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September 29, 1989

RTI/7839/02-03F

A Survey of the Status of Biomonitoring in State NPDES and Nonpoint Source Monitoring Programs

by

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Contract Number: 68-01-7350

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EPA 1079

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ACKNOWLEDGMENTS

Many individuals from the States, EPA Regional offices, and EPA Headquarters assisted the authors in the preparation of this document and deserve special thanks. First and foremost are Mr. William Painter of the Office of Policy, Planning, and Evaluation, Water Branch, who provided the original impetus and direction for this project and Dr. James Plafkin of the Office of Water Regulations and Standards, Assessment and Watershed Protection Division (AWPD), who as chairman of the EPA Ecological Assessment Policy Workgroup facilitated the use of the workgroup as a forum for exchanging information on biomonitoring. Special thanks is due the EPA Regional staff members on the EPA Ecological Assessment Policy Workgroup (listed in Table 2-1) who served as both sources of information interfacing directly with State contacts and as primary reviewers of information gleaned from various literature sources. Thanks is also due to other AWPD staff including Ms. Alice Mayio for her assistance in obtaining the required 305(b) reports and to Mr. Wayne Praskins for providing RTI with the results of the Lake Water Quality Standards questionnaire. Finally, thanks are extended to all the State employees who contributed information and clarified specific issues related to their monitoring programs.

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SECTION 1

INTRODUCTION

In December 1985, the U.S. Environmental Protection Agency (EPA) Office of Water and the EPA Office of Policy, Planning, and Evaluation (OPPE) initiated a major study of the Agency's surface water monitoring activities. The resulting report, *Surface Water Monitoring: A Framework for Change* (U.S. EPA, 1987), recommended the restructuring of existing monitoring programs to better address EPA priorities (toxics, nonpoint source pollution, and documentation of environmental improvements). One specific recommendation of the report was that EPA needed to accelerate the development and application into surface water monitoring programs of promising biological monitoring methods, including bioassay testing, instream biosurveys (including the EPA's Rapid Bioassessment Protocols [RBPs]), and tissue residue analyses for toxics.

In mid-1988, the Research Triangle Institute (RTI) was contracted by the EPA OPPE to survey the use of biomonitoring methods by States in their National Pollutant Discharge Elimination System (NPDES) and nonpoint source (NPS) monitoring programs. This report documents the use of biomonitoring methods by 50 States, the District of Columbia, the U S. Virgin Islands, and Puerto Rico. Only the Territories of American Somoa and Guam are not included.

Section 2 of this report summarizes the State NPDES biomonitoring requirements (both bioassay testing and instream biosurveys) placed on industrial and municipal permittees and each State's capabilities to conduct bioassay testing and biosurveys to monitor the effects of industrial and municipal discharges.

Section 3 presents information on St ...e surface water monitoring programs that address NPS impacts in rivers, lakes, and coastal/estuarine waters. In most cases, these programs assess point source impacts as well because NPS monitoring in many States is an offshoot of

1-1

these summaries were prepared, some States were undergoing major reevaluations of their various surface water monitoring programs, which involved implementing new requirements in their NPDES programs and redirecting some predominantly point source monitoring efforts toward NPS problems. Thus the summaries may reflect a mixture of both the old and new requirements or procedures used in some States' programs.

The EPA has not had the results of this report verified independently, nor have individual States verified the information in the State summaries. The intent of this report is to provide general summary information on the use of biomonitoring in State surface water monitoring programs No attempt has been made to compare the magnitude and intensity of biomonitoring efforts among States

SECTION 2

SURVEY OF BIOMONITORING USE IN NPDES PROGRAMS

2.1 NPDES INFORMATION ACQUISITION

The Research Triangle Institute (RTI) conducted a two-tiered search of the available information on the use of biomonitoring in various State NPDES programs. First, appropriate literature on State surface water monitoring programs was identified and obtained for review. Second, EPA Regional and State personnel involved in evaluating or developing State biomonitoring programs were contacted by telephone, letter, or in person as part of RTI's assistance to approximately 32 States in the preparation of their 304(I) reports.

2.1.1 Review of State Water Quality Monitoring Programs

The primary sources of information reviewed to prepare the summary sheets for each State, the District of Columbia, the U.S. Virgin Islands, and Puerto Rico (see Appendix A) include the following documents:

- Individual State 1988 305(b) reports (see Section 4 for a complete list);
- U.S. EPA. August 1987. *Program Survey--Biological Toxicity Testing in the NPDES Permits Program*. U.S. EPA, Permits Division, Office of Water Enforcement and Permits, Washington, DC; and
- U.S. EPA. January 1987-March 1989. Surface Water Assessment Program--Status Reports U.S. EPA, Office of Water, Office of Water Regulations and Standards, Washington, DC.

2.1.2 Assistance of State and EPA Regional Staff

A second method of identifying information to include in the State summaries involved contacting appropriate EPA Regional staff who routinely evaluate and review State monitoring programs; in specific cases, State personnel directly involved in surface water monitoring activities were contacted. To verify the accuracy of the prepared summary data sheets, each EPA Regional representative to the EPA's Ecological Assessment Policy Workgroup

Table 2-1. EPA Regional Representatives of the EPA Ecological Assessment Policy Workgroup

EPA Regional contacts

States within Region

Headquarters

James Plafkin Assessment and Watershed Protection Division Office of Water Regulations and Standards 401 M Street, SW Washington, DC 20460 (202) 382-7005

EPA Region 1

Michael Bilger Environmental Services Division 60 Westview Street Lexington, MA 02173 (617) 860-4342

Corrine Kupstas Water Management Division John F. Kennedy Office Building Boston, MA 02203 (617) 565-3546

EPA Region 2

Jim Kurtenbach Environmental Services Division Building 209 Woodbridge Avenue Edison, NJ 07828 (201) 321-6695

EPA Region 3

Ron Preston Environmental Services Division 303 Methodist Building 11th and Chapline Wheeling, WV 26003 (304) 233-2315 Connecticut Maine Massachusetts New Hampshire Rhode Island Vermont

New Jersey New York Puerto Rico Virgin Islands

Delaware District of Columbia Maryland Pennsylvania Virginia West Virginia

(continued)

See notes at end of table.

Table 2-1 (continued)

EPA Regional contacts

EPA Region 8

Bill Wuerthele Water Management Division 999 18th Street, Suite 500 Denver, CO 80202 (303) 293-1586

EPA Region 9

Jacques Landy Water Management Division 215 Fremont Street San Francisco, CA 94105 (415) 974-8294

EPA Region 10

Rick Albright Water Management Division 1200 Sixth Avenue Seattle, WA 98101 (206) 442-8514

Evan Hornig Water Management Division 1200 Sixth Avenue Seattle, WA 98101 (206) 442-1685

States within Region

- Colorado Montana North Dakota South Dakota Utah Wyoming
- Arizona California Hawaii Nevada American Samoa** Guam**

Alaska Idaho Oregon Washington

*Formerly the Monitoring and Data Support Division (MDSD).

**These two territories were not assessed in this report.

• Types of bioassay tests required, including test type (acute or chronic), specific test duration (hours or days), test design considerations (static, static renewal, or flowthrough), test organisms used (fish, invertebrate, algae), and test species used (if identified)

2.2.1.2 State Bioassay Capabilities. The second entry to the column headed

"Bioassay testing" in Figure 2-1 identifies each State's capabilities for conducting bioassay

testing including information on:

- Types of bioassays conducted, including test type (acute or chronic), specific test duration (hours or days), test design considerations (static, static renewal, or flowthrough), test organisms used (fish, invertebrate, algae), and test species used (if identified);
- Availability and use of mobile bioassay laboratory for conducting in situ bioassay testing: and
- Assistance given by Regional EPA laboratories or contractors in conducting bioassays for States that do not possess in-house capabilities.

For the purpose of this report, the term "the State" refers to the State agency responsi-

ble for surface water monitoring, and, in the summary tables and maps provided, a State is

identified in a specific category based only on capabilities of its surface water quality

monitoring agency For some States, no bioassay capabilities are described. This means that

the State surface water monitoring agency has no capabilities to conduct bioassay testing;

however, it does not necessarily mean that there are no capabilities to conduct bioassay

testing within the State Some States receive assistance from EPA Regional laboratories

and/or contractors. The reader should refer to the State-specific information given in

Appendix A

2.2.2 Instream Biosurveys

2.2.2.1 Permittee Requirements. The first entry in the column headed "Biosurveys" in

Figure 2-1 identifies the permit requirements for conducting biosurveys, including information (where available) on

- Type of dischargers (municipal or industrial) required to conduct biosurveys;
- Type of biosurvey conducted (upstream/downstream comparisons, before/after studies);
- Site-specific design considerations (duration of sampling, season of sampling, number of samplers used, and number of replicates);

State	1	lype al Permil	100		Bioassay R	lequirements		Blasurvey Requirements			
	Ind only	Mun only	16 M	None	Acute only	Chronic only	ASC	Nese	Comments		
AL			•				•	•			
AK			•				•		Biosurvey requirements are facility-specific. One permittee is required to monitor intertidal invertebrates and algae		
AZ			•		•			•			
AR			•				•	•			
CA			•		•				Specific major municipals in southern California applying for 301(h) permits or waivers and coastal putp and paper mills in northern California are required to conduct periodic biosurveys		
со			•				•		No State facilities are required to conduct biosurveys but two Federal facilities have biosurvey requirements.		
ст			•		•			•			
DE			•		•			•			
DC		•				•		•			
FL			•				•	•			
GA			•		•			•			
HI			•		•				Dischargers applying for 301(h) permits or waivers must conduct biosurveys of benthic, epibenthic, and planktonic organisms		
ID			•				٠		Several permits currently include biosurvey requirements		
IL.			•				•	•			
IN			•				•	•			
IA				•				•			
KS				•				•			
KY			•		:		•	•			
LA			•				•		Specific industrials must conduct biosurveys of fish and macroinvertebrates upstream and downstream of the discharge		

Table 2-2. Summary of Permittee Biomonitoring Requirements for the NPDES Program

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State	1	ype of Permit	lee		Bloassay A	e qui rements		Biosurvey Requirements			
	ind only	Men only	iam	None	Acute only	Chronic only	A&C	None	Comments		
PR	•	0					•	•			
AI			•		•			•			
SC			•				•		Several older industrial permits require blosurveys; these requirements are being phased out at permit renewal and are not included in new permits		
SD			•				•	•			
TN			•				•	•			
TX			•				•	•			
UT			•				•	•			
VT				•					A new program will require specific dischargers to monitor macroinvertebrates using rock-filled baskets upstream and downstream from the discharge		
VA			•				•		Specific dischargers must monitor macroinvertebrate commu- nities.		
VI				•				•			
WA			•				•	•	· · · · · · · · · · · · · · · · · · ·		
wv			•		•				Several industrial permits require macroinvertebrate biosurveys		
wi			•				•	•			
WY			•				٠	•			

Table 2-2. (continued)

o The State is considering adding bloassay requirements to municipal permits.

I & M = Industrial and municipal A & C = Acute and chronic



					Freshwater Specie	8		E	stuarine/Ma	rine Species	
	State	Daphnia sp.	Ceriodaphnia dubia	Pimephales prometas	Selenastrum capricornutum	Others	Mysidopsis bahia	Cyprinodon variegatus	Champia parvula	Others	Comments
	AL	A	A,C	A,C							
	AK					A.COncorhynchus kisutch Coho salmon smoll A.CO gorbuscha-Pink salmon smolt CThymallus arcticus-Arctic grayling	A,C			A-Rhepoxynius dubois A-Cancer magister-Dungeness crab A,C-Mytilus edulis-Blue mussel A,C-Crassostrea gigas-Pacific oyster A,C-Menidia sp -Silverside	
	AZ					A-with species recommended in EPA 600/4-85-013					
Ņ	AR	•	A,C	A,C							
15	CA			A		A-Salmo gairdneri-Rainbow trout A-Notemigonus crysoleucas- Golden shiner A-Gasterosteus aculeatus- Three-spine stickleback					Many marine/estuarine permit do not specify species to be used or exposure duration Bioassay requirements are contained in the California Ocean Plan document, however, specific requirements are only now being determined
	со		A,C	A,C							
	ст	A		A			•				
	DE	A		A							
	DC		С	с							
	FL		С	С		A-with three species (a lish, an invertebrate, and one species recommended in EPA 600/4-85/013					
	GA	A	A	A							
	_						*				

Table 2-3. Summary of Species Used by Permittees in NPDES Bioassay Testing Programs

(continued)

										_
				Freshwater Specie	8		E	stuarine/M	rine Species	
State	Daphnia Sp.	Ceriodaphnia dubia	Pinephales promotas	Selenastrum capricornutum	Others	Mysidopsis bahla	Cyprinedon variegatas	Champia parvuta	Others	Comments
MT		A,C	A,C							
NE		A	A							
NV		A	A		A-Salmo clarki-Cutthroat trout fry					
NH	A		A							
NJ	с		A,C			A	A			
NM	•	A,C	A,C							
NY	A,C		A.C		······································					
NC	•	A,C			·		-			
ND		A,C	A,C							
он		A,C	A,C	A					· · · · ·	
ОК	A	A.C	A,C							
OR		A,C	A,C		A,C-Salmo gairdneri-Ralnbow trout					
PA		A,C	A,C							
PR					A,C-Species not specified in permits					
AI	A		•							
sc	A	A,C			A-Lepomis macrochirus-Bluegill sunlish	A				
SD		A,C	A,C							
TN	A	С	A,C							
TX	A	A,C	A,C			A.C	A,C			

Table 2-3. (continued)

chronic testing in 34 States; fathead minnows are used for acute and/or chronic testing in 41 States; and *Selenastrum* is used for testing in 4 States Other species commonly required in NPDES permits in seven States with coldwater fisheries (Alaska, California, Idaho, Maine, Nevada, Oregon, and Washington) include several salmonids (coho and pink salmon and rainbow, brook, and cutthroat trout) Arizona and Florida allow some choice in selection of test species from among species recommended by the EPA (1985). The recommended species are summarized in Table 2-4.

For permittees discharging into estuarine/marine waters, the three most commonly required species include the mysid shrimp (*Mysidopsis bahia*), the sheepshead minnow (*Cyprinodon variegatus*), and the red algae (Champia parvula). *Mysidopsis* is used in acute and/or chronic testing in eight States, sheepshead minnows are used in acute and/or chronic testing in six States, and *Champia* is used in one State. Other estuarine/marine species used include the Pacific oyster, Blue mussel, two species of the benthic amphipod *Rhepoxynius*, and several sea urchins.

2.3.1.2 State Bioassay Capabilities. Detailed information on individual State capabilities for conducting bioassay testing is presented in Appendix A. These same data are summarized in Tables 2-5 and 2-6 for the reader's convenience. Table 2-5 summarizes State capabilities for conducting bioassay testing and instream biosurveys. In Table 2-5, State bioassay capabilities are identified that include the types of testing conducted and the availability of a State and/or Region-operated mobile bioassay laboratory for conducting in situ bioassays.

State capabilities for conducting bioassay testing are summarized in Figure 2-4 Seventeen States and Territories have no bioassay testing capabilities. They are Alaska, Anzona, California, District of Columbia, Idaho, Iowa, Nebraska, Nevada, New Mexico, North Dakota, Pennsylvania, Puerto Rico, South Dakota, Texas, Utah, the Virgin Islands, and Wyoming. Twelve States and Territories have capabilities to conduct only acute bioassay testing, and two States conduct only chronic bioassay testing. The remaining 22 States have both acute and chronic testing capabilities.

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Table 2-4. Footnotes

^aTo avoid unnecessary logistical problems in trying to maintain different test temperatures for each test organism, it would be sufficient to use one temperature (12 °C) for coldwater organisms and one temperature (20 °C) for warmwater organisms.

^bThe optimum life stage is not known for all test organisms.

- ^CMayes et al. (1983) found no significant difference in the sensitivity of fish ranging in age from 10 to 100 d in tests with nine toxicants.
- ^dDaphnia pulex is recommended over *D. magna* because it is more widely distributed in the United States, test results are less sensitive to feeding during tests, and it is not as easily trapped on the surface film.

Table 2-5. (continued)

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		81	oassay Capal	billty			Biosurvey Capability									
State		Tes	Types		Mob Ava	ile Lab Ilable			Org	anisms Sampled			Sampling Method			Analyses
	None	Acute	Chronic	A&C	State	Region	None	Fish	Macrolinv	Macrophyles	Periphyton	Plankton	Artificial substrate	Natural substrate	RBP	Metrics/Index
IN		•			•	•	-	•	•			•	•	•		
IA	•			[•									
ĸs		•						•	•	1	•			•	1	
KY				•	•	•		•	•	•				•	•	
LA				8				8	•			•				Species diversity and the index o community loss are determined The IBI is used to evaluate lish data.
ME	-			•	•	•			•				•			
MD				•		•		***	•							Species diversity and community structure are evaluated.
MA		•			•	•			•					•	•	Species richness, distribution, % pollution-tolerant species, EPT index, and feeding habits are determined. Hilsenoff's Biotic Index is used to evaluate data
MI .				•	•	•		•	•					•		The number of taxa, the abun- dance, and the number of indica- tor species are evaluated.
MN				•	•	•	•							•	•*	
MS		•			•	•		•	•	•	•		•	•	•	Species diversity is evaluated
MO			•						•					•	•	
MT		[•			•			•	•		•				
NE	•							•	•							IBI is used to evaluate fish data, ICI is used to evaluate macro- invertebrate data
NV	•					•		•	•		•					

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		Blosssay Capability							Blesurvey Capability									
	State		Test	Types		Met Art	ile Lab ilable	Organizms Sampled						Sampling Method			Analyses	
		None	Acute	Chronic	ALC	State	Region	None	Fish	Macrolev	Macrophyles	Pariphylae	Plankton	Artificial substrate	Hatural substrate	RBP	Metrics/Index	
	тх	•							•	•					•	•		
	UT	•					•		•	•				•	•		BCI is used to evaluate data	
	τv		•				•			• .					•		Species diversity and taxa richness are determined	
2-25	VA			1	•	٠	•	1 - 1	-	•							Community structure is evaluated for taxa presence/absence, abundance, and distribution.	
	vi	•					•		•	•		<u>,</u>						
	MA				•		•			•								
	wv				•		•			•								
	MI .				•	٠	•		٠	•	•	٠	•					
	WY	•					•		•		<u> </u>							

Table 2-5. (continued)

Biota sampled to monitor community structure.

* State is currently evaluating EPA's RBP for use in its biomonitoring program.

- A&C = Acute and chronic.
- BCI = Biotic Condition Index.

- ICI = Invertebrate Community Index.
- heb = Index of Well Being
- EPT = Ephemeroplera, Plecoptera, Trichoptera. IBI = Index of Biolic Integrity.

- MBI = Macroinvertebrate Biotic Index.
- RBP = Rapid Bioassessment Protocol

A mobile bioassay laboratory is available to 20 States located predominantly in Regions 1, 2, 4, and 5 to conduct in situ bioassays, but 33 States have no mobile bioassay laboratory (Figure 2-5). Most EPA Regions have a mobile bioassay laboratory available with the exception of Regions 6 and 7; the Region 2 mobile laboratory is currently not operational (Figure 2-6).

Table 2-6 summarizes species used by States in NPDES bioassay testing. Nineteen States currently conduct freshwater testing with the water fleas *Daphnia pulex* or *D. magna*. These species are primarily used in acute testing. The water flea *Ceriodaphnia dubia* is currently used in 23 States for acute and/or chronic bioassay testing, and 6 additional States are developing testing capabilities with this species. Similarly, the fathead minnow is currently used in 21 States for acute and/or chronic testing, and 3 additional States are developing testing capabilities with this species. The freshwater algae *Selenastrum capricornutum* is used in four States, and two additional States are developing testing capabilities. Arizona, Florida, Massachusetts, and Oregon are conducting microbial assays using Microtox^R; New Jersey is using the Ames/*Salmonella* assay to assess mutagenicity of effluents.

The use of bioassay testing in estuarine/marine waters is primarily limited to three species: the mysid shrimp (*Mysidopsis bahia*), the sheepshead minnow (*Cyprinodon variegatus*), and the red algae (*Champia parvula*). Four States currently conduct estuarine/marine testing with *Mysidopsis* (Florida, Maryland, Mississippi, and Virginia), three States currently conduct testing with the sheepshead minnow (Louisiana, Maryland, and Virginia), and Florida currently conducts testing with *Champia parvula*. Other species used in testing include the silversides (*Menidia beryllina* and *M. menidia*), the Blue mussel, and the Pacific oyster Three States also use Microtox^R for estuarine/marine screening (Florida, Massachusetts, and Washington).

