual Great Lakes will intensify.

**In the view of most water policy experts, lake level regulation is unnecessary, and even undesirable. Policy makers should therefore devise more effective means of communicating these realities to the public in times when lake levels are significantly different from their pre-existing long-term averages. At the same time, local regulatory devices such as zoning should be used to discourage high density development adjacent to the shorelines of the Great Lakes.**

The lack of proper marina facilities, identified as a key problem in both 1971 and 1986, poses a dilemma for policy makers. On the one hand, the issue can be resolved by developing new marinas, an initiative that has traditionally been left to the private sector. On the other hand, there is a larger issue of balancing private recreational use of the Great Lakes and their shorelines with the public responsibility of protecting water quality and environmentally sensitive coastlines.

**Policy makers need to satisfy the demand for recreational boating on the Great Lakes while recognizing their responsibility for protecting the integrity of the Great Lakes waters.**

## **Water Quality and the Threat of Toxic Pollutants**

The quality of inshore waters as reported by governmental representatives in the United States improved over the 15-year period. This improvement reflects in part the major expenditure of federal, state, and local funds as well as private industrial funds in compliance with the provisions of the Clean Water Act of 1972. Nevertheless, nearly a third of the governmental representatives felt the quality of their inshore waters is deteriorating.

**Policies must be established in both the United States and Canada to deal with the new challenges to water quality in the Great Lakes.**

**Legislation must be directed toward resolving the problems of non-point source pollution from both urban and rural areas as well as pollution arising from improper disposal of solid, toxic, and hazardous wastes.**

Toxic pollutants in the Great Lakes pose a special dilemma for policy makers. Although toxics are not viewed as equally problematic in all parts of the region, they are uniformly considered a major threat to the entire Great Lakes system. One issue facing government officials is the degree to which perceptions of isolated site-specific toxic pollutants are generally correct. In some instances, the presence of toxics may not be known because reliable scientific data are not available.

**An effective sampling and monitoring program for both toxics and conventional pollutants is needed and should be pursued by governmental agencies throughout the Great Lakes. This issue takes on added regional significance in the U.S. as more responsibility for pollution studies is shifted from the federal government in the U.S. to the individual states.**

The multiple sources of toxic pollutants (i.e. point discharges, non-point [especially agriculture], and airborne) require planners to develop new and improved strategies for limiting the production and discharge of toxic and hazardous wastes.

**Effective and proactive public policy should be established to insure that water quality in the Great Lakes will be enhanced for the benefit of present and future generations.**

#### **Variability in Institutional Perceptions of Environmental Problems**

Differential views on Great Lakes water quality and other environmental concerns exist in the United States and Canada. Policies which are sensitive to different perceptions should be formulated to improve and maintain environmental quality in the Great Lakes. For example, "hot spot" locations focus attention on key localities in both countries where serious problems currently exist.

**Serious consideration should be given to extending the "hot spot" concept by identifying other critical areas or regions which have resource problems beyond toxic and/or conventional pollution. These indicators can serve not only to publicize the location of environmentally critical places but also to aid in establishing priorities for action.**

Current levels of federal funding in the U.S. are insufficient to implement all of the needed water resource programs in the region.

**Increased leadership and coordination in the field of water resources, particularly among states and provinces, are needed. Likewise, the development of new and innovative funding sources, such as trust funds, is essential for planning, enforcement, and regulatory action.**

It is ironic that at a time when increased state and provincial leadership is being called for, these units of local government are seen by governmental representatives as

hindering the maintenance of Great Lakes water quality. The perception of these units as "hindering" in 1986 contrasts with the 1971 data showing that state and provincial governments aid in maintaining water quality.

**A concerted effort is needed to improve the reputation of state and provincial governmental units and reinforce their relationships with both governmental and non-governmental organizations active in the Great Lakes region.**

Surprisingly, about half of the governmental representatives were unable to report on the effectiveness of the 1972 and the 1978 Bi-National Water Quality Agreements between Canada and the United States.

**Federal agencies need to better communicate the content and purposes of U.S.-Canadian agreements to state, provincial, regional, and local governmental units, and to the public in the Great Lakes region.**

### **The Desirability of Proactive and Ecosystem-based Water Resource Planning**

Three planning deficiencies were ranked as most important by the 1986 respondents: (a) inadequate emphasis on water-oriented planning by all levels of government; (b) lack of inter-agency cooperation in planning; and (c) a piecemeal approach to planning which emphasizes solutions to short-term problems.

**Policy makers, especially at the state and provincial level, need to establish a framework for achieving effective and anticipatory water resource planning for the Great Lakes. This framework should establish a long-term perspective which anticipates problems and addresses them before they reach crisis proportions. The creation of an Office of the Great Lakes in the State of Michigan is an example of state commitment to a proactive and long-term framework.**

The 1986 survey identified high lake levels, toxic pollutants, and conventional pollutants as three key issues posing future threats to the Great Lakes.