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<u> </u>		·····		Freshwater Specie	8		6	rine Species		
State	Daphnia sp.	Certedaphnia dubia	Pinophales prometas	Selenastrum capriconautum	Others	Mysidepsis bahta	Cyprinodon variegatus	Charwpia parvela	Others	Comments
IA	A**		A**							NBC. Assistance provided by Region 7 and University of Iowa's State Hygienic Lab
KS	A		A							
KY	A,C		A,C		A.CPimephales promelas Fathead minnow sediment elutriate bioassays					
LA	۸	С	с				С			
ME		A,C								
MD	A	с*	A,C*			С	С			
MA	A**	c**	A**,C**		A-Microlog ^{A_}	A** C**			A-Microtox ^R C-Mylikus edulis-Blue mussel bioaccumulation study ^{**}	Assistance provided by EPA- Lexington Laboratory and contractors
MI			A		A,C-Caged fish used for ambient bloassays					
MN	A	A,C	A,C							
MS	A		•			A			A-Mysidopsis almyra	
MO		С	С							
MT		C								
NE	A**		A**							NBC Assistance provided by EPA for acute toxicity testing
NV										NBC Assistance provided by EPA-Duluth
NH	A	С								

Table 2-6.	(continued)
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				Freshwater Specie	1		E	rine Species		
State	Daphela sp.	Ceriodaphnia dubia	Pimephales prometas	Selenastrum capricomutum	Others	Mysidopsis bahla	Cyprinodon variegatus	Champia parvela	Others	Comments
IJ			A		A-Lepomis macrochirus- Btuegill suntish A-Ames/Salmonella testing					
NM		A**,C**	A**,C**							NBC. Assistance provided by EPA Regional Laboratory
NY		A,C								
NC		A,C	A							
ND		A*,C*	A*,C*	A*,C*						NBC Assistance provided by EPA-Duluth and EPA-Corvallis
он		A,C	A,C							
ок					A-Indigenpus fish species					
OR	A,C	С	A,C	С	A-Microtox ^R A-Chironomus sediment bloassay A-Gammarus sp. A-Hyalella azteca C-Caged fish and invertebrate studies					
PA		A**,C**	A**,C**							NBC Assistance provided by EPA-Wheeling, West Virginia Laboratory
PR										NBC Assistance provided by EPA Region 2 to develop bioassay test strategy
RI	A	A,C	<u> </u>			A**				Assistance provided by EPA-Narragansett Laboratory for marine bioassays
SC		A,C								
SD										NBC

Table 2-6.	continued)
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(continued)

	Freshwater Species			I	Estuarine/Marine Species					
State	Daphnia sp.	Coriodaphnia dubia	Pimephales promelas	Selenastrum capricomutum	Others	Mysidopsis bahia	Cyprinodon variegatus	Champia parvuia	Others	Comments
TN		A,C	A,C							
тх	A**	C**				A**				NBC Assistance provided by EPA Regional Laboratory and contractors
UT										NBC
VT	A	с*								
VA	A	A,C	A,C			A,C	A,C		A,C-Menidia menidia	
VI										NBC
WA		A,C							C-Rhepoxynius abronius amphipod sediment bioassay A-Microtox ^R sediment test A-Crassostrea gigas-Pacific oyster A-Mytilius edu lis -Blue mussel	
wv	A	С	A,C							
WI	A	A.C	С							
WY										NBC Assistance provided by EPA-Duluth Laboratory for acute and chronic testing.

Table 2-6. (continued)

A = Acute testing (< 96 hr exposure).

C = Chronic testing (>96 hr exposure).

NBC = No bioassay capabilities.

"State not currently conducting bloassays; capabilities under development "No State bloassay capabilities, contractor and/or EPA Regional lab conducts testing for the State



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2.3.2 Instream Biosurveys

2.3.2.1 Permit Requirements. Detailed information on individual State biosurvey requirements for permittees is presented in Appendix A. The same data are summarized in Table 2-2 for the reader's convenience. Very little specific information was available on permit requirements.

Requirements in NPDES permits for conducting instream biosurveys are summarized in Figure 2-7. Dischargers in 13 States may be required to conduct biosurveys to evaluate the impacts of their effluent on ambient biological communities. The reader should consult Appendix A for details on the specific requirements for biosurveys imposed by each of these States. RTI did not review specific permits in these 13 States to obtain specific information on the ecological communities chosen for biosurvey monitoring, the sampling method used, or the metrics used to assess community impacts. Although information was lacking for several States, eight States required permittees to conduct biosurveys of the benthic macroinvertebrate community at several sites in the receiving waterbody both upstream and downstream of the discharge. Specific information was also lacking on data analysis methods and metrics required to evaluate the biosurvey data.

2.3.2.2 State Capabilities. Detailed information on individual State capabilities for conducting biosurveys is presented in Appendix A. The same data are summarized in Table 2-5 for the reader's convenience. Biosurvey capabilities summarized in this table include identification of the biota sampled, sampling methods used (specifically for macroinverte-brates), and the methods of data analysis including the metrics or biological indexes applied.

State capabilities for conducting biosurveys associated with NPDES monitoring programs are summarized in Figure 2-8. Nine States do not conduct biosurveys (Alaska, Arizona, California, Hawaii, Iowa, Minnesota, New Hampshire, North Dakota, and Puerto Rico) The remaining 44 States and Territories use biosurveys to some extent to evaluate potential impacts to indigenous biological communities in the vicinity of point source discharges.





Of the 44 States with capabilities to conduct biosurveys, 1 State monitors fish only, 15 States monitor macroinvertebrates only, 16 States monitor both macroinvertebrate and fish communities, and 12 States monitor three or more different biological communities; however, macroinvertebrates are always one of the three groups sampled. Macroinvertebrate and fish communities are the predominant communities targeted for monitoring in a total of 43 and 28 States, respectively.

Several trends are apparent in sampling method and data analysis procedures associated with macroinvertebrate community assessments (see Table 2-5). Macroinvertebrates are sampled only on natural substrates in 15 States, only artificial substrate samplers are used in 2 States, and both natural and artificial substrate sampling is conducted in 10 States. For 20 States, information was lacking on sampling method used for macroinvertebrate biosurveys. Currently, 17 States use rapid bioassessment techniques or are evaluating the EPA's (1989) RBPs for use in their own State NPDES monitoring programs. These States are Alabama, Arizona, Arkansas, Colorado, Connecticut, Idaho, Kentucky, Massachusetts, Minnesota, Mississippi, Missouri, New York, North Carolina, Ohio, South Carolina, Tennessee, and Texas.

The most commonly applied data analysis techniques used on macroinvertebrate community data include the Invertebrate Community Index, the Biotic Condition Index, and the Shannon-Wiener Diversity Index. Species diversity, taxa richness, abundance, dominance, equitability, similarity, and the percentage of pollutant-tolerant and -intolerant species are used in various combinations to evaluate macroinvertebrate community structure. For many States, information was lacking on the specific data analysis methods or metrics used to evaluate macroinvertebrate community data

Several trends in sampling method and data analysis procedures are also apparent in fish community assessments. Although not summarized in Table 2-5, fish are sampled primarily using electrofishing techniques in conjunction with seining or trawling procedures, depending on the type and size of the waterbody sampled. The most commonly applied data

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analysis techniques used to evaluate fish community data include the Index of Biotic Integrity, the Biotic Condition Index, the Index of Well Being, and the Index of Community Loss. Species diversity, taxa richness, abundance, number of families, and number of indicator species are also used in various combinations to evaluate fish community structure. For many States, information was lacking on the specific data analysis methods employed or metrics used to evaluate fish community data.

2.4 SUMMARY

2.4.1 Comparison of Permittee Bioassay Testing Requirements with State Bioassay Testing Capabilities

It is clear from Fable 2-7 that in-house State capabilities for conducting bioassay testing to verify discharger toxicity testing results are lacking in some States, particularly for the *Ceriodaphnia* and fathead minnow bioassays in freshwater and the *Mysidopsis* and sheepshead minnow bioassays in estuarine/marine waters. Currently, 28 percent of all States have no in-house capabilities for conducting any freshwater bioassays and 76 percent of States with coastal/estuarine waters have no capabilities for conducting any marine/estuarine bioassays Even if States that use contractors or receive assistance from EPA Region laboratories are included, the total percent for marine/estuarine bioassays. Considering the essential nature of estuarine waters as nursery areas for valuable commercial fish and shellfish species, this deficiency in State capabilities should be of concern. Although many of these States receive assistance from EPA Regional laboratories or contractors to conduct bioassay testing, this assistance is usually provided for special toxicity evaluations at specified facilities each year and does not approach the magnitude or frequency of bioassay testing conducted by States with in-house capabilities.

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Number of States requiring species use by permittee	Number of States with in-house testing capability for the species		
26	19		
34	29 ^a		
41	24 ^D		
4	4 ^C		
8	4		
6	3		
1	1		
	Number of States requiring species use by permittee 26 34 41 4 4 8 6 1		

Comparison of Permittee Bioassay Testing Requirements Table 2-7. with State Bioassay Testing Capabilities

^aTotal includes six States developing this testing capability. ^bTotal includes three States developing this testing capability.

^CTotal includes two States developing this testing capability.

2.4.2 Comparison of Permittee Biosurvey Requirements and State Biosurvey Capabilities

A comparison of permittee requirements and State biosurvey capabilities reveals that, although 13 States require specific permittees to conduct biosurveys (see Figure 2-7), only 10 of these same States have in-house biosurvey capabilities in their surface water monitoring agency. In three States (Alaska, California, and Hawaii), the agency responsible for surface water monitoring has no capabilities to conduct biosurveys. Nationally, however, 44 States have some capabilities to conduct biosurveys associated with NPDES monitoring programs (Figure 2-8).

SECTION 3

SURVEY OF BIOMONITORING USE IN NPS PROGRAMS

3.1 NPS INFORMATION ACQUISITION

RTI conducted a two-tiered search of the available information on the use of biomonitoring in various State NPS programs. First, appropriate literature on State surface water monitoring programs was identified and obtained for review. Second, EPA Regional and State personnel involved in evaluating or developing State biomonitoring programs were contacted by telephone, letter, or in person as part of RTI's assistance to approximately 32 States in the preparation of their 304(I) reports.

3.1.1 Review of State Water Quality Monitoring Programs

The primary sources of information reviewed to prepare the summary sheets for each State, the District of Columbia, the Virgin Islands, and Puerto Rico (see Appendix B) include the following documents:

- Individual State 1988 305(b) reports (see Section 4 for a complete list);
- U.S. EPA. February 1988. The Lake and Reservoir Restoration Guidance Manual U.S. EPA, Criteria and Standards Division, Nonpoint Sources Branch, Washington, DC;
- U.S. EPA. January 1987-March 1989. Surface Water Assessment Program--Status Reports. U.S. EPA, Office of Water, Office of Water Regulations and Standards, Washington, DC; and
- North American Lake Management Society September 1987. Water Quality Standards for Lakes: A Survey. Tennessee Valley Authority, Knoxville, TN, pp. 1-2. (This survey was completed by State personnel and made available to RTI by Dr. Wayne Praskins of AWPD.)

3.1.2 Assistance of State and EPA Regional Staff

A second method of identifying information to include in the State summaries involved contacting appropriate EPA Regional staff who routinely evaluate and review State monitoring programs; in specific cases, this entailed contacting State personnel directly involved in surface water monitoring activities. To verify the accuracy of the prepared summary data sheets, each EPA Regional representative to the EPA's Ecological Assessment Policy

Workgroup coordinated the review of the State summaries prepared by RTI within his or her respective region. The Chairman and EPA Regional representatives of the Ecological Assessment Policy Workgroup are identified in Table 2-1.

3.2 COMPILATION OF BIOMONITORING DATA ASSOCIATED WITH NPS PROGRAMS

The primary source documents were reviewed and pertinent information was extracted and transferred to summary data sheets (Figure 3-1). These summary data sheets highlight basic information on biomonitoring (primarily biosurveys and toxics monitoring in fish/shellfish tissue) used by each State as part of its surface water monitoring program directed at NPS pollution assessment. The summary data sheets are arranged alphabetically by State in Appendix B.

The detail of the summary information provided in Appendix B reflects the level of detail in the State 305(b) reports and other literature sources; in some cases, this material was supplemented by information received from EPA Regional reviewers and State staffs. In some but not all cases, individual State staff reviewed a draft copy of their State's summary data sheet entries; however, States did not review the final summaries.

The format for the State summaries of biomonitoring in NPS programs is shown in Figure 3-1 Information for each State is summarized in a narrative under three primary headings: River Monitoring Program, Lake Monitoring Program, and Coastal/Estuarine Monitoring Program. Under these three headings, a variety of State-specific programs are discussed as they relate to NPS monitoring including such programs as:

- Ambient water quality monitoring,
- Ambient biological monitoring,
- Toxics monitoring,
- Intensive surveys,
- Citizen monitoring,
- Clean lakes monitoring,
- Use attainability studies,

3-2
Survey of Monit	oring in NPS Programs
State	
State Acronym	RIVER MONITORING PROGRAM
	LAKE MONITORING PROGRAM
	COASTAL/ESTUARINE MONITORING PROGRAM

- Intensive river basin studies, and
- Waterbody-specific studies

Although the survey of State NPS monitoring programs was originally conceived to identify the biomonitoring methods used (biosurveys and tissue residue analyses), information on chemical/physical water quality monitoring is also provided because some States do not conduct biosurveys or monitor tissue residues for toxics; however, these States have developed extensive chemical/physical monitoring programs to identify problems and assess trends in NPS pollution. In order to provide the most comprehensive perspective on State initiatives related to NPS monitoring, chemical/physical monitoring information was included.

As stated previously, for the purposes of this report, the term "the State" refers to the State agency involved in surface water monitoring. If other State agencies are involved in monitoring, they are mentioned as appropriate; however, in the summary tables and maps provided, a State is identified in a specific category based only on the capabilities of its surface water quality monitoring agency. The reader should refer to the State-specific summaries given in Appendix B for more detailed information.

3.3 NPS MONITORING PROGRAM RESULTS

Detailed information on the use of various monitoring methods in NPS programs is summarized for each State in Appendix B. The biomonitoring methods evaluated focus on instream biosurveys and tissue residue analyses using various aquatic organisms as indicators of toxics contamination. The use of chemical/physical water quality monitoring is also discussed

The discussion of each monitoring method has been divided into three areas associated with the three major ecosystems (rivers, lakes, and coastal/estuarine areas) that are monitored For biosurvey programs, the following information is identified for each of the three ecosystems:

- Monitoring approach (e.g., fixed-station, intensive survey, or ecoregion);
- Biological community sampled (e.g., fish, macroinvertebrate, macrophyte, periphyton, plankton);

- Sampling method used for benthic macroinvertebrates (artificial substrate, natural substrate, or use of a rapid bioassessment method); and
- Data analyses procedures including the identification of various biological indices and metrics

For tissue residue analysis programs, the following information is identified for each of the three ecosystems:

- Monitoring approach (e.g., fixed-station or intensive survey); and
- Biota sampled for toxics analyses (e.g., fish, macroinvertebrates, and/or macrophytes).

And for the chemical/physical water quality monitoring programs, the monitoring approach is identified for each of the three ecosystems.

3.3.1 Biosurveys

3.3.1.1 Rivers. The approach used by States to conduct biosurveys in rivers is shown in Figure 3-2 and additional details are summarized in Table 3-1. The largest number of States (18) conduct biosurveys using a combined fixed-station and intensive survey approach. The fixed-station approach allows the State to track long-term changes in ambient biological communities, and the intensive surveys are used to assess site-specific effects of NPS pollution on ambient communities. These latter studies are typically used to assess impacts of acid mine drainage, runoff from hazardous waste sites, urban runoff discharged via combined sewer overflows (CSOs), or pesticide runoff from agricultural/silvicultural operations. Twelve States conduct only intensive surveys, 9 States use a fixed-station approach, and 8 States (Alaska, California, Hawaii, Iowa, New Hampshire, North Dakota, Puerto Rico, and the Virgin Islands) conduct no biosurveys in rivers. Six States currently use or are evaluating use of a fixed-station and/or intensive survey approach coupled with an ecoregion approach whereby waterbodies within the State are classified within a specific ecoregion based on similar land surface form, land use, natural vegetation, soil type, habitat, and complement of resident biota. These States are Arizona, Arkansas, Minnesota, Nebraska, North Carolina, and Ohio.



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State	a Biological Sampling							Аррговс	h	Sampling Method			Analyses
	None	Fish	Macrolov	Macrophyles	Pariphytan	Plankten	Fixed	Intensive	Ecoregien	Artificial	Natural	RSP	Metrics/Index
AL		o	•				•	• 0 ▲		•	•	•	Species diversity, equitability, EPT index, taxa richness, and species composition are determined
AK	•			· · · · · · · · · · · · · · · · · · ·									
AZ		ο	•*				o ▲	• 0	••			••	An ecoregion approach and RBP are being evaluated
AR		•	•				•	• •	•		•	•	Community diversity, Dominants-In-Common Taxa Index, Quantitative Similarity Index, taxa richness, Indicator Assemblage Index, missing genera, functional group percent similarity, Shannon-Wiener Diversity Index, and relative abundance are determined.
CA		0					0	0					Fish are monitored for toxics
со		• 0	•					• •				•*	State is evaluating metrics in EPA's RBP
ст		• 0	•				•	• •			•	•	EPA's RBP will be incorporated into the State programs.
DE		0	•					● 0 ▲					Species diversity, species richness and tolerance/ Intolerance to pollution are determined
DC		0	•			•	•	ο					
FL		ο	•				0 ▲	•		•	•		Shannon-Wiener Diversity Index and Beck's Biotic Index are used to evaluate data
GA		•	•				•	•					Species diversity, equitability, taxa richness, and relative abundance are determined
HI	•												

Table 3-1. Summary of State Monitoring for NPS Programs-Rivers

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State	Biological Sampling							Арргаас	h	Sam	pilny Mothe	d	Analyses
	None	Flak	Macrolev	Macrophyles	Periphyten	Plankton	Fixed	Intensive	Ecorogien	Artificial	Natural	RSP	Metrics/index
ID			•								•	•	State is proposing ambient macroinvertebrate monitoring network using wire baskets
1L		• •	•				• 0 •	• • •		•	•		Karr's IBI is used for fish data; MBI is used for benthos
IN		•	•			•	• 0 •	• 0 4		•	•		Fish species diversity and community structure and macroinvertebrate species diversity and abundance are assessed
IA		0						o ▲					
ĸs		•	•		•		● ○ ▲	• 0 4			•		MBI is used to determine use support
KY		•	•		•	•	• 0 ▲	• 0 ▲					Taxa richness, species diversity, equitability, and relative abundance are determined for dialoms Relative abundance, species richness, composi- tion, and IBI are used on fish data. Community structure of macroinvertebrates is determined
LA		•	•					• • •					IBI, species diversity, and index of Community Loss are used to evaluate fish and macroinver- tebrate data.
ME		o	•				•	ο		•			
MD		é O	•			•	• 0 4	•		•	•		Community structure and species diversity are assessed
MA		•	•			•		• • •			•	•	Species richness, distribution, balance, EPT Index percent contribution of pollution-tolerant species and feeding habits are determined. Hitsenhoft's Biotic Index is used to evaluate data
MI		•	•								•		Number of taxa, relative abundance, and pollution- sensitive indicator species are determined

Table 3-1.	. (continue	:d)
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State			Bie	logical Sampling				Арргиас	h	Sampling Method			Analyses
	None	Fish	Macrotev	Macrophyles	Periphyten	Plankton	Fixed	Intensive	Ecorogion	Artificial	Natural	RBP	Metrics/index
MN		•						• 0 ▲	•			••	The State is interested in developing fish commun- ity biocriteria based on ecoregions and using the IBI to evaluate data. The State is interested in using RBPs in a proposed macroinvertebrate sampling program
MS		• 0	• 0	•	•		● 0 ▲			•	•	•	Species diversity is determined for all data, standing crop and percent coverage are determined for macrophytes.
MO		• 0	•				0 ▲	• 0 4			•	•	Rapid stream assessments (macroinvertebrates) are used in mining studies. Fish populations are evaluated before and after BMP implementation
мт		0 0	•		•			• 0 ▲		•	•		
NE		• 0	•				0 ▲	•	•				Macroinvertebrae data are evaluated using an ICI and Chutter Biotic Index. Total taxa, EPT taxa, percent intolerant and tolerant taxa, are also deter- mined. Fish data are evaluated using an IBI. The number of various species based on leeding habit, family, pollution tolerance, and fish condition are also determined
NV		ο	•		•		• 0 ▲	ο		•	0		Periphyton species are enumerated; total biomass and species diversity are determined for macro- invertebrates
NH	•							•					
NJ		•	• 0		•		•	● 0 ▲					Fish populations are evaluated for species diversity and health
NM		• 0	•			•	•	• 0 ▲					Winget and Mangum BCI and Shannon-Wiener Diversity Index are used to evaluate data
NY		0	• 0				•	• 0 •		•	•	•	Species diversity and richness are determined for macroinvertebrates

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State			Die	iogical Sampling)		Approach			Sampling Nothed			Analyses
	None	Fish	Macrolay	Macrophyles	Periphytee	Plankton	Fixed	Intensive	Ecorogion	Artificial	Natural	RSP	Nesics/index
NC		•	٠				•	• • •	•		•	•	Total taxa, taxa richness of pollution-intolerant EPT, and predominant assemblages are determined for macroinvertebrate data, fish community structure is evaluated.
ND		о						0					
ОН		• 0	•				• 0 ▲	•	•	•	•	•	twb and tBI are used to assess fish data; ICI is used to assess macroinvertebrate data
ОК		• 0	•		•	•	• •	o ▲					A diversity index is used to evaluate macroinver- tebraic and algae data
OR		ο	0			•	•	• •					
PA		• 0	•	•	•	•	● 0 ▲	● 0 ▲					
PR	•												
RI			•				•	•		•			Species diversity, composition, and species pollu- tion tolerance are assessed. Beck's Biotic Index is used to evaluate data.
SC		•	• 0			•	• 0 4				•	•*	Taxa richness, species diversity, equitability, and similarity are determined.
SD		•	•					● 0 ▲					Species diversity and health status of fish are assessed; community structure and diversity of macroinvertebraies are evaluated
TN		• •	•				•	● 0 ▲		•	•	•*	Diversity Index, taxa richness, equitability, and evenness are determined. RBP are being eval- used for macroinvertebrate sampling program
TX		• 0	•	•	•	•	● ○ ▲	•	•				

Table 3-1. (continued)

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State	Biological Sampling							Approac	h	Sam	pling Metho	4	Analyzes
	None	Fish	Macrolov	Macrophyles	Periphyton	Plankton	Fixed	Intensive	Ecoregion	Artificial	Hatural	RBP	Metrics/Index
UT		•	•				•			•	•		BCI is used to assess data
VT		• 0	•				•	0 ▲					Taxa richness and community diversity are used to evaluate macroinvertebrate data, tBI is used to evaluate fish data
VA		ο	•				• 0 •						Community structure, presence/absence, relative abundance, and distribution are determined
VI	٠												
WA		•	•				● ○ ▲	•					
wv		о	•			•	•	• 0 •		•	•		
WI		•	•		•		•		•		•		Hilsenoff's Blotic index is used to evaluate macroinvertebrate data.
WY		•						• • •					

Table3-1. (continued)

Biota sampled to monitor community structure

O Biota sampled to monitor tissue residues of pesticides, metals, and other priority pollutants

▲ Water sampled to monitor conventional, nonconventional, or priority pollutants

* Program currently under development

BCI = Biotic Condition Index.

BMP - Best Management Practice

ICI = Invertebrate Community Index

Iwb = Index of Well Being

- EPT Ephemeroptera, Plecoptera, Trichoptera
- MBI = Macroinvertebrate Biotic Index RBP = Rapid Bioassessment Protocols

IBI = Index of Biotic Integrity

The types of biological communities sampled in river biosurveys are summarized in Figure 3-3 and Table 3-1. Sixteen States collect both macroinvertebrates and fish, 9 States collect primarily macroinvertebrates, 2 States (Minnesota and Wyoming) collect primarily fish, and 18 States collect other biota (three or more different biota). In this latter group of States, all 17 sample macroinvertebrates, 14 sample fish, 12 sample plankton, 10 sample periphyton, and 3 sample macrophytes. Of the 45 States and Territories that conduct biosurveys, macroinvertebrates and fish communities are the predominant communities targeted for monitoring in a total of 42 and 32 States, respectively.

Several trends are apparent in sampling method and data analysis procedures associated with macroinvertebrate community assessment. Macroinvertebrates are sampled on natural substrates only in 10 States, only artificial substrate samplers are used in 2 States, and both natural and artificial substrate sampling is conducted in 13 States. Currently, 15 States use rapid bioassessment techniques or are evaluating the EPA's (1989) RBPs for use in their State NPS monitoring programs. These States are Alabama, Arizona, Arkansas, Colorado, Connecticut, Idaho, Massachusetts, Minnesota, Mississippi, Missouri, New York, North Carolina, Ohio, South Carolina, and Tennessee.

The most commonly applied data analysis techniques used on macroinvertebrate community data include the Shannon-Wiener Diversity Index, the Invertebrate Community Index, the Biotic Condition Index, Beck's Biotic Index, and the Macroinvertebrate Biotic Index. Species diversity, taxa richness, indicator species (percent pollution-tolerant and -intolerant species), equitability, abundance, and the Ephemeroptera, Plecoptera, and Trichoptera (EPT) index are used in various combinations to evaluate macroinvertebrate community structure. For many States, information was insufficient on the specific data analysis methods employed or metrics used to evaluate macroinvertebrate community data.

Several trends are apparent in sampling method and data analysis procedures associated with fish community assessment. Although not summarized in Table 3-1, fish are sampled primarily using electrofishing techniques in conjunction with seining or trawling procedures, depending on the type and size of the waterbody sampled. The most commonly





applied data analysis technique used to evaluate fish community data was the Index of Biotic Integrity, which was used by seven States. The Shannon-Wiener Diversity Index, Biological Condition Index, Index of Well Being, and the Index of Community Loss were used less frequently for fish data evaluations. Species diversity, richness, abundance, number of pollution-sensitive or -tolerant indicator species, equitability, and fish health status were used in various combinations to evaluate fish community structures. For many States, information on the specific data analyses methods employed or metrics used to evaluate fish community data was insufficient

3.3.1.2 Lakes The approach used by States to conduct biosurveys in lakes is shown in Figure 3-4 and additional details are summarized in Table 3-2. The majority of States (24) that conduct lake biosurveys use an intensive survey approach, 2 States (Delaware and Wisconsin) use a fixed-lake approach, and 3 States (Pennsylvania, Texas, and Vermont) use both a fixed-lake approach and an intensive survey approach. The intensive survey approach allows States to monitor those lakes where known or suspected pollution problems need to be evaluated, use of the fixed-lake approach allows a specific number of lakes to be monitored each year to evaluate trends in water quality. Many States reported that the intensive monitoring strategy was chosen because of a lack of funding for lake programs. This is further emphasized by the fact that 14 States conduct no biological sampling (either biosurveys or tissue residue analyses) in lakes at all

The types of biological communities sampled in lake biosurveys are summarized in Figure 3-5. In 19 States, monitoring efforts are directed at several different biological communities (including fish, macroinvertebrates, macrophytes, periphyton, and plankton): in 2 States (the District of Columbia and Washington), monitoring is directed exclusively at macroinvertebrates. In 7 States (Arizona, Colorado, Iowa, Louisiana, Mississippi, Missouri, and West Virginia), monitoring is directed exclusively at fish, and in Maryland, monitoring is directed at both macroinvertebrate and fish communities. In the 19 States that conduct biosurveys of from one to five different types of biota, 14 States sample plankton, 12 States sample



State	Biological Sampling							Арргоас	h	Sampling Method			Analyses
	None	Fish	Macroliny	Macrophyles	Periphylon	Plankton	Fixed	Intensive	Ecoregion	Artificial	Natural	RBP	Metrics/Index
AL		0						0 ▲					Fish are monitored for toxics
ΛК	•												
AZ.		•						• • •					Species composition, relative abundance, age, growth condition, and length frequencies are determined for fish Carlson's TSI based on trans- parency, chlorophyll a, total phosphorus, and nitrogen data is used to assess water quality
٨N	•												
CA		()						υ					Fish are monitored for metals, pesticides, and other organic compounds
co		• 0						● 0 ▲					
СІ	•						~						
DE				•			•						Carlson's TSI based on chlorophyll a, transpar- ency, total phosphorus, total nitrogen, and oxygen deficit data is used to assess water quality Macrophyte coverage is assessed
DC			•					•					
FL	•												Carlson's TSI based on chlorophyll a, transparency, lotal nitrogen, and phosphorus data is used to assess water quality
GA	•						•						Carlson's TSI based on chlorophyll a, transparency, and total phosphorus data is used to assess water quality
H	•												
ID I					•			•		•			A TSI of 11 water quality parameters (based on a one-time sampling) was used to classify a subpopulation of the State's lakes. Periphyton growth rates are monitored to evaluate eutrophication.

Table 3-2. Summary of State Monitoring for NPS Programs-Lakes

Slate		Biological Sampling						Approac	h	Sampling Method			Analyses
	None	Fish	Macroinv	Macrophyles	Periphyton	Plankton	fixed	Intensive	Ecoregion	Artificial	Natural	RBP	Metrics/Index
II		•	•	•		•	⊖ ▲	● 0 ▲ .					Carlson's TSI is used to assess the severity of impairment from algae and macrophyle growth The TSI was based on total phosphorus, transparency, and chlorophyll a
IN	•							•					Primary productivity is assessed
IA		•											Fishery assessments are made
ĸs		•	•		•	•	0	• 0 •					Fish tissues are monitored for toxics Carlson's TSI based on chlorophyll a data is used. No metrics are specified for analysis of biosurvey data
KY		0					•	0 ▲					Carlson's TSI based on chlorophyll a data is used to assess water quality
LA		• 0						● ○ ▲		•	Ļ		Total organic carbon (TOC) is used to assess overall lake water quality
ME						•		•					Phytoplankton and zooplankton species composition is assessed
MD		•	•					•					Fisheries surveys are conducted
MA		0		•		•		• 0 ▲					Toxics are monitored in lish and macrophyte lissues Algal counts and chlorophyll a concentra- lions are determined
МІ		0						O ▲					Carlson's TSI based on transparency, chlorophyll a, or total phosphorus is used to assess water quality Fish size and species composition are determined Mercury content of indicator lish species is evaluated
MN		0						() ▲					Carlson's TSI based on transparency, chlorophyll a, and total phosphorus is used to assess water quality
MS		•						•					Fish species identification and population balance are assessed

Table 3-2. (continued)

Table 3-2. (con	tinued)
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State	Biological Sampling						Approach			Sampling Method			Anatyses
	None	Fish	Macrolav	Macrophytes	Periphyton	Plankton	Fixed	Intensive	Ecoregion	Artificial	Natural	RBP	Metrics/Index
MO		• 0											Fish populations are monitored for pesticide contamination and predator-prey dynamics
MT	•							•					A contractor monitors nutrients and algal growth
NF	•							•					Carlson's TSI based on mean summer transparency is used to assess water quality
NV		0					o	0 ▲					
NH				•		•		•					Taxa identification, percent abundance, and density are assessed for phytoplankton and zooplankton. Abundance of macrophytes is evaluated.
N.I		٠		•		•		•					Fish species identification and health are assessed
NM		0	•			•							Winget and Mangum BCI and Shannon-Wiener Diversity Index are used to evaluate macroinver- tebrate data
NY		0	0			•							
NC						•		•					NC's TSI based on total phosphorus, total organic nitrogen, transparency, and chlorophyll a is used to assess water quality. Phytoplankton species composition is assessed
ND		0						0 ▲					
он				•				•					A Lake Condition Index with IBI (fish) and 12 other biological, chemical, and physical parameters is being implemented
ОК		o) •					Carlson's TSI based on chlorophyll a is used to assess water quality
OR _		•	•	•				•		•	•	•	Fish species and age class structure are determined

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State	Biological Sampling							Approach			pling Metho	d	Analyses
	None	Fish	Macrolnv	Macrophyles	Periphyton	Plankton	Fixed	Intensive	Ecoregion	Artificial	Natural	RBP	Metrics/Index
PA		•	•	•		•	•	•					
PR	•							•					
FI -	٠												
SC		()					0 ▲						
SD						•		•					Algal species identification or chlorophyll a concentration is determined
IN		0						0 ▲					
IX		•	•	•	•	•	•						Carlson's TSI based on transparency, chlorophyll a, and total phosphorus data is used to assess water quality
UT	•												
VI	,	•	•	•			•						Trophic condition is determined using transpar ency, chlorophyll a, and mean phosphorus data Macrophyte density is assessed
VA		0		•		•	o ▲						Habitat suitability and benthic community structure are assessed
VI	•												
WA			•					•					Benthic community structure is assessed
wv		• 0						● ∪ ▲					Trophic condition of State lakes has never been documented
wi		• 0	•	•		•	• 0 •						TSI based on transparency, total phosphorus and chlorophyll a data is used to assess water quality
WY	•												

 Table 3-2. (continued)

Biola sampled to monitor community structure

 ϕ . Biota sampled to monitor tissue residues of pesticides, metals, and other priority pollutarits

▲ Water sampled to monitor conventional, nonconventional, or priority pollutants

BCI = Biotic Condition Index

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-BP id B sme cols



macrophytes, 8 States sample macroinvertebrates, 8 States sample fish, and 3 States sample periphyton communities in various combinations. Of the 29 States and Territories that conduct lake biosurveys, the fish, plankton, and macrophyte communities are the predominant communities sampled for monitoring in 16, 14, and 12 States, respectively

No trends in sampling method and data analysis procedures are seen associated with fish, macroinvertebrate, and plankton community sampling. Too few States provided specific information in their 305(b) reports on sampling methods or data analysis procedures to assess any trends

3.3.1.3 Coastal/Estuarine Areas The approach used by States to conduct biosurveys in coastal/estuarine areas is summarized in Figure 3-6 and in Table 3-3. Of the 25 States and Territories that have coastal waters, 9 conduct no biosurveys. Of the remaining 16 States that conduct biosurveys, 7 States conduct both fixed-station and intensive surveys, 6 States conduct intensive surveys, and 3 States conduct biosurveys using a fixed-station approach.

The types of biological communities sampled in coastal/estuarine biosurveys are summarized in Figure 3-7. In eight States, monitoring efforts are directed at several different biological communities (including fish, macroinvertebrates, macrophytes, periphyton, and plankton) in various combinations; in five States, monitoring efforts are directed at macroinvertebrates, and in three States, monitoring efforts are directed at both fish and macroinvertebrate communities. In the 16 States conducting biosurveys in coastal/estuarine areas, 10 States sample macroinvertebrates, 8 sample plankton, 5 sample fish, 3 sample macrophytes, and 1 samples periphyton. Macroinvertebrates, plankton, and fish communities are the three predominant communities sampled for monitoring.

No trends in sampling methods and data analyses are seen with macroinvertebrate. plankton, and fish community sampling. Too few States provided specific information in their 305(b) reports on sampling methods or data analyses procedures used to assess any trends.





State	Biological Sampling							Approach			pling Metho	d	Analyses
	None	Fish	Macrolov	Macrophyles	Periphylon	Plankton	Fixed	Intensive	Ecoregion	Artificial	Natural	ABP	Metrics/Index
A1		•	•				•						Taxa richness, species composition, and relative abundance are determined
АК	•												
CA			()				U						State Mussel Watch Program monitors 14 heavy metals and 41 synthetic organic compounds in mussel and clam tissue along 1,100 miles of coast- line at 135 stations
CI		0	Ö				A	0 ▲					State Bioaccumulation Monitoring Program monitors residues of loxicants in finfish and shellfish tissues in Long Island Sound
DF		0	0	•		•							State has extensive program to monitor long-term productivity of Inland Bays. Fish and shelllish are screened for toxics.
1L			• 0				•	• 0 •			•		Species composition, density, and taxa richness are assessed. TSI is modified for use in evaluating eutrophication in estuaries. Shellfish tissues are monitored for metals.
GA			U				•	0					Chlorophyll a analyses are used to evaluate water quality Shellfish are monitored for metals and organic compounds
н		n	0			•	•	O ▲					Fish and shellfish are monitored for toxicants
LA		•	0			•		● ○ ▲					Species diversity is assessed, chlorophyll a concentrations are determined. Fish and shellfish are monitored for pesticides and priority pollutants
ME			•					•					The State's biologically based water classification system for estuarine waters is under development Species diversity is assessed
MD		• 0	• •	•		•	• 0 •	• 0 •			•		Biomass and dominant species of benthos are assessed, plankton species composition and lish species composition are determined. Macroinver- tebrates and fish are monitored for metals and organic compounds.
ΜΛ				•		•							Algal species composition and chlorophyll a concentrations are determined
MS			•		•	•	•	•		•			Benthic macroinvertebrate community structure and periphyton plankton community structure are assessed. Chlorophyll # concentrations are determined.

Table 3-3. Summary of State Monitoring for NPS Programs—Coastal and Estuarine Waters

Slate	Błołogical Sampling						Approach			Sampling Method			Analyses
	None	Fish	Macrotov	Macrophyles	Periphylon	Plankton	Fixed	Intensive	Ecoregion	Artificial	Natural	RBP	Metrics/Index
NH	•												
NJ		0	C			• ,	•						Chlorophyll a analyses and species composition are determined for phytoplankton. Fish and shell- lish are monitored for toxic pollutarits
NY		o	0					0 ▲					
NC		0	•				•	• 0 •			•		Taxa richness and species composition are deter- mined. Fish are monitored for metals, pesticides, and other organics.
0R		0	O					O ▲					Fecal coliform concentrations are monitored. Fish and shellfish are monitored for pesticides, metals, and other organics.
PA	•												Fecal coliform concentrations are monitored
RI			· 0			• •		• 0					Species composition is determined. Shellfish are monitored for lecal coliform and metals
SC		0	• 0								•		Multihabital sampling for benthos is conducted and species composition and taxa richness are determined. Fish and shelllish are monitored for toxics.
TX		•	•				• 0	•					Fish are monitored for metals and organics
VA		0						0					
VI		•	•					•					
WA		0	•				• 0 ▲	•			•		The number of taxa, abundance, equitability, and dominance of pollution-sensitive/tolerant species are determined. Shannon-Wiener Diversity Index and an infaunal trophic index are used to assess benthic community structure.

Table 3-3. (continued)

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Biola sampled to monitor community structure

Biota sampled to monitor tissue residues of pesticides, metals, and other priority pollutants.

▲ Water sampled to monitor conventional inonconventional, or priority pollutants



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3.3.2 Tissue Residue Sampling

3.3.2.1 Rivers The approach used by States to conduct tissue residue sampling in rivers is shown in Figure 3-8 and additional details are summarized in Table 3-1. The majority of States (27) conduct tissue sampling programs using an intensive survey approach, 10. States use a combination of the fixed-station and intensive survey approaches, and 9 States use a fixed-station approach. Seven States (Alaska, Hawaii, Idaho, New Hampshire, Puerto Rico, Rhode Island, and the Virgin Islands) either have no tissue residue sampling program in rivers or contract this work to universities, private consultants, other State agencies, or Federal agencies (e.g., U.S. EPA, U.S. Fish and Wildlife Service, or U.S. Forestry Service). The reader should consult Appendix B for detailed State-specific information on toxics monitoring.

The specific riverine community or communities that are targeted for tissue residue sampling are summarized in Figure 3-9. The majority of States (39) monitor fish tissues exclusively, seven States (Arkansas, Connecticut, Mississippi, New Jersey, New York, South Carolina, and Oregon) monitor both fish and macroinvertebrate tissues

3.3.2.2 Lakes. The approach used by States to conduct tissue residue sampling in lakes is shown in Figure 3-10 and additional details are summarized in Table 3-2. The majority of States (28) conduct no tissue sampling to mollitor for toxics contamination or contract this work to universities, private consultants, other State agencies, or Federal agencies (U S EPA, U S Fish and Wildlife Service, or U S Forestry Service). The reader should consult Appendix B for detailed State-specific information on toxics monitoring. Of the remaining States (25), the majority (19) conduct tissue residue sampling as part of intensive surveys in areas known or suspected of having toxics problems, four States (Illinois, Kansas, Nevada, and Virginia) conduct tissue residue sampling using both a fixed-station monitoring network and intensive survey approach, and two States (South Carolina and Wisconsin) use a fixed-station monitoring approach.

The specific lacustrine community or communities that are targeted for tissue residue sampling are summarized in Figure 3-11. As was the case for riverine toxics monitoring









Figure 3-11. Types of biota sampled in tissue residue monitoring in lakes.

programs, the majority of States that conduct tissue residue sampling monitor fish tissues exclusively (23), and only two States monitor fish and other biota. Massachusetts monitors fish and macrophyte tissues. New York monitors both fish and macroinvertebrate tissues

3.3.2.3 Coastal/Estuarine Areas The approach used by States to conduct tissue residue sampling in coastal/estuarine areas is shown in Figure 3-12 and additional details are summarized in Table 3-3. The majority of States (13) conduct tissue sampling programs using an intensive survey approach, four States (California, South Carolina, Texas, and Washington) use a fixed-station approach, and only Maryland uses a combination of a fixed-station and intensive survey approach. Seven States (Alabama, Alaska, Maine, Mississippi, New Hampshire, Puerto Rico, and the Virgin Islands) either have no tissue residue sampling program in coastal/estuarine areas or contract this work to universities, private consultants, other State agencies, or Federal agencies (UIS EPA, UIS Fish and Wildlife Service, or UIS Forestry Service). The reader should consult Appendix B for detailed State-specific information on toxics monitoring.