**Policy makers should recognize the leadership role of state and provincial governments in examining lake levels and toxic and conventional pollutants. However, it is crucial that networks be established to facilitate planning and information exchange between states and provinces on the one hand and federal and international governmental units on the other.**

It is widely accepted that the Great Lakes should be managed as an integrated ecosystem. From a physical systems perspective, the integration of management initiatives makes sense. However, given the complex and vast nature of the Great Lakes institutional structure, this goal has proven elusive. While no one can foresee the future with complete accuracy, it is reasonable to conclude that the problems of sustained resource management of water and related land resources in the Great Lakes region will grow in number and complexity. The ability to meet and resolve these problems will depend in large measure

on the establishment of adequate funding and effective planning and management for the entire Great Lakes.

**The cultivation of intergovernmental cooperation throughout the region is essential to the eventual management of the Great Lakes as a holistic physical system.**

Information from both the 1971 and the 1986 surveys discussed in this report contributes to an understanding of the historic context in which environmental policy has been made and suggests issues that require further actions. Similarly, new information on the perceptions of government representatives about the status of the Great Lakes will help in monitoring the effects of environmental policy in the future.

**Information from both surveys needs to be widely shared with policy makers and planners throughout the region. New information about the perceptions of government representatives can be gleaned from future surveys similar in design to those discussed in this report.**

APPENDIX  
1986 Questionnaire





# 1986 Great Lakes Environmental Resource Study

## A. RESOURCE UTILIZATION AND PLANNING

Please rate the importance of each of the following issues in your jurisdiction by circling the appropriate number.

<u>1. ISSUES DEALING WITH THE DESTRUCTION OF RESOURCES</u>	Not Important			Very Important		Not Applicable
a) Water pollution due to inadequate municipal sewage facilities	1	2	3	4	5	—
b) Water pollution due to inadequate industrial sewage facilities	1	2	3	4	5	—
c) Water pollution due to agricultural runoff	1	2	3	4	5	—
d) Pollution of both land and water due to disposal of solid waste materials	1	2	3	4	5	—
e) Beach and slope erosion	1	2	3	4	5	—
f) Sedimentation due to poor land use practices	1	2	3	4	5	—
g) Alteration of shoreline by filling or dredging	1	2	3	4	5	—
h) The threat of thermal pollution	1	2	3	4	5	—

2. <u>ISSUES DEALING WITH USE OF RESOURCES</u>	Not Important					Very Important	Not Applicable
a) Inadequate accessibility both visual and functional, to the waters edge	1	2	3	4	5	_____	
b) Conflicts over land uses by competing users e.g. developer/conservationist	1	2	3	4	5	_____	
c) Poor quality development adjacent to shoreline	1	2	3	4	5	_____	
d) Decreasing land available to public use	1	2	3	4	5	_____	
e) Congestion and inferior facilities in recreation developments	1	2	3	4	5	_____	
f) Reduced enjoyment of shore areas due to erosion prevention structures such as breakwaters or retaining walls	1	2	3	4	5	_____	
g) Lack of proper marina facilities	1	2	3	4	5	_____	
h) Lack of proper port facilities	1	2	3	4	5	_____	

13. ISSUES DEALING WITH  
PLANNING FOR THE  
WISE USE OF RESOURCES

	Not Important			Very Important		Not Applicable
	1	2	3	4	5	—
a) Inadequate emphasis on water oriented environmental planning by all levels of government	1	2	3	4	5	—
b) Lack of inter-agency cooperation with regard to this matter	1	2	3	4	5	—
c) A piecemeal approach to planning-solving of immediate problems with no long range comprehensive planning	1	2	3	4	5	—
d) Need for state or province wide zoning of shorelines	1	2	3	4	5	—
e) Lack of resource information	1	2	3	4	5	—
f) Inadequate zoning and building regulations	1	2	3	4	5	—
g) Lack of planning methods, goals, policies and identification of user values	1	2	3	4	5	—

B. WATER QUALITY

4. How does your agency rate the quality of the inshore waters\* of the Great Lakes in your jurisdiction? (CHECK ONE)

- High quality - no pollution at any time of the year
- Medium quality or generally high quality but some indications of pollution at certain times of year. This does not restrict human use however.
- Low quality or polluted to the extent that human use of the waters is occasionally restricted.
- Very low quality or seriously polluted to the extent that human use of the waters would pose a health hazard.

5. How much of a problem are toxic pollutants in the shore waters within your jurisdiction? (CIRCLE A NUMBER)

Not a Problem					Very Big Problem
1	2	3	4	5	

SKIP TO QUESTION 9

6. Where are the toxic pollutants located? (CHECK ALL THAT APPLY)

- In the water column
- Sediments
- Fish
- Other (SPECIFY: \_\_\_\_\_)

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\* Inshore waters are generally considered waters from the shoreline to the place where the depth is 60 feet.