The specific coastal/estuarine community or communities that are targeted for tissue residue sampling are summarized in Figure 3-13. The majority of States that conduct tissue residue sampling (nine) monitor both marine/estuarine fish and macroinvertebrate tissues, four States (North Carolina, Texas, Virginia, and Washington) monitor fish tissues exclusively, four States (California, Florida, Georgia, and Rhode Island) monitor macroinvertebrates exclusively. and Massachusetts monitors macrophyte (algae) tissues

3.3.3 Chemical/Physical Monitoring Programs

3.3.3.1 Rivers The approach used by States to monitor ambient water quality parameters in rivers is shown in Figure 3-14 and additional details are summarized in Table 3-1. The majority of Stales (28) conduct both fixed-station and intensive surveys to assess water quality. Seven States use an intensive survey approach, 10 States use a fixed-station approach, and 5 States (Arizona, Arkansas, Minnesota, Texas, and Wisconsin) use a fixed-station, intensive survey, and/or ecoregion approach. Only Alaska, California, and the



Figure 3-12. Approach used in coastal/estuarine tissue residue monitoring programs.



Figure 3-13. Types of blota sampled in tissue residue monitoring in coastal/estuarine areas.



Figure 3-14. Approach used in river chemical/physical monitoring programs.

Virgin Islands conduct no riverine chemical/physical monitoring or contract this work to universities, private consultants, other State agencies, or Federal agencies (e.g., U.S. Geological Survey). The reader should consult Appendix B for more State-specific monitoring information on chemical/physical monitoring programs.

3.3.3.2 Lakes The approach used by the States to monitor ambient water quality parameters in lakes does not parallel the approach used in rivers, as shown in Figure 3-15 and in Table 3-2. The majority of States (31) conduct only intensive surveys to assess water quality. Six States use a fixed-station approach and 10 States use both a fixed-station and intensive survey approach in lakes. Only 6 States conduct no lacustine chemical/physical monitoring or contract this work to universities, private consultants, or other State or Federal agencies. In Hawaii and the U.S. Virgin Islands, there were no lakes that required monitoring.

The majority of States that conduct chemical/physical monitoring in lakes generally use some Trophic State Index (TSI) to monitor lake water quality degradation. Carlson's Index is the index of choice for most States. These TSIs are based on transparency (Secchi depth), chlorophyll a concentration, total phosphorus concentration, or total nitrogen concentration considered either singly or in various combinations. The use of TSIs is the primary method employed by States in prioritizing or categorizing lakes as to their stage of eutrophication (enrichment with nutrients)

3.3.3.3 Coastal/Estuarine Areas. The approach used by States to monitor ambient water quality parameters in coastal/estuarine areas is shown in Figure 3-16 and additional details are provided in Table 3-3. The largest number of States (10) conduct both fixed-station and intensive surveys to assess water quality. Seven States conduct intensive surveys, and six States use a fixed-station monitoring approach. Only two States (Alaska and California) with coastal/estuarine waters conduct no ambient water quality monitoring or contract this work to universities, private consultants, other State agencies, or Federal agencies (e.g., U.S. Geological Survey). The reader should consult Appendix B for more State-specific monitoring information on chemical physical monitoring programs.





Figure 3-16. Approach used in coastal/estuarine chemical/physical monitoring programs.

3.4 SUMMARY

3.4.1 Monitoring Method Selection

States have used several different combinations of monitoring methods to evaluate the effects of NPS impacts in rivers, lakes, and coastal/estuarine areas. Figure 3-17 summarizes the percentage of States utilizing the various monitoring methods: biosurveys, tissue residue analyses, and chemical/physical water quality analyses. It is clear from this figure that 79.2 percent of all States monitor rivers using all three monitoring methods while only 28.3 percent and 48 percent of all States use this same strategy in monitoring lakes and coastal/estuarine areas, respectively. The emphasis in river monitoring programs is definitely on an integrated approach of the two biomonitoring methods supported by ambient chemical/physical water quality monitoring. If the States that use biosurvey and chemical/physical data are added to those that use all three monitoring programs. For rivers, the use of all other combinations of the three monitoring methods accounts for only 13.2 percent of States. Only 3.8 percent of all States conduct no monitoring of rivers. A national map summarizes the use of the different monitoring methods in rivers (Figure 3-18).

A very different combination of monitoring methods is used by States to assess NPS impacts in lakes (Figure 3-17). It is clear from this figure that lakes are the most poorly monitored ecosystems, with 9.4 percent of States conducting no monitoring. With regard to biosurveys, only 54.7 percent of States use biosurveys in their lake monitoring programs. This includes those States that use all three monitoring methods (28.3 percent) and those that use biosurveys coupled with chemical/physical monitoring (26.4 percent). For lakes, the use of tissue residue analyses and a combination of tissue residue analysis and chemical/physical water quality monitoring accounts for 18.7 percent of State approaches to lake monitoring, and chemical/physical water quality monitoring techniques alone are used in 17.2 percent of State programs. A national map summarizes the use of the different monitoring techniques in lakes (Figure 3-19).


Figure 3-17. Comparison of techniques used by States to monitor NPS impacts in rivers, lakes, and coastal/estuarine areas.



Figure 3-18. Summary of State NPS monitoring approaches in rivers.



For coastal/estuarine monitoring programs, States have adopted a combination of monitoring methods intermediate between those used in rivers and lakes (Figure 3-17) Coastal/estuarine areas are monitored in all but 4 percent of the 25 States with coastal/estuarine waters, which is comparable to the percentage shown for rivers. Sixty-four percent of States use biosurveys in their monitoring approach. This includes those States that use all three monitoring methods (48 percent) and those that use only biosurveys coupled with chemical/physical monitoring (16 percent). This is a higher percentage than that shown for lake monitoring (54.7 percent) but is a lower percentage than that shown for river monitoring (83.0 percent). In coastal/estuarine areas, 24 percent of the States use tissue residue sampling and a combination of chemical/physical water quality monitoring and tissue residue sampling and 8 percent of the States conduct chemical/physical water quality monitoring only. A national map summarizes the use of the various monitoring techniques in States with coastal/estuarine waters (Figure 3-20).

3.4.2 Monitoring Approach

3.4.2.1 Biosurveys. The monitoring approach for conducting biosurveys used by States for river, lake, and coastal/estuarine systems is shown in Table 3-4. The largest percentage of States (34 percent) employ both a fixed-station and intensive survey approach followed by an intensive survey (22.7 percent), fixed-station (16.9 percent), and fixed-station and/or intensive survey and/or ecoregion (11.3 percent) approach. About 15 percent of all States do not conduct biosurveys in rivers. In contrast, lake monitoring is conducted predominantly using an intensive survey approach (45.3 percent), with both the fixed-station approach and fixed-station and intensive survey approach representing 3.8 percent and 5.6 percent, respectively. Forty-five percent of all States do not conduct biosurveys in lakes Coastal/estuarine areas are monitored about equally by States using a fixed-station and intensive survey approach (24 percent), followed by the fixed-station only approach (12 percent). About 36 percent of States with coastal/estuarine areas do not conduct biosurveys

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Figure 3-20. Summary of State NPS monitoring approaches in coastal/estuarine areas.

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Ecosystem	No biosurveys	Fixed- station	Intensive surveys	Fixed- station and intensive surveys	Fixed- station and/or intensive survey and/or ecoregion
Rivers	15 1 (B)	16.9 (9)	22.7°(12)	34 0 (18)	113(6)
Lakes	45.3 (24)	3.8 (2)	45.3 (24)	5.6 (3)	0(0)
Coastal/estuarine areas	36 0 (9)	12 0 (3)	24 0 (6)	28 0 (7)	0 (0)

Table 3-4. Approaches Used by States for Conducting Biosurveys in Different Ecosystems

^aResults are presented as percent of States (number of States) using approach

Table 3-5.	Communities	Sampled	in Biosurvey	Monitoring	Programs
------------	-------------	---------	--------------	------------	----------

Ecosystem	Fish	Macroinvertebrates	Fish and macro- invertebrates	Other biota
Rivers	4 4 (2)	200 (9)	48 9 (22)	267 (12)
Lakes	24 1 (7)	69(2)	3.4 (1)	65 5 (19)
Coastal/estuarine areas	0(0)	31 2 (5)	18 8 (3)	50 0 (8)

^aPercentages are based only on the number of States actually conducting biosurveys

With respect to the communities sampled in biosurveys, there were considerable differences (Table 3-5) In rivers. 48.9 percent of States sample both fish and macroinvertebrates. 26.7 percent sample other biota (this usually included both fish and macroinvertebrate and various combinations of macrophytes, periphyton, and plankton), 20.2 percent sample only macroinvertebrates, and 4.4 percent sample only fish. In lakes, the largest percentage of States (65.5) sample other biota (this usually includes both fish and macroinvertebrates and combinations of plankton, macrophytes, and periphyton), 24.1 percent sample only fish, 6.9 percent sample only macroinvertebrates, and only 3.4 percent sample fish and macroinvertebrates. In coastal/estuarine biosurveys, the largest percentage of States (50 percent) sample other biota (this included fish, macroinvertebrates, plankton, macrophytes, and periphyton in varying combination), 31.2 percent sample only macroinvertebrates, and 18.8 percent sample both fish and macroinvertebrates.

3.4.2.2 Tissue Residue Sampling. The monitoring approach for conducting tissue residue sampling used by States for river, lake, and coastal/estuarine systems is shown in Table 3-6. In rivers, the largest percentage of States (51.0 percent) employ an intensive survey approach, followed by both a fixed-station and intensive survey approach (18.8 percent) and a fixed-station only approach (17.0 percent). For tissue residue monitoring in lakes, the same basic pattern is seen for those States conducting sampling; 35.8 percent employ the intensive survey approach. 7.5 percent employ fixed-lake and intensive survey, and 3.8 percent employ a fixed-lake only approach, however, over 52 percent of States do not conduct tissue residue sampling in lakes. For coastal/estuarine monitoring, States also selected a similar monitoring strategy with 52 percent using an intensive survey approach, 16 percent using a fixed-station approach, and 4 percent using a fixed-station and intensive survey approach. Only 28 percent of the States oid not conduct tissue residue sampling of their coastal/estuarine waters.

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Ecosystem	No sampling	Fixed- station	Intensive survey	Fixed-station and intensive survey
Rivers	13 2 (7)	17.0 (9)	51.0 (27)	18.8 (10)
Lakes	52 8 (28)	38(2)	35.8 (19)	75(4)
Coastal/estuarine areas	28 0 (7)	16.0 (4)	52.0 (13)	40(1)

Table 3-6. Approaches Used by States Conducting Tissue Residue Analysis Monitoring in Different Ecosystems a

^aResults are presented as percent of States (number of States) using approach

Table 3-7.	Biota Sampled in Tissue Residue Monitoring Programs	
	in Different Ecosystems	

Ecosystem	Fish	Macroinvertebrates	Fish and macro- invertebrates	Others
Rivers	80.5 (29)	0 (0)	19.5 (7)	0 (0)
Lakes	92.0 (23)	0(0)	40(1)	40(1)
Coastal/estuarine areas	22 2 (4)	22.2 (4)	50 0 (9)	5 6 (1)

^aPercentages (numbers of States) are based only on the number of States actually conducting biosurveys

The types of biota collected in residue analyses monitoring is similar for all three ecosystems and is limited predominantly to fish and/or macroinvertebrates (Table 3-7). In rivers, 80.5 percent of States sample fish only and 19.5 percent sample both fish and macroinvertebrates. In lakes, 92.0 percent of States sample fish only, 4.0 percent sample both fish and macroinvertebrates, and 4.0 percent sample other biota (macrophytes). In coastal/estuarine areas, 50 percent of States sample both fish and macroinvertebrates (generally shellfish species), 22.2 percent sample only fish, 22.2 percent sample only macroinvertebrates, and 5.6 percent sample other biota (macrophytes)

3.4.2.3 Chemical/Physical Water Quality. The approaches used by States to conduct chemical/physical water quality monitoring are summarized in Table 3-8. In rivers, the largest percentage of States (54.7 percent) employ both a fixed-station and intensive survey approach, followed by a fixed-station approach (18.9 percent), an intensive survey approach (11.3 percent), and a fixed-station and/or intensive survey and/or ecoregion approach (9.4 percent) For chemical/physical monitoring in lakes, a different pattern in the monitoring approach is seen. 58.5 percent of States use intensive surveys, 18.9 percent use the combined fixed-lake and intensive survey approach, and 11.3 percent of States use only a fixed-lake approach. In coastal/estuarine areas, the approach to chemical/physical monitoring is more comparable to that used in rivers. 40 percent of States use a fixed-station and intensive survey approach, 28 percent use an intensive survey only approach, and 24 percent use a fixed-station only approach.

The specific composition of monitoring methods and approaches chosen by States for incorporation into their surface water monitoring programs must take into consideration several important factors including.

- The nature, size, and percentage of waterbodies in each ecosystem encompassed by each State
- The specific nature, magnitude, and sources of pollution problems confronting each. State (e.g., predominantly point source or NPS),
- The in-house capabilities for planning, implementing, and evaluating the results of the various types of biomonitoring as well as associated chemical/physical monitoring efforts

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Ecosystem	No sampling	Fixed- station	Intensive surveys	Fixed- station and intensive surveys	Fixed- station and/or intensive survey and/or ecoregion
Rivers	57(3)	189 (10)	11 3 (6)	54 7 (29)	94(5)
Lakes	113(6)	113(6)	58.5 (31)	18.9 (10)	0 (0)
Coastal/estuarine areas	80(2)	24.0 (6)	28 0 (7)	40 0 (10)	0 (0)

Table 3-8.Approaches Used by States for Chemical/Physical
Water Quality Monitoring in Different Ecosystems^a

^aResults are presented as percent of States (number of States) using approach

- The extent of cooperative monitoring and/or assistance provided to the State by Regional laboratories and/or other Federal agencies conducting monitoring efforts within the State, and
- Most important, the resources available to direct monitoring to those water quality problems in greatest need of identification and mitigation

Differences in the character of the various monitoring programs identified in this survey of 50

States and Territories can be attributed to one or more of these factors

SECTION 4

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APPENDIX A

SURVEY OF MONITORING IN NPDES PROGRAMS

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State	Bioassay testing	Biosurveys

AL Specific primary and secondary industrial and specific municipal dischargers that have toxic effluents are required to conduct acute and chronic bioassay testing. If the receiving stream dilution is greater than 100:1, then only acute testing is required; if less than 100:1, then chronic testing is required.

Dischargers are required to conduct acute 48-hr fathead minnow and/or daphnid tests (using *Daphnia pulex* and *Ceriodaphnia dubia*) and may be further required to conduct chronic 7-d fathead minnow and/or *Ceriodaphnia dubia* tests if acute testing results indicate toxicity.

The State currently has the capabilities to conduct acute 48-hr static and flow-through tests using fathead minnows (*Pimephales promelas*) and *Daphnia pulex* or *Ceriodaphnia dubia* at 50 facilities per year. Chronic toxicity testing using *Ceriodaphnia dubia* and the algae *Selenastrum capricornutum* are scheduled to begin in July 1989. Future bioassay work will include more emphasis on chronic toxicity tests and increased use of the mobile bioassay laboratory.

The State is interested in implementing EPA's Rapid Bioassessment Protocols for its invertebrate monitoring program. Dischargers are not required to conduct biosurveys

The State examines about 20 instream assessment sites per year as part of water quality demonstration and special studies Hester-Dendy substrates and instream handpicking are used to collect macroinvertebrates.

Water quality demonstration studies (conducted on streams before and after wastewater treatment plant construction or upgrades to document stream improvement) above and below stations are monitored for chemical, physical, and biological quality

Special studies are conducted to evaluate pollution complaints, impacts by point and/or nonpoint sources, proposed permit reissuance, water quality standards, and for enforcement activities. Special studies include macroinvertebrate community surveys, chemical/ physical water quality information, and flow measurement. In estuarine/coastal biosurveys, benthic macroinvertebrates are quantitatively sampled (dredge hauls) and evaluated for taxa richness, species composition, and relative abundance

Sediment sampling and primary productivity estimates are made depending on study objectives.

State	Bioassay testing	Biosurveys
AK	Specific industrial and municipal permits require effluent toxicity testing tailored to each discharger. New major municipal permits and minors of concern currently require bioassay testing (e.g., one permittee conducts chronic bivalve testing once per year depending on NOEC values).	One permittee is required to develop a monitoring program to determine the effects of a ballast water treatment system on water quality and marine biota in Port Valdez. The permittee must evaluate sublethal effects on individual organisms and conduct community and population level analyses. The permittee monitoring bas shown a difference in abundance and conation of
	One permittee is required to conduct effluent and in situ toxicity testing. The acute 96-hr LC ₅₉ static tests are con- ducted on three species: a salmonid (coho salmon	intertidal invertebrates and algae and has indicated reduction in growth ring height in barnacles
	[Oncorhynchus kisutch] or pink salmon [Oncorhynchus gorbuscha] smolts), an amphipod (Rhepoxynius dubois), and an economically important crustacean, the Dun- geness crab (Cancer magister). In addition, a 20-d bio- accumulation test using cobo salmon is proposed. The	For new permits, the State may require biological monitoring at fixed stations, bioassays, and chemical studies of effluents, and monitoring of hydrocarbon concentrations in sediments.
	<i>in situ</i> toxicity tests are conducted on four species: two species of litter feeders (the blue mussel [<i>Mytilus edulis</i>] and the brachiopod [<i>Laqueus californianus</i>]) and two species of sediment dwellers (the polychaete worms [<i>Nepthys procera</i> and <i>Nereis sp.</i>]). These if situ tests involve body burden analyses for metals.	The State (Department of Environmental Conservation) currently does not conduct biosurveys; however, the Alaska Department of Fish and Game does conduct bio- surveys in support of special water quality studies
	Another permittee is required to maintain a continuous flow biomonitoring facility. Salmonids are exposed to effluents 10% higher than the concentration projected for	
	the receiving water. The new permit when issued will require bioassays using two species: salmonids and Arctic graylings (<i>Thymallus arcticus</i>).	
	Another permittee is required to conduct marine toxicity	

Another permittee is required to conduct marine toxicity tests, including an echinoderm fertilization test and a larval mussel test.

State	Bioassay testing	Biosurveys
AZ	Acute bioassay testing is required in major industrial and municipal permits Permits require use of test species	Dischargers are not required to conduct biosurveys
	contained in ''Methods for Measuring the Acute Toxicity of Effluents to Fresh Water and Marine Organisms,'' EPA 600/4-85/013. Usually, 100 percent effluent is specified; serial dilutions are not performed.	The State does not currently conduct biosurveys The State is developing a rapid bioassessment protocol for streams based on macroinvertebrates collected from pools and riffle areas.
	Currently, the State does not have the capabilities to conduct whole-effluent toxicity tests. Tests are performed by the EPA Laboratory in Duluth or by two contractors. Some municipalities (e.g., Flagstaff) also have bioassay capabilities.	The State is also evaluating the use of the ecoregion concept to set surface water quality standards Arizona considers that a long-term study (3-5 yr) of the five ecoregions in the State would be required to establish surface water quality standards.

Survey	of	Monitoring	i in	NPDES	Programs	(continued))
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State	Bioassay testing	Biosurveys	
AK (cont.)	Other permittees are required to conduct acute and chronic bioassay testing on a variety of species, includ- ing the oyster (<i>Crassostrea gigas</i>), the blue mussel (<i>Mytilus edulis</i>), the silverside (<i>Menidia sp.</i>), and the opposum shrimp (<i>Mysidopsis bahia</i>).		
	Many offshore oil and gas exploration facilities must bioassay muds and additives to be discharged using <i>Mysidopsis bahia</i> .		
	The State currently does not conduct bioassay tests.		

State	Bioassay testing	Biosurveys
CA	Specific major and some minor industrial and municipal facilities require effluent toxicity testing depending on individual Regional Basin Plan requirements. All	Extensive biological surveys are conducted by ocean dischargers as part of the 301(h) permit process
	industrial and municipal facilities discharging into estuarine or ocean areas are required to conduct acute bioassays.	Specific permits for major municipals in southern California and for coastal pulp and paper mill discharger in northern California contain requirements for conducting periodic biosurveys.
	Specified dischargers are required to conduct acute static 96-hr rainbow (<i>Salmo gairdneri</i>) or steelhead trout (<i>Salmo gairdneri</i>), fathead minnow (<i>Pimephales</i> <i>promelas</i>), golden shiner (<i>Notemigonus crysoleucas</i>), and 3-spine stickleback (<i>Gasterosteus aculeatus</i>) toxicity tests. Region 2 requires an acute flowthrough 96-hr test for some permits (oil refineries). Region 3 is considering requiring a continuous instream toxicity test with rainbow trout for some permits. Generally, 50% survival of the test species is required, assuming 10% mortality in the control; however, some regions require 90% survival. Test frequency depends on the industry involved and may be biweekly, monthly, quarterly, or annually.	The State does not currently conduct biosurveys; however, biosurveys may be conducted as part of special studies within individual regions of the State
	Some inland (freshwater) dischargers are required to do tissue and sediment monitoring. Pulp and paper mill permits require semiannual sampling of crayfish, rainbow trout, and suckers that are analyzed for dioxins and furans	
	The State does not currently conduct bioassay testing	

State	Bioassay testing	Biosurveys
AR	Specific industrial and municipal facilities are required to conduct bioassay testing using acute static 48-hr	Dischargers are not required to conduct biosurveys.
	Daphnia toxicity tests quarterly for 2 yr. A 90% or greater	The State conducts receiving water macroinvertebrate
	survival rate must be achieved in test species. EPA	and sometimes lish assessments at 16-18 paired
	Region 6 requires that both industrial and municipal majors conduct obtable bioaspay testing using the 7 d	stations per year as part of the lixed station water quality
	Ceriodaphnia dubia and 7-d fathead minnow (Pimenhales prometas) test. Acute bioassay testing with	of paired stations situated above and below discharges.
	these species is required in some situations in place of chronic testing.	In FY86-87, the State tested application of a rapid bio- assessment technique of selected habitats (riffles or pools) (Plafkin et al. [1987 and 1989] and Shackleford
	The State conducts acute static 48-hr <i>Daphnia</i> toxicity tests at 6-12 facilities per year. Toxicity tests also are performed in conjunction with Compliance Sampling Inspections to determine the presence of toxicity below discharges. The 24-hr abbreviated definitive test is performed with <i>Daphnia</i> for determining an LC ₅₀ .	[1987 and 1988]). These semiquantitative methods were determined to be more cost-effective. A Biometric Scor- ing System was used to identify severely impaired sites.
	The State is developing facilities to conduct chronic bioassay tests with fathead minnows (<i>Pimepffales promelas</i>) and <i>Ceriodaphnia dubia</i> . Toxicity screening is also carried out using the Microtox ^R assay.	
	To supplement existing biological methods, the State is evaluating the use of <i>Gammarus</i> in sediment bioassays and obviotoxicity testing.	

State	Bioassay testing	Biosurveys
CO	Specific industrial and municipal facilities require acute static 48-hr <i>Ceriodaphnia</i> and acute static 96-hr fathead minnow (<i>Pimephales promelas</i>) toxicity tests. Testing is	In general, dischargers are not required to conduct biosurveys. Permits for two Federal facilities do require instream biosurveys.
	usually quarterly, but can be monthly for larger facilities. Chronic bioassay testing may be required for some	The State Water Quality Control Division conducts
	facilities A new State policy will require bioassay testing for most major permits at renewal.	biosurveys in support of use classification in standards setting. Biosurveys are also used in evaluation of

On selected waters, the State has conducted acute flowthrough 96-hr toxicity tests using fathead minnows, channel catfish (*Ictalurus punctatus*), and rainbow trout (*Salmo gairdneri*) for standards setting purposes The State has the capability to conduct *Ceriodaphnia* and fish bioassays both in a laboratory setting and in the State's mobile bioassay laboratory. The State will conduct future fish bioassays on a site-specific basis as resources allow The State also conducts *Ceriodaphnia dubia* bioassays in constructing ambient toxicity profiles at selected high-priority sites.

EPA Region 8 and the State jointly have conducted upstream/downstream ambient toxicity testing using chronic 7-d *Ceriodaphnia* on waterways of environmental concern using the State's mobile bioassay laboratory In addition, the Region's mobile bioassay laboratory has been used in cooperative studies on State waters. The State Water Quality Control Division conducts biosurveys in support of use classification in standards setting. Biosurveys are also used in evaluation of specific waters listed in the 319 NPS assessment The State is currently evaluating metrics in EPA's Rapid Bioassessment Protocols for use in data assessment

State	Bioassay testing	Biosurveys
СТ	Specific industrial and municipal facilities are required to conduct toxicity testing using a fish and an invertebrate	Dischargers are not required to conduct biosurveys
	species Most dischargers conduct acute 96-hr fathead minnow (<i>Pimephales promelas</i>) tests and acute 48-hr Daphnia tests In the future, it is anticipated that all dis-	The State samples fish and macroinvertebrates at problem-oriented sites (two to five surveys per year).
	chargers whose effluent is known to contain toxics will be required to conduct acute bioassay tests.	Intensive biosurveys of macroinvertebrate communities are conducted at 10 to 20 sites per year in the fall.
	In 1987, the State conducted acute static 48-hr fathead minnow tests and <i>Daphnia pulex</i> tests on whole effluent of all municipal sewage dischargers.	The State maintains 10 fixed stations where the benthic component of the ambient aquatic community is examined.
	The State has a mobile bioassay laboratory and conducts chronic 7-d <i>Ceriodaphnia</i> or acute 48-hr <i>Daphnia pulex</i> bioassay tests for instream monitoring purposes at sites identified as being impacted by a large number of industrial discharges.	The State is incorporating rapid bioassessment methods into its biological monitoring programs.
	Marine bioassay testing is not currently conducted by the State Additional funding is being sought to contract for this capability.	

State	Bioassay testing	Biosurveys
DE	Specific industrial and municipal facilities require bioassay toxicity testing. A discharger must conduct	Dischargers are not required to conduct biosurveys
	three consecutive 48-hr whole-effluent toxicity tests using Daphnia and fathead minnows (Pimephales promelas) guarterly. If average mortality is greater than 20%, the	The State conducts fish and macroinvertebrate surveys at 8 of the 200 monitoring stations per year
	discharger conducts a 96-hr definitive toxicity test to generate an effluent LC ₅₀	Biosurveys are also conducted periodically as part of special studies associated with specific point source or nonpoint source pollution problems
	The State currently conducts a two-phase toxicity	
	evaluation for all dischargers.	Headquarters
	In Phase I, the State conducts an acute static test with Ceriodaphnia and fathead minnows (<i>Pimephales promelas</i>) to screen effluent.	
	In Phase II, only dischargers identified in Phase I as having toxic effluent will be examined Phase II will	
	involve characterization of dischargers effluent through chemical-specific analysis and the use of definitive tox- icity tests Phase II is projected to start in late 1989.	

State	Bioassay testing	Biosurveys
DC	A specific municipal facility requires that monthly chronic 7-d Ceriodaphnia and fathead minnow (<i>Pimephales</i>	Dischargers are not required to conduct biosurveys
	promelas) tests be conducted for the first 2 months of the permit; thereafter, the more sensitive test is continued monthly for the duration of the permit.	The District collects phytoplankton samples monthly at five Potomac River stations, five Anacostia River, and three tributary stations. Zooplankton are collected at two Potomac River and one Anacostia River station
	Daily 24-hr composite-effluent samples are collected for seven consecutive days and are used for test and renewal of serial dilutions of 100%, 50%, 25%, 12 5%, 7%, and 0% effluent The data are analyzed using Probit analysis and/or graphs	A District-wide macroinvertebrate survey collects sam- ples at 11 different sites.

GA COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Fixed-Station Monitoring Network

The primary monitoring activity in estuaries is associated with the fixed-station trend monitoring network Approximately eight stations are located in estuarine areas that are monitored monthly for routine water quality parameters including chlorophyll *a* analysis. Water and sediment are collected at core stations and are analyzed for metals and organics. No macroinvertebrate or fish community sampling is conducted in the coastal/estuarine zone

Toxics Monitoring

At 13 estuarine sites, shellfish are examined for metals and organic compounds.

HI COASTAL/MARINE MONITORING PROGRAM

The State currently does not conduct biosurveys to evaluate water quality In the 1988 305(b) report, the State recommends that consideration be given to the use of biosurveys, particularly in monitoring receiving waters as described below

As noted in the 305(b) report, "Biosurveys are background surveys of organic life found in receiving waters such as streams and coastal waters prior to point and nonpoint discharges by man. Once a representative description of life in the receiving waters is determined, an acceptable rate of decline must also be selected to serve as a warning that unacceptable point and/or nonpoint discharges are occurring such that life in the receiving waters is being threatened. This is a resource intensive approach to water quality antidegradation. In order to develop and implement biosurveys in Hawaii, the Department of Health must form a partnership with the Department of Land and Natural Resources and the U.S. Fish and Wildlife Service who have the knowledge and expertise in regard to organic life in Hawaiian waters. The U.S. Fish and Wildlife Service has already begun doing biosurveys of streams in Hawaii. The biosurvey approach must be adapted to address coastal waters."

Rapid bioassessment protocols may be used by qualified biological personnel in assessing designated use support A use is fully supported if there is no evidence of modification of the community (within the natural range of a control/ecoregion).

Fixed-Station Network

The State has recently approved the implementation of a 208 shoreline and ocean station network covering all major islands that will monitor physical/chemical water quality parameters such as nitrogen, phosphorus, algae, dissolved oxygen, organic carbon content, and concentrations of *Enterococcus* indicator bacteria

Intensive Surveys

The State has conducted intensive monitoring surveys at selected offshore locations to determine normal variations in water quality, particularly in embayments.

Toxics Monitoring

Nearshore fish and marine bottom sediment are collected from selected estuaries to evaluate trends and identify hot spots annually. Fish and shellfish from selected estuaries are also monitored annually for metals, pesticides, and other toxic residues.

Survey of Monitoring in NPS Programs

State

HI LAKE MONITORING PROGRAM

(cont)

Natural lakes in Hawaii are uncommon. The State has only four small lakes. Due to their destinctive nature, assessment under Section 314 of the Water Quality Act of 1987 is not applicable for the purpose of the 305(b) report.

ID RIVER MONITORING PROGRAM

Rapid Bioassessments

The State has started conducting rapid bioassessments using macroinvertebrate communities, although there are few biosurveys conducted except by the State Fish and Game Department. The State is proposing a new ambient monitoring network that would include macroinvertebrate collections (wire baskets).

The State currently does not conduct biosurveys to evaluate water quality. Instream water quality parameters are evaluated to determine the effectiveness of Best Management Practices (BMPs) The State is in the process of developing sediment criteria. Some habitat evaluations are conducted associated with salmonid fisheries

Portneuf River Study

The State has recently completed a water quality report on selected tributaries of the Lower Portneuf River Eight tributaries were chosen as sampling sites to determine the amount of agricultural pollutants that may affect the water quality of the Portneuf River. Nutrients and sediment were the major pollutants during times of high flows, although every stream consistently exceeded most EPA nutrient standards throughout the entire study period. Bacterial counts were inversely related to flow and are another major pollutant during low creek flows.

Rock Creek Rural Clean Water Program

Since 1981, the State has conducted an intensive long-term monitoring study. The study is directed at assessing NPS impacts from irrigated cropland and documenting improvements associated with implementing BMPs. Stream sediments, substrate dissolve oxygen, nutrients, bacteria, and aquatic life are evaluated.

LAKE MONITORING PROGRAM

The State currently does not have a statewide lake monitoring program

Clean Lakes Program

The Trophic State Index (TSI) used to classify a subpopulation of Idaho's lakes through a one- time sampling during peak productivity was developed using a linear-weighted sum of 11 water quality variables.

Cascade Reservoir Study

In 1988, the State began the first State-funded Clean Lakes study of Cascade Reservoir The program will follow Federal guidelines to ensure eligibility for future Federal implementation funding.

IA RIVER MONITORING PROGRAM

Water Quality Assessments

The State does not routinely use biological sampling in the surface water monitoring program. Monitoring programs associated with rivers and streams include a fixed-station monitoring network composed of 59 stations for monitoring changes in water quality parameters, intensive surveys that since 1985 have involved water quality parameters and fish tissue, and sediment monitoring for pesticide residues.

Toxics Monitoring

Pesticide monitoring is conducted in surface waters at 10 stations across lowa.

EPA Region 7 scans for toxics in fish collected at 20 stations on rivers in late summer The State conducts intensive surveys in some waterbodies known to be contaminated with toxic compounds. Channel catfish fillets have been analyzed for chlordane contamination in the Des Moines River and Turkey River.

LAKE MONITORING PROGRAM

Toxics Monitoring

EPA Region 7 scans for toxics in fish collected in specified lakes in late summer.

Intensive Surveys

The State does not use instream biological sampling in its routine surface water monitoring program, but it does conduct limited biosurveys of organisms as part of special intensive surveys. Earlier studies were designed to assess water quality of waterbodies influenced by point sources, but more recent studies reflect the relatively greater impacts of NPS, particularly agricultural and urban runoff on water quality. Between October 1985 and October 1987, several intensive lake studies were conducted associated with NPS programs. These are discussed below.

1986 Iowa Lakes Study

The physical characteristics, water quality, and fisheries of 16 lowa lakes were evaluated during the summer of 1986. The objectives were to provide information to justify selection and funding of NPS pollution control projects, compare water quality data from 1979 to 1986, and to update limnological information.

IA LAKE MONITORING OGRAM

(cont)

1986-1987 Prairie Rose Lake Studies

Between May and September during 1986 and 1987, lake samples were collected to monitor lake quality during implementation of NPS control practices. This was part of the Federal Rural Clean Water Program.

1987-1990 Iowa Lake Studies

Water quality sampling was conducted in the spring and summer of 1987 on five lowa lakes. An assessment of each lake's fishery was compiled. Approximately 30 lakes will be intensively sampled for various physical, chemical, and biological parameters in 1989 and 1990 as part of the State Lake Assessment grant, along with a detailed evaluation of watershed land use and runoff potential.

Survey of Monitoring in NPS Programs

State

ID Lake Pend Oreille Study

(cont.)

Region 10 and the State funded a study to monitor periphyton growth rates in Lake Pend Orielle in littoral-exposed shore and embayment areas. Data suggest accelerating eutrophication is occurring, particularly in developed and relatively confined areas of the lake.

IL RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a 207-fixed-station trend monitoring network in which all stations are sampled every 6 weeks for routine chemical parameters and 21 metals.

As part of the Ambient Water Quality Monitoring Network, the CORE subnetwork consists of 38 river stations sampled every 6 weeks for a total spectrum of water quality parameters, twice a year for water column organics, and every 3 years for sediment contamination and macroinvertebrates

Intensive River Basin Surveys

The State (Illinois EPA) conducts intensive river basin surveys in cooperation with the Illinois Department of Conservation (IDOC) at approximately 105-165 sites each year. The following monitoring is conducted: fisheries, macroinvertebrates (using natural and artificial substrate [Hester-Dendy] samplers), water chemistry, and habitat evaluation. Sediment and fish contaminant samples are collected at selected sites to supplement the data base Fisheries data are analyzed using Karr's Index of Biotic Integrity (IBI), while macroinvertebrate data are analyzed using the Macroinvertebrate Biotic Index (MBI). Habitat evaluations are made at each site

The Biological Stream Characterization (BSC) is utilized to determine use attainment in streams The stream classification system is predicated largely on attributes of lotic lish communities. In the absence of lisheries data, macroinvertebrate data or physical habitat descriptors may be used. The BSC method is driven primarily by an assessment of lish community structure as represented by the IBI. The IBI method incorporates 12 measures (metrics) of lish community structure, including species composition and species richness, trophic state composition, and abundance and condition. The MBI used in Illinois is a modification of the method of Hilsenhoff (1982)

Fish Contaminant Program

The State monitors toxics (20 pesticides and PCBs) in fish populations at 73 fixed-stream stations biennially and an additional 36 nonpermanent stream sites annually during basin surveys. Composite fillets are collected at all 73 sites, and whole-fish samples are collected at 32 sites. Analyses for other environmental pollutants are conducted as needed

Pesticide Monitoring Network

The State maintains a pesticide monitoring network that screens water column samples for 15 pesticides commonly used in agriculture at 30 stations. Sampling is conducted during six of the nine total 6-week sampling cycles. Samples are collected during every cycle from April through July and every other sampling cycle during August through March

LAKE MONITORING PROGRAM

IL (cont)

Ambient Water Quality Monitoring Network

The State maintains a CORE network consisting of three Lake Michigan stations The stations are sampled every 6 weeks for routine chemical parameters, twice a year for water column organics, and every 3 yr for sediment contamination and macroinvertebrates. Where possible, fish contaminant samples are collected every 2 yr

Intensive/Clean Lakes

This monitoring is diagnostic (Phase I) and evaluative monitoring (Phase II) for take protection and restoration projects under the Clean Lakes Program. Monitoring is generally conducted biweekly from May through September and monthly or bimonthly from October through April at 15-20 takes per year. The following are sampled: routine water quality parameters (including chlorophyll *a*, total phosphorus, Secchi disk transparency) at the surface and at depths and biological resources (phytoplankton, benthos, fish, and aquatic vegetation). Sediment is analyzed for solids, nutrients, organics, and metals

Ambient Trends

This monitoring is conducted at 15-20 specified lakes to determine long-term trends in lake quality and to evaluate pollution control/restoration programs. Trend lakes are monitored five times: once during the spring runoff/turnover period (April or May), three times during the summer (June, July, and August), and once during fall turnover (September or October). Three lake sites are usually monitored with water quality samples collected at the surface for all station and near the bottom at the deepest site. Parameters monitored include routine water quality parameters (total phosphorus, Secchi disk transparency, other nutrients, and toxics) and chlorophyll a.

Diagnostic/Evaluation

Lakes in this program are monitored to diagnose problems, encourage development of management plans, and evaluate effectiveness of implemented programs. Lakes are sampled for one diagnostic year and for one or more years following implementation Lakes are sampled five times per year at spring turnover, during the summer, and at fall turnover as described for the Trend Monitoring Program. Field observations of water color, amount of sediment, algae, macrophytes and weather are recorded. Data analyses include examination of limnological parameters, Trophic State Index (TSI) values, and biological data including rating the severity of impairment from sediment, algae, and macrophytes. Under this program, 16 lakes were sampled in 1986 and 27 in 1987; 7 lakes were sampled both years.
IL LAKE MONITORING PROGRAM

(cont)

Volunteer Lake Monitoring

Approximately 150 lakes are monitored annually in this program. Participants are trained to measure Secchi disk transparency and record field observations relating to other important characteristics of lake ecology Volunteers are encouraged to sample a lake at least twice per month from May through October, at three or more sites per lake Volunteers at selected lakes (12-15 annually) collect water samples for analyses of nutrients and suspended solids Carlson's Trophic State Index is used to assess water quality

Fish Contaminant Program

The State Fish Contaminant Program monitors toxics (20 pesticides and PCBs) in fish populations at 20 lake stations annually to detect changes that require implementation of management strategies Composite fillets are collected at all stations and whole-fish samples are collected at specified sites

IN RIVER MONITORING PROGRAM

Fixed-Station Water Quality Monitoring Network

The State maintains a fixed-station water quality monitoring network consisting of 106 stations Physical, chemical, and bacteriological analyses are run on samples from all 106 stations. Water samples are routinely sampled for a limited number of toxics, mostly metals. Phytoplankton are monitored at 41 stations

Toxics Monitoring and Control Program

The State uses a combination of chemical/biological monitoring to identify toxic pollutants from point source and NPS pollution The State collects fish tissue and sediment once biannually at 11 of 22 CORE Program stations (part of the Fixed-Station Water Quality Monitoring Network) and at 60 to 90 other sites annually Tissues are analyzed for PCBs, metals, and selected pesticides with three composites per site. For fish residue analyses, three sets of fish samples (five fish each) are collected at each station. In addition, fillet samples are collected at some stations for comparison of "edible portion" and "whole fish" samples. Sediment samples are analyzed for 137 pollutants

The CORE stations are divided into two groups and are sampled in alternate years. In addition to those fish collected and analyzed for toxic substances, species diversity and community structure of all fish populations are recorded during sampling. This provides qualitative information as to the composition of the fish community at these stations. These data can be compared to data obtained in previous years or from other studies to give some indication of how the fish community is reacting to changes in water quality.