10. How important is each of the following possible solutions to the problem of deteriorating water quality in your jurisdiction?

	Not Important			Very Important	
a) More funds to upgrade waste water treatment plants	1	2	3	4	5
b) Stricter enforcement of existing regulations and standards	1	2	3	4	5
c) New regulations aimed at further restricting the sources of pollution	1	2	3	4	5
d) Redistribution of responsibility for pollution control among existing government agencies	1	2	3	4	5
e) The creation of new agencies with responsibility for water pollution control	1	2	3	4	5
f) Increased leadership from public officials in the field of water quality	1	2	3	4	5
g) Increased coordination of the activities of the existing agencies who have responsibility for managing the water quality in your area	1	2	3	4	5

11. Have attempts to improve and maintain the quality of the inshore waters in your area been aided or hindered by the following groups? To what degree have the groups been influential?

	Aid	Hinder	Hardly any influence in your area			A great deal of influence in your area	
			1	2	3	4	5
Conservation groups	___	___	1	2	3	4	5
Ecology activists	___	___	1	2	3	4	5
Rod and gun clubs	___	___	1	2	3	4	5
Professional planners, landscape architects, engineers, etc.	___	___	1	2	3	4	5
Other civic associations (SPECIFY) _____	___	___	1	2	3	4	5
Student groups	___	___	1	2	3	4	5
Real estate developers	___	___	1	2	3	4	5
Homeowners	___	___	1	2	3	4	5
Industrial corporations	___	___	1	2	3	4	5
Utility companies	___	___	1	2	3	4	5
Federal agencies and regulations	___	___	1	2	3	4	5
State agencies and regulations	___	___	1	2	3	4	5
Others (SPECIFY) _____	___	___	1	2	3	4	5

12. There are several activities for protecting water quality and shorelines in the Great Lakes. Please indicate how much responsibility your agency has for each of the following within your jurisdiction.

	No Responsibility at All			Complete Responsibility	
	1	2	3	4	5
a) Financing sewer construction	1	2	3	4	5
b) Financing storm drain construction	1	2	3	4	5
c) Industrial pollution control	1	2	3	4	5
d) Solid waste disposal	1	2	3	4	5
e) Thermal pollution control	1	2	3	4	5
f) Boat sewage discharge	1	2	3	4	5
g) Erosion control	1	2	3	4	5
h) Industrial development	1	2	3	4	5
i) Marshland development	1	2	3	4	5
j) Cluster development	1	2	3	4	5
k) Construction of recreational facilities	1	2	3	4	5
l) Zoning	1	2	3	4	5
m) Preservation of natural shoreline	1	2	3	4	5
n) Land use planning	1	2	3	4	5
o) Regional planning	1	2	3	4	5



13. How responsible are the following agencies and/or groups for protecting the water quality within your jurisdiction?

	Not Responsible	Partially Responsible	Completely Responsible
Federal	1	2	3
State/Provincial	1	2	3
Regional	1	2	3
Local	1	2	3

14. For agencies having responsibility, how effective have they been in protecting the water quality adjacent to your jurisdiction?

	Not Effective				Very Effective
Federal	1	2	3	4	5
State/Provincial	1	2	3	4	5
Regional	1	2	3	4	5
Local	1	2	3	4	5

15. For each agency, check the main implementing mechanism(s) used to protect water quality adjacent to your jurisdiction. Indicate how effective each mechanism checked has been in protecting water quality.

	Mechanism In Use	Not Effective	1	2	3	4	5	Very Effective
<b>a. FEDERAL</b>								
1) Regulations	—	1	2	3	4	5		
2) Incentives	—	1	2	3	4	5		
3) Legislation	—	1	2	3	4	5		
<b>b. STATE/PROVINCIAL</b>								
1) Regulations	—	1	2	3	4	5		
2) Incentives	—	1	2	3	4	5		
3) Legislation	—	1	2	3	4	5		
<b>c. REGIONAL</b>								
1) Regulations	—	1	2	3	4	5		
2) Incentives	—	1	2	3	4	5		
3) Legislation								
<b>d. LOCAL</b>								
1) Regulations	—	1	2	3	4	5		
2) Incentives	—	1	2	3	4	5		
3) Legislation	—	1	2	3	4	5		

16. What additional implementing mechanisms would more effectively protect the water quality adjacent to your jurisdiction?

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17. Are there inter-agency initiatives that your agency participates in to protect the water quality adjacent to your jurisdiction?