Monitoring for aquatic macroinvertebrates is done at the 22 CORE Program stations (11 of the 22 stations sampled annually), as part of 6-10 intensive surveys, and at up to 15 use evaluation sites annually. The State conducts both natural and artificial substrate sampling using Hester-Dendy macroinvertebrate samplers. Samplers are retrieved, and the organisms are collected, preserved, and identified to the lowest taxon possible and counted Species diversity and abundance are used to assess water quality. Phytoplankton are also collected at all biosurvey sites, and occasionally tissue residue monitoring of resident mussels, crayfish, frogs, turtles, fish eggs, or vegetation is conducted

Habitat and Use Attainability Studies

Each year, habitat and use attainability studies are conducted to determine the existing and/or potential uses that various stream reaches will support. During the study, a checklist that includes detailed information regarding the physical, chemical, and biological nature of the stream, as well as a description of the riparian land use, is completed This information is used to prepare a habitat evaluation report that describes the existing and potential uses of the stream. In 1986-1987, habitat and use attainability studies were conducted on 31 streams.

IN LAKE MONITORING PROGRAM

(cont)

Special Studies

Primary productivity studies are also part of the biological monitoring program. These are not done on a routine basis, but are used in conjunction with special lake studies. These studies provide information on the rates of algal photosynthesis and respiration.

KS RIVER MONITORING PROGRAM

Trend Monitoring Network

The State samples macroinvertebrates by the kick method at 37 water quality trend stations annually and at 18 additional stations that are reserved for rotation in both time and location The latter stations are sampled for 3 to 5 years to establish a data base and are then replaced by other stations.

The degree of use support for streams is evaluated using a Macroinvertebrate Biotic Index (MBI). An MBI greater than 5.40 indicates nonsupport of the aquatic life use; an MBI between 4.51 and 5.39 indicates partial support; and an MBI of less than 4.51 indicates full support of the aquatic life use.

The Kansas Biological Survey is developing a biotic index for use in the State's stream biological monitoring program Appropriate materials for identification of stream macroinvertebrates are being developed. Available data on pollution tolerances of these organisms are summarized to improve the biotic index now in use in the monitoring program Separate biotic indices for nutrients, oxygen-demanding substances, pesticides, metals, and suspended solids are included.

Intensive Surveys

Macroinvertebrate and fish communities are usually sampled along with various chemical constituents and fecal coliform in intensive surveys. The State analyzes edible fish tissue for studies of waterbodies where human health impacts are known or suspected. Periphyton assessments are sometimes made as part of special studies. Most special studies are associated with point source dischargers; a few are associated with NPS pollution problems

Special Studies

A 2-year study of fish community sampling data was initiated to determine the feasibility of using fish data in the biological network program. A feasibility report is pending Generally, for special studies, macroinvertebrate and fish communities are sampled along with various chemical constituents and fecal coliform bacteria. The State conducts sediment sampling for toxic pollutants in waterbodies as part of special investigations.

Toxics Monitoring

The State collects fish at 44 sites as part of the Regional Ambient Fish Tissue Analyses Program. Whole fish analyses are performed by EPA Region 7 for 130 toxic pollutants. The target species of this program is the carp *(Cyprinus carpio)* The residue analyses are conducted on composites of three or more whole fish to increase sensitivity to the low concentrations of pollutants and to improve representativeness of the sample

KS LAKE MONITORING PROGRAM

(cont)

Routine Lake Monitoring

The State began triennial intensive surveys of the 24 Federal reservoirs and selected city, county, and State fishing lakes in 1975 The intensity of the surveys changed in 1985 to allow time to sample more lakes each year. Instead of sampling several stations on each lake, one site at the deepest location is sampled once during the period of thermal/dissolved oxygen stratification (summer) Currently, 60 reservoirs and lakes are monitored for general water quality parameters, including total phosphorus, chlorophyll a, Secchi disk transparency, other nutrients, and toxic substances (water and fish tissue) The Trophic State Index (TSI) was determined from the resulting data

Criteria for evaluating the degree of aquatic life use support for lakes and wetlands are the same as those used for stream evaluations. Additionally, lake trophic state and the changes in support of designated uses are evaluated. The degree of aquatic life support is estimated from Carlson's TSI, which was calculated based on available chlorophyll *a* data. TSIs less than 50 were considered full support; TSIs from 50-59 were considered partial support; and TSIs greater than 59 were considered nonsupport.

Biologists from the Department of Wildlife and Parks are asked to complete a questionnaire designed to provide information to assess existing water quality for four major impacts for lakes and wetlands areas: macrophytes, surface algae, sedimentation, and turbidity. Eutrophic lakes were those lakes with a TSI greater than 50 and/or having indications of significant impacts from macrophytes or surface algae based on the questionnaire distributed to the Department of Wildlife and Parks.

Intensive Surveys

Macroinvertebrate and fish communities are usually sampled along with various chemical constituents and fecal coliform in intensive surveys The State analyzes edible fish tissue for studies of waterbodies where human health impacts are known or suspected Periphyton and phytoplankton assessments are also made as part of some bioassessments. The types of monitoring conducted in each intensive survey depend on site-specific conditions of the waterbody and type of pollution problem.

Toxics Monitoring

The State collects fish at 44 sites as part of the Regional Ambient Fish Tissue Analyses Program. Whole fish analyses are performed by EPA Region 7 for 130 toxic pollutants. The target species of this program is the carp *(Cyprinus carpio)* The residue analyses are conducted on composites of three or more whole fish to increase sensitivity to the low concentrations of pollutants and to improve representativeness of the sample

Survey of Mon	itoring in NF	PDES Progran	ns (contin	ued)

State	Bioassay testing	Biosurveys
KS	There are no bioassay testing requirements associated with the State's permit program	Dischargers are not required to conduct biosurveys
	The State screens selected effluents of industrials and municipals using the 24-hr Daphnia pulex and 24-hr fathead minnow (Pimephales promelas) toxicity test No chronic toxicity testing is currently conducted.	The State samples macroinvertebrates by the kick method at 37 water quality trend stations per year and at 18 additional stations that are reserved for rotation in both time and location. The latter stations are sampled for 3-5 yrs to establish a data base and are then replaced by other stations.
		Macroinvertebrate and fish communities are usually sam- pled along with various chemical constituents and fecal coliform in intensive surveys to locate the source of pollution. Periphyton assessments are made as part of special studies.

Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
IA	There are no biological toxicity testing requirements for municipal or industrial facilities	Dischargers are not required to conduct biosurveys.
	The State has no in-house bioassay testing capabilities, but these services are provided to the State through the University of Iowa's State Hygienic Laboratory that conducts all water quality monitoring for the State and performs acute bioassay screening testing on daphnids and fathead minnows (<i>Pimephales promelas</i>)	The State primarily uses biosurveys to assess impacts of nonpoint source (NPS) pollution
	EPA Region 7 performs static 24-hr acute toxicity tests on daphnids and fathead minnows (<i>Pimephales</i> <i>promelas</i>) on 10-12 industrial and municipal facilities per year suspected of discharging toxics in their effluents.	

KY RIVER MONITORING PROGRAM

Ambient Biological Monitoring Network

The State's biological monitoring program currently consists of a network of 33 stations in 10 river basins. As part of this network program, algae are sampled at 29 stations, macroinvertebrates at 29 stations, fish at 5 stations, fish tissue (for residue analyses of 40 pollutants) at 10 stations, and sediment at 32 stations. Data collected at these stations are used to ensure that existing water quality is maintained, provide background values for future trend comparisons, and recognize emerging problems in the areas of toxic residues, bacteriological contamination, and nuisance biological growth. Program emphasis is directed at evaluating warmwater aquatic habitat (WAH) use support instream, determining the presence and concentration of toxic residues in fish tissue and sediments, and evaluating municipal and industrial effluents for toxic conditions. The assessment criteria for each of the biological components is listed below.

Algae samples including both plankton (algae suspended in the water column) and periphyton (attached algae) are collected Plankton chlorophyll a, periphyton chlorophyll a, and periphyton ash-free dry weight are measured at each site, and diatoms are identified to species and enumerated. Diatom community structure indices (taxa richness, diversity, and equitability) and relative abundance values were calculated

Macroinvertebrates are collected for community structure and function evaluations at selected biological monitoring sites. Stream reaches are considered fully supporting WAH use if the macroinvertebrate information reflected no alterations in community structure or functional composition for the available habitats, and if habitat conditions were relatively undisturbed.

Fish are collected for community structure evaluation at selected biological monitoring sites. The condition of the fish community is determined by analysis of relative abundance, species richness, and species composition as well as by use of an Index of Biotic Integrity (IBI). The IBI is used to assess biotic integrity directly by evaluation of 12 attributes, or community metrics, of fish communities in streams. These community metrics include measurement of species richness and composition, trophic structure, and fish abundance and condition.

KY RIVER MONITORING PROGRAM (continued)

(cont.)

Intensive Biological Surveys

The State uses the intensive survey to evaluate site-specific water quality problems. Information is used to document attainment/impairment of designated water uses, verify construction grant decisions, address issues raised in petitions for water quality standard variances or use redesignations, and document water quality improvements and progress resulting from water pollution control efforts. During 1986-1987, four intensive surveys were conducted. The streams were assessed by evaluating the biological, physicochemical, toxicological and habitat data, and known watershed activities in concert with direct observation and professional judgment.

Identification of Best Management Practices

Low Altitude Photography (LAP) is an excellent tool for obtaining information on land use in a watershed. The identification of land uses helps locate sources of NPS pollution.

Field assessments are conducted in watersheds identified as priority, based on NPS pollution impacts Two on-site planning teams (Division of Conservation and Division of Water) provide identification of "on land" activities and water monitoring activities Intensive surveys may also be conducted by the Ecological Support Section of the Division of Water and are usually restricted because of resource constraints to demonstration watersheds where LAP has been completed

LAKE MONITORING PROGRAM

The State maintains an ambient monitoring program for lakes statewide. Nine Kentucky lakes were sampled to evaluate problems of accelerated eutrophication, and three lakes were sampled to evaluate trends relating to potential acid precipitation impacts. Monitoring is conducted once per month during the spring, summer, and fall (April to October) for routine water quality parameters, including total phosphorus, chlorophyll *a*, Secchi disk transparency, and other nutrients Carlson's Trophic State Index (TSI) is determined from chlorophyll *a* concentrations, and data from the growing season (April to October) were used to obtain a seasonal average. Fish tissue samples are evaluated for toxics in specific cases

Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
IN	Specific industrial and municipal permits require acute static 48-hr Daphnia magna toxicity tests The chronic	Dischargers are not required to conduct biosurveys
	7-d Ceriodaphnia and embryo-larval fathead minnow (<i>Pimephales promelas</i>) toxicity tests are also required for some of the facilities.	The State collects macroinvertebrates at approximately 40 sites per year depending on the number of intensive surveys and the number of sites per survey.
	The State conducts 48-hr acute static Daphnia magna screening tests on major industrials and municipals (10-25 facilities) annually. The State currently operates a mobile bioassay laboratory. At the present time, chronic bioassay tests are performed by the U.S. EPA or contractors.	Hester-Dendy artificial substrate samplers and natural substrate sampling are used by the State to sample mac- roinvertebrates at 11 of their 22 CORE stations and to conduct 6-10 intensive surveys and 5 facility-related studies annually. Fish are also surveyed at these stations for species diversity and community structure Phytoplankton samples are also collected
	The EPA conducted 25 Ames/Salmonella tests on wastewater effluents to measure the potential for muta- genicity	Approximately 4-6 weeks before the fish and sediment sampling occurs, three Hester-Dendy samplers are set at each sampling station. At the time of fish collection and natural substrate benthic sampling, these samplers are retrieved, and organisms are identified to the lowest taxon possible. Differences in species diversity and abundance upstream and downstream of major dis- chargers are used for point source evaluations Habitat evaluations are made at each intensive survey site.
		Macroinvertebrates only are assessed at 15 use evaluation stream locations to determine existing and/or potential use.
		Primary productivity studies are also performed on a nonroutine basis, but are used to provide information on wasteload allocations and for lake studies These studies provide information on rates of algal photosynthesis and respiration.

State	Bioassay testing	Biosurveys

IL Specific industrial and municipal facilities require bioassay testing, which includes an acute static 96-hr test for fathead minnows (*Pimephales promelas*) and algae (*Selenastrum capricornutum*), acute static 48-hr *Ceriodaphnia dubia* test, and for dischargers into small streams the chronic 7-d fathead minnow and *Ceriodaphnia dubia* tests are required.

Dischargers may opt to do Ames/ salmonella testing or extensive chemical analyses combined with a toxicological review quarterly.

The State performs approximately 50 acute static 96-hr and flowthrough toxicity tests per year at the rate of one sample per facility and is currently using three species in bioassay tests: fathead minnows, *Ceriodaphnia dubia* and *Selenastrum capricornutum* The State currently operates a mobile bioassay laboratory. Dischargers are not required to conduct biosurveys.

Macroinvertebrate communities are sampled by the State at 50 sites per year in facility-related stream surveys using natural substrate sampling Water chemistry, stream flow, and habitat data upstream and incrementally downstream of dischargers are also collected. Macroinvertebrate data for facility-related studies are evaluated using a modified family-level Macroinvertebrate Biotic Index (MBI) to assess the severity and extent of the pollution impacts.

Two intensive river basin surveys (20-50 sites each) are conducted as a cooperative effort between the Illinois EPA and the Department of Conservation. Data collection includes fisheries, macroinvertebrates (by natural substrate and artificial [Hester-Dendy] samplers), water chemistry, and habitat information. These surveys are often conducted in conjunction with facilities-related surveys. Fisheries data are evaluated using Karr's Index of Biological Integrity (IBI). Macroinvertebrate data are evaluated using the MBI.

The State also maintains a fixed-station network of 43 sites that are sampled following a 3-yr rotation. The State conducts both natural and artificial substrate (Hester-Dendy) sampling. Macroinvertebrate data for this network are evaluated using the MBI.

The State conducts special surveys for surveillance monitoring in response to suspected water quality problems and in support of enforcement proceedings. The survey design and sampling media are dependent on the site-specific objectives

Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
ID	Specific industrial and municipal facilities require chronic toxicity testing or both chronic and acute toxicity testing	Several permits currently include biosurvey requirements
	(either with one or three test species) Major industrial facilities often are required to conduct the standard rainbow trout toxicity test whereby > 80% survival must	The State has started conducting rapid bioassessments Macroinvertebrate communities are sampled in approxi- mately two to three studies per yea. In general.
	be observed in 65% effluent. Major municipals often are required to conduct chronic Ceriodaphnia tests, acute	however, there are few biosurveys conducted except those performed by the Fish and Game Department.
	minnow tests), and chronic <i>Selenastrum</i> growth tests. By the end of 1989, the State will be requiring bioassay testing for the most sensitive species in all new permits of concern	The State is proposing to reactivate the ambient water quality network, which will include invertebrate collections using artificial substrate (wire baskets)
		The City of Boise conducted a 1-yr study that included
	The State currently has no bioassay capabilities.	collection of benthic invertebrates on artificial substrates (two colonization periods), fish biosurveys using electrofishing techniques (length, weight, species), and supplementary information on chemical analyses of the sediment and particle size distribution The benthic data were analyzed using both parametric and nonparametric statistics Species diversity, the number of families

represented, species density, relative abundance, and the coefficient of community loss were also evaluated

State Bioassay testing

HI Recent draft and final permits include requirements for monthly static or flow-through 96-hr acute bioassay testing, with limits to be effective 1 yr after permit issuance Dischargers are given a choice of test species, including: Ceriodaphnia dubia; two fish species (Tilapia mossambica and Corvphaena hippurus); live sea urchin species (Echinometra mathaei, E. oblonga, Colobocentrotus atratus, Heterocentrotus mammillatus, Tripneustes gratilla); and two shrimp species (Penaeus vannamei and P. monodon). The discharge limitation will be 50% survival in 100% effluent. Life stages and other testing requirements are specified for each species. The State is committed to the inclusion of bioassay toxicity testing in permits for all major industrial and municipal dischargers Inclusion of bioassay requirements has taken some time, and relatively few appropriate aquatic species endemic to Hawaii's ocean waters are available. The State is receiving contractor assistance to develop protocols for marine species.

The State conducted acute 24-hr and 7-d chronic toxicity tests using *Ceriodaphnia dubia* and fathead minnows (*Pimephales promelas*) on effluents from four wastewater treatment plants The lowest observed effect concentration (LOEC), the no observable effect concentration (NOEC), and the chronic value (ChV) were calculated for each wastewater discharge. *Ceriodaphnia dubia* has not been of practical value so far as it is sensitive to sall water which is often present in sewage treatment effluent in Hawaii.

The State has recently completed research into the use of a sea urchin sperm fertilization test and is investigating use of the larvae of the bivalve *Isognomon californicum* as a growth assay for whole effluent testing

An EPA protocol is available for the marine red algae (*Champia parvula*) that occurs in Hawaii. Research into the distribution and abundance of this species needs to be conducted in order to assess its potential for bioassay testing by the State

Biosurveys

Dischargers applying for 301(b) permits or waivers from secondary treatment must do extensive biosurveys of the ocean environment in the vicinity of their outfalls Benthic, epibenthic, and planktonic organisms are surveyed. Diversity and species abundance are evaluated Tissue samples from certain species may be analyzed for specific chemical constituents to evaluate potential for bioaccumulation Since most municipals discharging to marine waters apply for 301(h) waivers, most have conducted biosurveys. These biosurvey results are submitted to the University of Hawaii for assessment, interpretation, and recommendations.

The State does not currently conduct biosurveys.

The EPA conducted a biosurvey as part of a congressional mandate to study the effects of ocean discharges from two sugar mills on the island of Hawaii This survey concentrated on impacts to coral and water quality. Further biosurveys have been required of these mills as part of their applications for zones of mixing

State	Bioassay testing	Biosurveys
FL	Specific industrial and municipal permits require bio- assay toxicity testing, and these requirements are being	Dischargers are not required to conduct biosurveys
	added to permits for all major facilities and for all minor facilities with design flow greater than 0.5 MGD or where information indicates potential toxicity	The State collects data on the biological diversity of the macroinvertebrate community based on natural substrate samples and artificial substrate samples as part of their 5-year rotating ambient basin monitoring
	When the instream waste concentration (IWC) is greater than or equal to 1% at critical low flow, the discharger is required to conduct 7-d <i>Ceriodaphnia</i> survival and repro- duction tests and 7-d fathead minnow (<i>Pimephales</i> prometas) larval survival and growth tests on a 24-hr	network. Basin networks are targeted each year for intensive studies (6-10 studies/year). The data are analyzed for species diversity using the Shannon-Wiener Index and Beck's Biotic Index.
	composite sample and on a series of effluent concentra- tions including the IWC with test solutions renewed daily. The discharger is required to conduct these toxicity tests every 2 months for 1 yr and once every 6 months thereafter.	Coastal/estuarine biosurveys are also conducted. Grab samples of bottom sediment are evaluated for species composition, density, and taxa richness.
	When the IWC is less than 1% at critical low flow condi- tions, the discharger is required to conduct static 48-hr toxicity tests on three species (fathead minflow, <i>Cerio- daphnia dubia</i> , and other species selected from EPA 600/4-85/013, Table 1). Tests are conducted in 100% effluent once every 2 months for 1 yr and once every 6 months thereafter for the permit's duration.	
	A permit violation occurs when an LC_{50} is found in any one of four grab samples collected over a 24-hr period	
	The State currently conducts both 48-hr acute and chronic toxicity tests using a variety of test species. Acute testing is conducted using <i>Ceriodaphnia dubia</i> ; <i>Daphnia pulex</i> (the fathead minnow); the bannerfin shiner (<i>Notropis leedsi</i>); the silverside (<i>Menidia</i> <i>beryllina</i>); the mysid shrimp (<i>Mysidopsis bahia</i>) algae (<i>Selenastrum capricornutum</i> and <i>Champia parvula</i>); and the Microtox ^R bacterium (<i>Photobacterium phosphoreum</i>).	
	Chronic 7-d toxicity testing is conducted using two species, Ceriodaphnia dubia and the bannerfin shiner.	

The State operates a mobile bioassay laboratory to conduct Toxicity Identification Evaluations

Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
GA	Specific industrial and municipal facilities are required to conduct acute static renewal 48-hr toxicity tests using	Dischargers are not required to conduct biosurveys
	fathead minnows (<i>Pimephales promelas</i>). If this screening test is failed (greater than 10% mortality occurs), the discharger must conduct a flowthrough	The State monitors 40 sites for macroinvertebrates and 6 sites for fish as part of a trend monitoring network.
	96-hr test using fathead minnows or 96-hr static renewal test with fathead minnows, Ceriodaphnia dubia or Daphnia pulex	Biological impact studies related specifically to point sources are made at 15-20 sites per year where macro- invertebrates, fish, sediment, and water chemistry of the stream and facility effluent are evaluated Quantitative
	The State conducts 96-hr flowthrough testing and static testing. The State expects to conduct a larger number of static toxicity tests, using <i>Daphnia pulex</i> and fathead minnows and to conduct approximately 12 flowthrough fathead minnow tests per year using a mobile bioassay laboratory. Chronic <i>Ceriodaphnia</i> bioassay capabilities are currently under development.	biosurvey data in Georgia are evaluated for species diversity and equitability. Qualitative biosurvey data are evaluated for taxa richness and relative abundance

GA RIVER MONITORING PROGRAM

Fixed-Station Trend Monitoring Network

The State operates a fixed-station trend monitoring network in cooperation with the USGS on streams, rivers, lakes/reservoirs, and estuaries in 15 river basins. Water samples are collected at approximately 110 stations monthly for routine analyses. Water and sediment samples are collected at 40 core stations for metals and organic analyses; macroinvertebrate samples are collected at 40 stations, and fish samples are collected at 6 stations. Quantitative biosurvey data in Georgia are evaluated for species diversity and equitability. Qualitative biosurvey data are evaluated for taxa richness and relative abundance

Toxics Monitoring

At 20 sites, residue analyses of fish and sediments are conducted for metals and organic compounds.

Intensive Surveys

From 1981-1983, the State funded a 2-year study of the effects of NPS pollution from urban, agricult_ral, and commercial forestry sources in 21 streams. Chemical as well as biological sampling was conducted, including evaluation of the periphyton (diatom) community, macroinvertebrates and fish (Cook et al. 1983; CTA, Inc. 1983) This work was conducted by two contractors for the State.

LAKE MONITORING PROGRAM

Clean Lakes Program

A statewide classification survey of freshwater lakes was conducted to assess the trophic condition of each lake and to develop a priority list for restoration and/or preservation for 175 public lakes. The survey included depth profiles for dissolved oxygen, temperature, pH and conductivity, sample collection for chlorophyll *a*, total phosphorus, nitrogen series, turbidity, and water clarity (Secchi disk depth). Carlson's three trophic indexes were combined in a single Total Trophic State Index (TTSI).

FL COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Water Quality Assessments

To assess estuarine water quality, the State monitors six water quality categories (water clarity, dissolved oxygen, oxygen-demanding substances, bacteria, nutrients, and biological diversity) in coastal/estuarine areas. In addition, the State classifies estuaries using the TSI used for lakes with minor modifications.

Coastal/estuarine biosurveys are also conducted by the State. These involve the use of grab samplers for bottom sediment sampling. Sediment collections are evaluated for species composition, density, and taxa richness.

Toxics Monitoring

The State analyzes for six metals in ambient waters at 61 fixed stations, for metals in shellfish tissues at 30 to 40 sites, and for metals in sediment at 200 to 300 sites.

FL RIVER MONITORING PROGRAM

River Basin Network Monitoring

The State has no permanent biological monitoring network River basin networks are targeted each year for intensive studies (6-10 studies/year).

To assess river water quality, a Water Quality Index (WQI) was developed based on the quality of water as measured by six water quality categories (water clarity, dissolved oxygen, oxygen demanding substances, bacteria, nutrients, and biological diversity). Biological diversity is assessed for macroinvertebrates (collected on natural substrate and on artificial substrate samplers) using the Shannon-Wiener Index of biological diversity and Beck's Biotic Index.

Toxics Monitoring

The State analyzes for six metals in ambient waters at 61 fixed stations and for metals at 200 to 300 sites.

LAKE MONITORING PROGRAM

The State monitors lake water quality conditions using three different monitoring programs: ambient monitoring network, intensive surveys, and rotating basin assessments. Monitoring frequency varies in each program based on the monitoring purpose and the specific waterbody being sampled. All three programs involve year-round sampling The following water quality parameters are evaluated for each lake sampled: total phosphorus, chlorophyll *a*, Secchi disk transparency, and other nutrients. Toxic substances are monitored only in the ambient monitoring network and the rotating basin assessments.

The State classifies lakes using a Trophic State Index (TSI) procedure based on the chlorophyll, Secchi disk depth, and total nitrogen and phosphorus concentrations The procedure is based on a trophic classification scheme developed by Carlson (1977) This TSI is also applied to Florida's estuaries with minor modifications

DC RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring

The District maintains a 76-fixed-station monitoring network in which all stations are sampled monthly. Metal analyses of water-samples are performed quarterly

Plankton Surveys

The surface water monitoring program collects phytoplankton samples monthly at five Potomac River stations, five Anacostia River, and three tributary stations. In addition, zooplankton tows are made at two Potomac River and one Anacostia River station.

Macroinvertebrate Surveys

A districtwide macroinvertebrate survey was initiated in late spring of 1987. A total of 11 different lotic and lentic sites were sampled. Sampling equipment and methods differed depending on station-specific characteristics of depth, water velocity, and substrate type.

Toxics Monitoring

Fish tissues are analyzed for metals and certain priority pollutants.

LAKE MONITORING PROGRAM

Macroinvertebrate Surveys

A districtwide macroinvertebrate survey was initiated in late spring of 1987. A total of 11 different lotic and lentic sites were sampled. Sampling equipment and methods differed depending on station-specific characteristics of depth and substrate type

DE COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Inland Bay Studies

The State is involved in an aggressive research program that focuses on the inland bays Baseline information on phytoplankton, submerged aquatic vegetation, and macroalgae populations in the three inland bays has been collected as part of a multiyear study. Other projects include: (1) an Inland Bays Flocculation/Coagulation Study that examines size distribution of suspended and colloidal particles in the bays; (2) the Coastal Sussex Cooperative River Basin Study that will examine the effects of erosion on long-term productivity, the extent of sedimentation damage, and the effects of animal wastes on water quality; (3) a study of larval hard clam mortality under high suspended sediment and low dissolved oxygen concentrations; and (4) a study of turbidity in the Indian River Bay

Note: Delaware received a grant from the 1987 Water Quality Act's Nonpoint Source Management Program provision to implement the State's NPS pollution control program. Delaware's program will incorporate education, research, technical assistance, financial incentives to land owners, and regulations The goal is to control NPS pollution from urban and agricultural runoff and hazardous waste sites The program will target Middle Run/Upper Pike Creek Basin, Murderkill River Basin, Nanticoke River Basin, and the Inland Bays.

Toxics Monitoring

Fish and shellfish are screened for toxics annually.

DE RIVER MONITORING PROGRAM

Ambient Monitoring Network

The State maintains a network of 200 fixed-station ambient monitoring sites. Most stations are sampled monthly or bimonthly, some less frequently Samples are analyzed for conventional, nonconventional, and toxic pollutants. Toxic metals are analyzed regularly in priority basins and at least once per year in all basins.

Special Studies

Instream biological surveys are conducted as part of special studies in Delaware. These studies are conducted periodically as needed. The studies that focus on the macroinvertebrate community correlate species diversity and richness with species' ability to deal with stress (enrichment and toxicity). Species are categorized as sensitive, facultative, or tolerant to pollution. The results of two recent biological surveys for White Clay Creek (impacted by urban runoff) and the Brandywine River (impacted by bacteria contamination) are used to monitor improvement or degradation trends in water quality.

Toxics Monitoring

Fish and/or sediments are screened for foxics annually.

LAKE MONITORING PROGRAM

Ambient Lake Monitoring

The State conducts ambient monitoring of the majority of Delaware's lakes once per month year-round (except during the winter months), and this program assesses three Carlson indexes to characterize the trophic state of the lakes surveyed (chlorophyll *a*, transparency [Secchi disk], total phosphorus, and other nutrients) Because Delaware lakes contain extensive macrophytic and filamentous algae, the chlorophyll *a* index did not agree in many cases with the transparency or phosphorus indexes, so total nitrogen and oxygen deficit were added to the trophic state evaluation.

Survey of Monitoring in NPS Programs

State

CT COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Bioaccumulation Monitoring

Residue analyses of shellfish and finfish tissue from Long Island Sound is conducted as part of the State's Bioaccumulation Monitoring Program.

CT RIVER MONITORING PROGRAM

Ambient Biological Monitoring Stations

The State maintains a fixed network of ambient biological monitoring stations in selected streams. This program examines changes in the benthic component of the aquatic community, which is used as the primary indicator of biological integrity. Ten fixed stations on seven waterbodies are currently monitored. Future monitoring at fixed stations will focus on the addition of new sites on unassessed waterbodies and resumed sampling of discontinued sites at a 6-year interval. Additional biological data are obtained from the State's Fisheries Bureau, U S EPA, Fish-and Wildlife Service, and Army Corps of Engineers.

Intensive Surveys

Biological monitoring also includes intensive monitoring related to critical water quality problems and synoptic surveys to assess minor pollution episodes

Rapid Bioassessments

The State is currently evaluating the EPA Biological Data Management System (BIOS) with the intent of utilizing the system for data storage, retrieval, and analysis. Rapid bioassessment methods as documented in recent EPA guidance will also be incorporated in this program to make more efficient use of limited personnel resources

Toxics Monitoring

A Statewide fish tissue monitoring program is currently under development and will involve collection of three target species for analyses of metals, organics, phenols, and polynuclear aromatics in the edible portion. Bioaccumulation monitoring of fish and invertebrate tissues for PCBs was conducted in the Housatonic River.

LAKE MONITORING PROGRAM

Water Quality Assessments

The Department of Environmental Protection and the Connecticut Agricultural Experiment Station conducted a joint study, in the 1970s, of the severity of eutrophication problems at 70 recreational lakes An updated water quality assessment for 69 of these lakes was conducted in early 1988

CO RIVER MONITORING PROGRAM

Intensive Surveys

The State Water Quality Control Division currently conducts instream biosurveys of rivers in support of use classification in standards setting Biosurveys have also been used in evaluation of specific waterbodies listed in 319 Nonpoint Source Assessments.

Rapid Bioassessments

The State has been evaluating metrics in the EPA's Rapid Bioassessment Protocols for use in data analyses

Toxics Monitoring

The State collects fish for residue analyses of toxics on a site-specific basis.

LAKE MONITORING PROGRAM

Intensive Surveys

The State Water Quality Control Division currently conducts biosurveys associated with NPS pollution in lakes

Toxics Monitoring

The State collects fish for residue analyses of toxics on a site-specific basis.

CA No detailed information is available in the State's 1988 305(b) report on the statewide use of biosurveys in the NPS program California is divided into nine regions that appear to have separate programs for meeting specific regional monitoring needs

RIVER MONITORING PROGRAM

Toxics Monitoring Program

The State does monitor fish tissues for toxics in rivers for concentrations of metals, pesticides, and other organic compounds associated with both point source and nonpoint sources (e.g., mining activities, agriculture, urban runoff).

LAKE MONITORING PROGRAM

Toxics Monitoring Program

The State does monitor fish tissues for toxics in lakes for concentrations of metals, pesticides, and other organic compounds associated with both point source and nonpoint sources (e.g., mining activities, agriculture, urban runoff).

COASTAL/ESTUARINE MONITORING PROGRAM

Ambient Toxicity Characterization Program—San Francisco Bay

The State (San Francisco Bay Regional Water Quality Control Board) has contracted with Lawrence Berkeley Laboratories (LBL) to conduct a survey to characterize the distribution of ambient toxicity in San Francisco Bay The goal of the project is to evaluate the spatial and temporal distribution of ambient toxicity in the Bay sing chronic bioassays as indicators of toxic effects. Although the program primarily targets point source discharges, some testing will be conducted at special sites associated with oil spills, extensive urban runoff, and near dredge spoil disposal areas.

Toxics Monitoring Program

The State does monitor shellfish tissues for toxics in estuaries/coastal areas for concentrations of metals, pesticides, and other organic compounds associated with both point source and nonpoint sources (e.g., mining activities, agriculture, urban runoff) The State Mussel Watch Program monitors 14 heavy metals and 41 synthetic compounds in mussel and clam tissue along 1,100 miles of coastline at 135 stations

Survey of Monitoring in NPS Programs

State

AR **Toxics Monitoring**

(cont)

The State collects fish and/or shellfish at 12 to 20 sites in a problem-oriented program for residue analyses of metals, pesticides, and PCBs.

LAKE MONITORING PROGRAM

The State currently does not have a specific statewide lake monitoring program. Fixed-station amb ont monitoring is performed on some lakes.

AR RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a fixed-station water quality monitoring network of 110 stations sampled monthly or annually, depending on sample type

Biological Surveys

The State maintains a biomonitoring program for the purpose of identifying environmental impacts from different sources and determining use support status. Bioassessments (biosurveys) are conducted on an annual basis at selected Arkansas streams. At these sites, the aquatic invertebrate communities are examined as a measure of aquatic life use. The biosurveys have been used in trend monitoring and in NPS and point source impact studies. Most recently, a greater emphasis has been placed on point source monitoring through the use of paired stations above and below a discharge.

Rapid Bioassessments

In FY86-87, the State tested application of a rapid bioassessment protocol using macroinvertebrates for selected habitats (riffles and pools). Sites are determined to be impaired based on a Biometric Scoring System Seven metrics are used to evaluate community diversity: Dominants-In-Common, Common Taxa Index, Quantitative Similarity Index, taxa richness, Indicator Assemblage Index, missing genera, and functional group percent similarity (Shackleford, 1988). Biosurvey data are entered for computer storage with verification of interpretations accomplished via an in-house program, "BIOED."

Ecoregion Program

The Arkansas Department of Pollution Control and Ecology developed ecoregional standards for physical, chemical, and biological parameters Evaluation of physical parameters included hydrological measurements (stream flow velocity, stream gradient, and mean stream depth and width) and habitat conditions (stream substrate, instream and canopy-cover vegetation, bank stability, and riparian vegetation). Evaluation of chemical parameters included fecal coliform, ammonia-nitrogen and ortho-phosphate concentrations, chlorophyll *a*, turbidity, total suspended solids, total dissolved solids, biochemical oxygen demand, total phosphorus, nitrate + nitrate-nitrogen, chloride, sulfate, total iron, specific conductivity, alkalinity, hardness, and manganese. The evaluation of biological parameters included biosurveys of benthic macroinvertebrate and fish populations. Samples were used to taxonomically characterize the aquatic community, and to identify indicator taxa and relative abundance. The Shannon-Wiener diversity index and indices of evenness, variety, and dominance were calculated to assess overall community health.

AZ RIVER MONITORING PROGRAM

Fixed-Station Monitoring

No formal ecological monitoring was completed during FY86-87 Currently, the State relies heavily on information generated from its fixed-station water quality monitoring network and intensive surveys to assess water quality problems Chemical analyses of water, sediment, and biota form the basis of the evaluation

Ecoregion Program

The Arizona Department of Environmental Quality (ADEQ) is examining the application of ecoregior.3 to water quality standards. As part of this, the ADEQ intends to survey regional reference sites to determine the aquatic species that best characterize ecoregions, to refine water quality standards, and to better manage NPS pollution from mining and ranching

Rapid Bioassessments

The State is developing a rapid bioassessment protocol for streams based on macroinvertebrates collected from riffles and pools

Toxics Monitoring

Water, sediment, and fish are collected for tissue residue analyses by EPA for metals, pesticides, volatile organics, PCBs, and plasticizers at approximately 20 sites.

LAKE MONITORING PROGRAM

Game and Fish Monitoring Program

The Arizona Game and Fish Department conducts extensive limnological surveys (one-four times/year during spring or summer), which include analyses of water (total phosphorus and other nutrients), sediment, and fish tissue samples to determine any changes in the aquatic resources due to pollution. Fisheries surveys are also performed to identify species composition, relative abundance, age, growth condition, and length frequencies.

Clean Lakes Program

In 1983, under the Clean Lakes Program, a priority list containing 56 lakes was developed based on Carlson's Trophic State Index (TSI) and recreational use The TSI index was weighted 80% and recreational use 20% to generate the final ranking. Trophic condition is estimated based on Secchi disk depth, chlorophyll **a**, total phosphorus, and total nitrogen.

AK RIVER MONITORING PROGRAM

Biological Surveys

The State does not currently conduct monitoring to evaluate NPS pollution problems in streams and rivers However, the Alaska Department of Fish and Game conducts biosurveys in support of special studies

LAKE MONITORING PROGRAM

Biological Surveys

The State does not currently conduct monitoring to evaluate NPS pollution problems in lakes. However, the Alaska Department of Fish and Game conducts biosurveys in support of special studies.

COASTAL/ESTUARINE MONITORING PROGRAM

Biological Surveys

The State does not currently conduct monitoring to evaluate NPS pollution problems in estuarine and coastal areas. However, the Alaska Department of Fish and Game conducts biosurveys in support of special studies.

Toxics Monitoring

Special studies are conducted by NMFS for the State to determine residue analyses of aromatic hydrocarbons in tissues of three marine fish.

AL LAKE MONITORING PROGRAM

(cont)

Toxics Monitoring

The State currently has no routine lake monitoring program except in its toxics program, which samples water and fish tissue for toxic compounds (metals, PCBs, and other organics) at three to six locations per year on a 3-year rotating basis.

Clean Lakes Program

There is some lake monitoring conducted as part of a Phase I Clean Lakes Program for Bayview Lake

COASTAL/ESTUARINE MONITORING PROGRAM

Fixed-Station Monitoring Network

As part of the lixed-station monitoring program, the State added five coastal stations in 1987 and added seven stations in Mobile Bay in 1988. Routine physical/chemical water quality parameters are monitored at all stations, and macroinvertebrates and fish are sampled at some of these coastal and estuarine stations. Benthic macroinvertebrates are quantitatively sampled (dredge hauls), and the data are analyzed for taxa richness, species composition, and relative abundance.

AL RIVER MONITORING PROGRAM

Fixed-Station Monitoring

The State employs biological sampling in its fixed-station ambient monitoring program. The main focus of biological monitoring is on macroinvertebrates, defined as those organisms retained on a U.S. Standard No. 30 mesh sieve, which are collected utilizing Hester-Dendy-type multiple-plate artificial substrate samplers or handpicked with forceps over a measured period of time. Following collection and processing of samples, the organisms are enumerated and identified to the lowest possible taxonomic level. From this information, species diversity, equitability, Ephemeroptera, Plecoptera, Trichoptera (EPT) index, taxa richness, and species composition are calculated and the condition of the stream assessed. Biological monitoring is a valuable addition to physical/chemical water quality sampling in that it will detect long-term detrimental effects that water chemistry alone may miss. A well-planned biological assessment will also detect a healthy stream when the water chemistry data are inconclusive.

Intensive Surveys

The State employs biological sampling in its intensive survey program. Biosurveys are conducted as informational surveys related to pollution complaints in streams suspected of being adversely impacted by point and/or nonpoint sources, in water quality standards studies, and in studies to collect data related to enforcement activities. These studies include aquatic biological community surveys, chemical and physical water quality information, and flow measurement. Sediment sampling and primary productivity estimates may also be included depending on the study objectives.

Rapid Bioassessments

The State's biological staff is currently involved with other EPA Region 4 States and Region personnel in an effort to develop a viable and rapid bioassessment protocol. This will allow more waterbodies to be biologically monitored with the limited resources available.

Toxics Monitoring

The State collects fish for residue analyses of metals, PCBs, and organic compounds at three to six locations per year on a 3-yr rotating basis.