Yes       No      -----> SKIP TO QUESTION 20

18. What is the major initiative? \_\_\_\_\_

19. Is it effective?       Yes       No

20. My agency thinks the 1972 Water Quality Agreement between Canada and the United States has been effective.

Very True       Somewhat True       Not Very True       Not At All True       Don't Know

21. My agency thinks the 1978 Water Quality Agreement between Canada and the United States has been effective.

Very True       Somewhat True       Not Very True       Not At All True       Don't Know

C. CHANGING WATER LEVELS

22. How much of a problem are high lake water levels adjacent to your jurisdiction?

Not a Problem				Very Big Problem	
1	2	3	4	5	

23. For each of the following, how significant is the impact of high lake water levels adjacent to your jurisdiction?

	Very Significant Impact			Not a Significant Impact	
	1	2	3	4	5
a) Flooding	1	2	3	4	5
b) Shoreline erosion	1	2	3	4	5
c) Loss of private beachfront	1	2	3	4	5
d) Loss of public beachfront	1	2	3	4	5
e) Decreasing tourism	1	2	3	4	5
f) Wetlands	1	2	3	4	5

24. Should government take action to minimize the variability of lake levels in the future?

\_\_\_ Yes                      \_\_\_ No

25. Does your organization/agency recommend additional diversions of the Great Lakes to decrease current high lake water levels?

Yes

No

----> GO THE QUESTION 28

26. Which of the following lakes should these additional diversions come from: (CHECK AS MANY AS YOU WISH)

Lake Erie

Lake Huron

Lake Michigan

Lake Ontario

Lake Superior

27. Should the quantity of water diverted reduce the average lake level by: (CHECK ONE)

6 inches or less

About 6-12 inches

More than one foot

Don't Know

D. THE FUTURE

28. How big a threat will each of the following pose to the inshore water within your jurisdiction in the next 15 years?

	Not a Threat				Major Threat
	1	2	3	4	5
a) Toxic pollution	1	2	3	4	5
b) Other types of pollution	1	2	3	4	5
c) Ecosystem destruction	1	2	3	4	5
d) Urban growth	1	2	3	4	5
e) Recreational growth	1	2	3	4	5
f) Industrial development	1	2	3	4	5
g) Nuclear power plant construction	1	2	3	4	5
h) Fossil fuel plant construction	1	2	3	4	5
i) Agricultural development	1	2	3	4	5
j) Mining operations	1	2	3	4	5
k) Diversion/consumptive use	1	2	3	4	5
l) High lake levels	1	2	3	4	5
m) Other _____	1	2	3	4	5

29. How big a threat will each of the following pose to the entire Great Lakes system during the next 15 years?

	Not a Threat				Major Threat
	1	2	3	4	5
a) Toxic pollution	1	2	3	4	5
b) Other types of pollution	1	2	3	4	5
c) Ecosystem destruction	1	2	3	4	5
d) Urban growth	1	2	3	4	5
e) Recreational growth	1	2	3	4	5
f) Industrial development	1	2	3	4	5
g) Nuclear power plant construction	1	2	3	4	5
h) Fossil fuel plant construction	1	2	3	4	5
i) Agricultural development	1	2	3	4	5
j) Mining operations	1	2	3	4	5
k) Diversion/consumptive use	1	2	3	4	5
l) High lake levels	1	2	3	4	5
m) Other _____	1	2	3	4	5

30. Does the 1985 Great Lakes Charter between the 8 Great Lakes states and the 3 Canadian provinces provide a useful mechanism for addressing these threats?

\_\_\_ Yes

\_\_\_ No

\_\_\_ Don't Know

JURISDICTION/AGENCY CHARACTERISTICS

Which of the following best represents your agency? (CHECK ONE)

- |  |   |
|--|---|
| <input type="checkbox"/> Township              | <input type="checkbox"/> State/Provincial |
| <input type="checkbox"/> County                | <input type="checkbox"/> Regional         |
| <input type="checkbox"/> City                  | <input type="checkbox"/> Federal          |
| <input type="checkbox"/> Other (SPECIFY) _____ |   |

The population density of the area under your agency's jurisdiction, in number of persons per square mile is: (CHECK ONE)

- |                                       |  |
|---------------------------------------|--|
| <input type="checkbox"/> Less than 20 | <input type="checkbox"/> 100-499           |
| <input type="checkbox"/> 20-49        | <input type="checkbox"/> 500-999           |
| <input type="checkbox"/> 50-99        | <input type="checkbox"/> Greater than 1000 |
| <input type="checkbox"/> Unknown      |  |

The area under your jurisdiction can be classified primarily as the following: (CHECK ONE)

- |                                       |   |
|---------------------------------------|---|
| <input type="checkbox"/> Industrial   | <input type="checkbox"/> Recreational               |
| <input type="checkbox"/> Residential  | <input type="checkbox"/> Wild                       |
| <input type="checkbox"/> Agricultural | <input type="checkbox"/> Residential and Industrial |

Thank you for completing the questionnaire. If you have any additional comments, please add them in the space below.



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