APPENDIX B

SURVEY OF MONITORING IN NPS PROGRAMS

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Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
WY	Specific municipals are required to conduct acute 48-hr Daphnia sp. toxicity tests guarterly As industrial and	Dischargers are not required to conduct biosurveys
	municipal permits are reissued, all majors and selected minors will have acute and chronic bioassay toxicity requirements using <i>Ceriodaphnia dubia</i> and fathead minnows (<i>Pimephales promelas</i>) in static renewal tests.	The State Water Quality Agency conducts no instream biological monitoring, however, the State Fisheries Agency provides information used in the classification of State waters
	The State has no bioassay toxicity testing capabilities. The EPA's Duluth Laboratory has been conducting a number of acute and chronic bioassays for the State, principally related to evaluation of oil treater discharges	

Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys
WI	Specific industrials (pulp and paper mills) are required to conduct chronic 7-d <i>Ceriodaphnia</i> and fathead minnow	Dischargers are not required to conduct biosurveys
	(Pimephales promelas) toxicity tests on effluents and to perform acute static 96-hr toxicity tests on Ceriodaphnia dubia and fathead minnows. Acute static 96-hr bioassay toxicity testing using Ceriodaphnia dubia and fathead	The State maintains 40-50 trend monitoring sites where macroinvertebrates, periphyton, fish, macrophytes, zoo- plankton, phytoplankton, and chlorophyll a are assessed
	minnows is required for specific municipal dischargers.	The State maintains an extensive macroinvertebrate sampling program involving 400-500 samples, but this is
	The State has the capability of conducting the Ames/Salmonella mutagenicity test for screening envi- ronmental samples	primarily directed toward assessment of nonpoint source pollution as is the Bureau of Fisheries Management's Fish Community Program.
	The State has the capability of conducting acute static toxicity testing using <i>Daphnia magna</i> , <i>Daphnia pulex</i> , and <i>Ceriodaphnia dubia</i> . Future testing will be directed toward conducting chronic 7-d <i>Ceriodaphnia dubia</i> and fathead minnow tests	
	Although the State has a mobile bioassay laboratory, the facility is not currently used	

State	Bioassay testing	Biosurveys
wv	Bioassay testing is required for specific industrial dischargers annually, semiannually, or more frequently and for specific municipal permits with pretreatment	Some industrial permits require instream macroinverte- brate assessment
	programs that receive industrial contributions	Ambient macroinvertebrate community assessments are conducted as part of a 42-station long-term trend moni-
	Standard permits require a static 48-hr LC ₅₀ test on fathead minnows (<i>Pimephales promelas</i>) and Daphnia pulex	toring network statewide. Some of these stations overlap with the 27 long-term water chemistry sites
		Macroinvertebrate communities are also assessed as
	Annually, the State conducts approximately 100 acute 48-hr fathead minnow and <i>Daphnia magna</i> or <i>Daphnia</i> <i>pulex</i> tests of effluents and/or ambient waters. At eight sites, "minichronic" 7-d fathead minnow, and <i>Ceriodaph- nia dubia</i> toxicity tests were conducted on ambient samples (these tests are not routinely performed)	part of approximately 20 special studies that consist of four to five sampling sites per study These studies primarily involve "upstream/ downstream" monitoring associated with NPDES permit issuance
Survey of Monitoring in NPDES Programs (continued)

State	Bioassay testing	Biosurveys

WA The State is in the process of dramatically increasing bioassay requirements Bioassay testing is required in major industrial and several municipal permits and involves a 96-hr acute salmonid toxicity test (usually rainbow trout [Salmo gairdneri]). The toxicity criteria generally specify 80% survival of the test species in 65% effluent using the receiving water as dilution water. The current interim policy requires only acute testing of three species, although most majors are being required to conduct chronic testing with Ceriodaphnia or Daphnia for freshwater systems. For marine systems, most majors are being required to conduct chronic testing with one of four echinoderm species (Dendraster excentricus, Strongylocentrotus purpuratus, S. franciscorum, or S. droebachiensis), the ovster (Crassostrea gigas), or the mussel (Mytilus edulis). Some Puget Sound dischargers are being required to conduct sediment toxicity testing with the amphipod Rhepoxynius abronius. All major dischargers to Puget Sound are monitored for acute and chronic toxicity effects

> Four Federal facilities are required by permit to conduct chronic *Ceriodaphnia* and *Selenastrum capricornutum* testing, and some Federal facilities are required to conduct testing using marine species where appropriate.

A new policy by the State will require pulp mills (and perhaps all major industrial dischargers) to do the following: 307(a) toxics scan, acute and chronic bioassays, ambient water chemistry, sediment chemistry, and benthic invertebrate community analyses. Pulp mills will have to sample dioxin in fish tissue as well.

The State is also initiating a program of acute and chronic *Ceriodaphnia* testing requirements for dischargers The State has recently started sediment testing at 50 Puget Sound stations, which includes amphipod and Microtox^R sediment bioassays as well as an analysis of benthic infauna and sediment chemistry Dischargers are generally not required to conduct biosurveys; however, a new State policy will require pulp mills and perhaps all industrial dischargers to conduct benthic invertebrate community analyses.

The Municipality of Metropolitan Seattle (METRO) evaluates habitat suitability for salmonids and benthic community structure in 25 rivers and 27 lakes.

All major dischargers to Puget Sound are monitored by the State for ambient effects, specifically benthic infaunal community structure, and fish abnormalities (this is not routinely conducted).

The State has recently started evaluating benthic infaunal communities at 50 stations in Puget Sound

ND RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State ambient fixed-station monitoring network consists of 97 stations in four river basins operated by the USGS, 33 stations operated by the North Dakota Department of Health, 4 stations operated by the State of Minnesota in the Red River Basin, and 11 stations operated by the US Corps of Engineers. At the 33 stations operated by North Dakota, routine water quality parameters are sampled monthly, quarterly, or seasonally.

Biosurveys

The State does not conduct biosurveys associated with NPS pollution problems in streams and rivers.

Toxics Monitoring

The State collects fish from 10 locations per year for residue analyses of organochlorine pesticides, PCBs, and metals. The State also collects sediment for residue analysis on a site-specific basis.

LAKE MONITORING PROGRAM

1986 Nelson Lake Study

A comprehensive monitoring program to sample water chemistry, aquatic biota, and sediments was conducted by a contractor for the State. The study included analyses of the aquatic community (phytoplankton, zooplankton, and periphyton) in Nelson Lake. Trace metal residue analyses were performed on tissue samples from seven fish species and on lake sediments.

OH RIVER MONITORING PROGRAM

Ambient River Monitoring Network

The State collects water quality and sediment chemistry data annually in conjunction with biosurvey data collected at National Ambient Water Quality Monitoring Network (NAWQMN) stations and other monitoring statichs on 11 major Ohio rivers

The State has developed biological criteria for its rivers and streams using a biosurvey/ecoregion approach. A set of least-impacted reference sites across the State and within each of the live Ohio ecoregions was carefully selected and sampled for fish, macroinvertebrates, and water column and sediment chemistry. Based on these results, criteria for three biological indices were derived: the Index of Biotic Integrity (IBI for fish), the modified Index of Well-Being (Iwb for fish), and the Invertebrate Community Index (ICI for macroinvertebrates). Macroinvertebrate community monitoring is conducted in approximately 15 river basins at over 165 sites each year as part of the Intensive Biological and Water Quality Survey Program and at sites included in the National Ambient Water Quality Monitoring Network (NAWQMN) on 11 major Ohio rivers. At these stations, macroinvertebrates are collected using modified Hester-Dendy multiplate artificial samplers; they also are collected from natural substrate using dipnets and hand picking. Fish are sampled primarily by electroshocking and seining. Stations are primarily located downstream of point source dischargers; however, an expanded monitoring effort during 1988 was planned to assess NPS impacts. Habitat evaluations are also made at each site using a qualitative habitat evaluation index.

Paired Watershed Study

A cooperative Federal, State, and local agency monitoring program was established to determine the effectiveness of conservation tillage in reducing pollutant loading of steams. Farmers in one watershed (1,450 acres) maximize use of conservation tillage, while farmers in an adjacent watershed (1,847 acres) use conventional tillage. Crop production records will be maintained of all fertilizer and pesticide applications. The runoff entering streams will be monitored to determine differences in water quality accountable to the tillage system used.

Toxics Monitoring

As part of the Great Lakes Surveillance Program for Lake Erie, monthly water quality monitoring is conducted on 12 of the larger Lake Erie tributaries. Sampling to monitor the concentration of toxic substances in fish tissue and sediment was done at selected sites

As part of the Intensive Biological and Water Quality Survey Program, ambient water quality samples are collected for routine chemical and metals analyses in 12 to 15 river basins per year

NC LAKE MONITORING PROGRAM

(cont)

Phytoplankton Ambient Network

Lake water quality is assessed by evaluation of phytoplankton populations as related to pertinent chemical and physical data. This ambient network consists of locations within waterbodies that have shown potential for eutrophication Lakes are sampled once during the peak growing season. Two to twelve stations are located on each lake depending on size. Samples are collected from the surface, euphotic zone, and hypolimnion Samples are analyzed for chlorophyll *a*, nutrients, and other chemical/physical parameters. The NC Trophic State Index (NCTSI) is the primary tool for evaluating the trophic status of lakes. The index is based on total phosphorus, total organic nitrogen, Secchi depth, and chlorophyll *a* The NCTSI relates to tropic classification as follows:

NCTSI	Trophic Status	
< -2 0	Oligotrophic	
-2.0 to 0.0	Mesotrophic	
0.0 to 5 0	Eutrophic	
> 5.0	Hypereutrophic	

Algal Bloom Studies

A statewide algal bloom reporting procedure was established in 1984. This program involves identification and enumeration of samples and a review of water quality data to assess the role that algal growth might have played in a specific pollution situation (e.g., fish kill) under investigation.

Special Monitoring Studies (1986-1987)

Falls of the Neuse Reservoir and B Everett Jordan Lake Studies--These studies consisted of monthly sampling
of physical, chemical, and biological parameters at nine stations (Falls Reservoir) and eight stations (Jordan
Lake) to determine trophic status and suitability of raw water supplies.

NC COASTAL/ESTUARINE MONITORING PROGRAM (cont)

(cont.)

Benthic Macroinvertebrate Surveys

As part of the NPS Program, coastal/estuarine biosurveys are conducted for benthic organisms using a timed effort employing sweep nets and fine-mesh samplers In addition, sediment grabs (petite Ponar samplers) are evaluated for the infauna community Data analyses includes determination of taxa richness and species composition. Trends are assessed where applicable. Marine biosurvey data are not subjected to all the metrics used to c valuate freshwater biosurvey data Marine biosurveys differ from freshwater biosurveys in that marine waters are not ranked as to their pollution category.

Special Monitoring Studies (1986-1987)

 Broad Creek--This study evaluated the biological changes in the Broad Creek estuary due to artificial salinity manipulations. The study was performed between February and June 1986 in cooperation with North Carolina State University

NY LAKE MONITORING PROGRAM

Citizen's Statewide Lake Assessment Program

In this program, during the summer, 53 lakes are sampled 15 times by private citizens. The following parameters are monitored: Secchi depth, temperature, pH, acid neutralizing capacity (ANC), specific conductance, chlorophyll a, nitrate nitrogen, and total phosphorus at the surface and at depth at one or more locations. In some lakes, dissolved oxygen (DO), lake level precipitation acidity, precipitation amount, and aquatic plant populations are also assessed.

Lake Classification and Inventory Program

Approximately 30 lakes each year are sampled in specific geographic regions of the State Samples are collected for pH, ANC, specific conductance, temperature, DO, chlorophyll a, nutrients, and plankton at the surface and at depth at the deepest point of the lake five times per year from May through October.

Water Quality Surveillance Network

Seven stations are sampled in this network. The sampling pattern is similar to the Lake Classification and Inventory Program with the addition of major ions. Each take is sampled once in the spring, summer, and fall at both the surface and at depth. Two takes have more than one sampling location.

Special Lake Studies

The State monitors four Adirondack Lakes (Twitchell Lake, West Lake, Brook Trout Lake, and Silver Lake) as part of the Long-Term Acidity Monitoring Study. These lakes are sampled throughout the year in a similar fashion to lakes sampled in the Lake Classification and Inventory Program, with the addition of major ions and aluminum species. Toxics may be monitored in water, sediment, fish, and invertebrate species as part of special lake studies

COASTAL/ESTUARINE MONITORING PROGRAM

Long Island Sound Studies

These studies are conducted jointly by the States of New York and Connecticut, Regions 1 and 2, the National Oceanic and Atmospheric Administration (NOAA), and the Interstate Sanitation Commission The State has been active in studying the extent and effects of toxic contamination in the Sound through finfish, lobster, and eel contamination studies

NC RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains an extensive ambient water quality monitoring program consisting of 340 stations, 38 of which are located in estuarine waters. Stations are distributed evenly according to basin size throughout the State's major river basins. The fixed-station ambient monitoring network is a dynamic system. Parametric coverage and frequency are routinely modified to derive needed information. At a minimum, the entire network is reviewed every 3 yr All stations are sampled monthly, quarterly, or semiannually depending on their relative importance. Pesticides, other organic compounds, and metals are monitored in the water column; metals also are monitored in sediment.

Benthic Macroinvertebrate Network

The State maintains a Benthic Macroinvertebrate Ambient Network (BMAN). This fixed-station network consists of approximately 180 sampling locations; approximately 80 freshwater and 10 estuarine sites are sampled annually Stations are sampled at varying frequencies (e.g., some sites are sampled each year, some every other year, and some every third year). This schedule provides maximum coverage and foundation for a long-term data base.

Sampling requires approximately 6 man-hours per site and incorporates the use of kick nets, sweep nets, chironomid collections, and visual inspections. The water quality of an area is assessed by determining total taxa richness, taxa richness of pollution intolerant groups (Ephemeroptera, Plecoptera, Trichoptera [EPT]), and predominant "indicator" assemblages. Biological results are compared to existing chemical and physical data for an area and are examined for between-year variations in flow Samples are collected from July to early September to approximate worst-case conditions (low flow and high temperature).

Special Monitoring Studies (1986-1987)

- Little Yadkin River--This study used fish community structure data to evaluate the effects of sediment control structures in a drainage that receives NPS loading. The study included four sites and was performed during July 1987
- Lumber River--This study used fish community structure to gather background data in the area of a proposed hazardous waste dump site. The study was performed during September and October 1986, and a followup study was performed in July 1987.

Toxics Monitoring

The State collects lish at 30 to 50 sites per year for residue analyses of pesticides and metals

NM RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State obtains routine water quality data from 7 fixed stations and 11 NASQAN stations operated by the USGS and the New Mexico Interstate Stream Commission Monitoring System Routine water quality parameters are sampled bimonthly, additional nutrients and trace elements are sampled quarterly, radiochemicals are sampled semiannually (at selected stations), and phytoplankton are sampled seasonally (five to seven times per year) In addition, 46 long-term stations are monitored by USGS in perennial streams statewide

Trace element residue analyses are conducted on water samples collected during intensive surveys Pesticides are also monitored as deemed necessary

Intensive Surveys

The State conducts intensive and reconnaissance surveys of physical, chemical, and biological conditions in selected stream segments Approximately eight intensive river monitoring studies are conducted annually Generally, three macroinvertebrate samples are collected at each chemical sampling site Macroinvertebrate community structure is evaluated using the Winget and Mangum Biotic Condition Index (BCI) and the Shannon-Wiener Diversity Index. Only one fish survey has been conducted by the Environmental Improvement Division because fisheries information is collected routinely by the New Mexico Game and Fish Department

Toxics Monitoring

The State does not currently collect fish for residue analyses; however, fish residue analyses are provided by other agencies as a cooperative effort (e.g., USFWS and New Mexico Department of Game and Fish).

LAKE MONITORING PROGRAM

Approximately five lake monitoring studies are conducted annually Biological sampling for zooplankton, phytoplankton, and benthic macroinvertebrates are included in each lake study. One sample is collected at a shallow station and another at a deep station Sampling is usually performed seasonally during the spring, summer, and fall, although some winter sampling is also conducted. The following water quality parameters are also monitored total phosphorus, chlorophyll a, Secchi disk transparency, and other nutrients. Toxic substances are monitored in water and fish tissue samples through cooperative efforts with the New Mexico Department of Game and Fish or the U.S. Fish and Wildlife Service

NY RIVER MONITORING PROGRAM

Rotating Intensive Basin Surveys (RIBS)

The State conducts ambient monitoring for toxic and conventional water quality parameters in four media (water column, sediment, macroinvertebrates, and fish) as part of the Rotating Intensive Basin Studies The major drainage basins are divided into three groups. Each group is monitored for a 2-yr period within a 6-yr cycle. During each 2-yr study, 24 water samples are collected and are analyzed for nine metals and volatile halogenated organics. Two spatial composites of surficial sediments are analyzed for metals, organochlorine pesticides, and PCBs. Macroinvertebrates are collected two to six times at each site for metals, pesticides, and PCB analyses. One fish collection of two to four species is made as part of the RIBS program.

The State also collects macroinvertebrates at 38 trend monitoring sites and at 50 special survey sites per year Macroinvertebrates are collected two to six times at each Rotating Intensive Basin Studies (RIBS) station and are analyzed for community structure including species diversity and richness. The macroinvertebrates are collected using six multiplate collectors in large streams or by two rapid bioassessments (kick samples) in small wadeable tributaries

Toxics Monitoring-Bioindicator Species

The State also uses laboratory-reared midge larvae as bioconcentrators by placing them in areas of suspected contamination for designated periods of time.

Toxics Monitoring--Fixed-Station Water-Quality Networks

The State maintains a fixed-station toxics surveillance network to monitor 14 metals, 29 volatile halogenated organics, and 24 aromatic hydrocarbons in the water column at 76 sites statewide. Eleven sites are located in major rivers to monitor overall water quality, 44 sites are situated downstream of either point source dischargers (41) or hazardous waste sites (3), and the remaining 21 sites are designated as background stations.

Fish Contaminant Monitoring

The State collects fish at 100 sites per year for tissue residue analyses of some metals (primarily mercury), PCBs, and organochlorine pesticides.

NJ LAKE MONITORING PROGRAM

(cont)

Biological Surveys

Very little biological monitoring for NPS pollution has been performed in lakes The Division of Fish, Game, and Wildlife conducts fish community assessments These include a determination of the primary types of fish found and healthiness of the fish community

Lakes Management Program

This sampling program collects water samples from 20 public lakes statewide primarily including those with high recreational use. Samples are analyzed for nutrients, turbidity, algae, and coliform bacteria

COASTAL/ESTUARINE MONITORING PROGRAM

Ambient Water Quality Monitoring

Routine water quality monitoring in New Jersey's bays, estuaries, and coastal reaches is performed by the Interstate Sanitation Commission and Delaware River Basin Commission, which monitor for bacteria, DO, nutrients, and toxics

Intensive Studies

Site-specific intensive studies are conducted by the State to address specific pollution problems:

- USEPA New York Bight Water Quality Survey--Involves phytoplankton and chlorophyll a analyses at 12 stations for 16 weeks
- NJ Coastal Eutrophication Study--Involves supplemental data collection on brown and red tides and includes phytoplankton, chlorophyll *a*, and related parameters at 14 stations monthly.
- Barnegat Bay Study--Involves an investigation of the fate and effects of marina-associated pollutants on commercially important fish and shelllish, eutrophication, and nutrient loading in Barnegat Bay and development of a critical pathway analyses for the Oyster Creek Nuclear Generating station using the hard clam, Mercenaria mercenaria.

State		·	
NJ (cont.)	COASTAL/ESTUARINE MONITORING PROGRAM		
(,	•	Coastal Bloom (Green Tide) StudyInvolves monitoring near shore waters from Atlantic City to Ocean City to determine physiochemical conditions required for Gyrodinium aureolum blooms Eighteen stations are sampled weekly for physical/chemical parameters (including chlorophyll a concentrations) and phytoplankton counts.	

• Toms River Estuary Study--Involves a survey of the estuary to determine the extent and causes of bacterial contamination of public bathing areas.

NH LAKE MONITORING PROGRAM

(cont)

Special Studies

The WSPCC conducts intensive lake studies (typically 1 year in duration) on specific lake problems, such as algal suppression using aluminum sulfate, effects of wetlands manipulation on nutrient removal, diagnostic/feasibility studies, and effects of causeway construction across a reservoir.

Citizen Monitoring

Citizen volunteers sample lakes biweekly for the 3 summer months. The water quality parameters measured include total phosphorus, chlorophyll a, and Secchi disk transparency.

COASTAL/ESTUARINE MONITORING PROGRAM

Special Studies

Special monitoring studies in coastal areas include research on the Great Bay estuary by the University of New Hampshire, studies proposed as part of the National Estuarine Research Reserve, and potential studies by the Water Quality Section of shellfish waters in several bays to define the sources of bacterial contamination

NJ RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The three State and Federal ambient water quality monitoring networks include 114 monitoring sites statewide that collect data on routine water quality parameters and metals Two networks are affiliated with the USGS--the NASQAN and the State/USGS Joint Primary Network. NASQAN consists of 6 stations, and the State/USGS joint network consists of 82 stations. Sampling frequency is six times per year for routine water quality parameters, two times per year for supplemental water column parameters, and yearly for sediment parameters (metals, organic pesticides, herbicides, and PCBs). The EPA also maintains a Basic Water Monitoring Network of 26 stations sampled four times yearly (seasonally). Additional samples are collected yearly for metals and various dissolved minerals

Intensive Studies

Very little instream monitoring for NPS pollution has been performed in rivers. The Division of Fish, Game, and Wildlife conducts fish community assessments. These include a determination of the primary types of fish found and healthiness of the fish community.

Site-specific intensive surveys are conducted to examine specific pollution problems:

- USGS/NJ Hopewell Pennington Basin Study--Involves characterizing ambient water quality of three creeks using data from 135 macroinvertebrate samples and 48 periphyton samples.
- Pinelands Biomonitoring Intensive Survey--Involves sampling periphyton and macroinvertebrates at 20 stations two times per year.
- Toxic Database Biomonitoring Data Collection--Involves sampling for macroinvertebrates and fish at 10 stations two times per year.
- US EPA Basic Water Biomonitoring Program--A fixed-station program for sampling periphyton and macroinvertebrate data at 30 stations two times a year. This program has been conducted only once

Toxics Monitoring

The State is monitoring PCBs and organochlorine pesticide residues in select linfish collected from New Jersey waterways

NV RIVER MONITORING PROGRAM

Water Quality Monitoring Network

The State maintains an extensive fixed-station water quality monitoring network that regularly samples 74 stations on 14 major river basins. The network monitors routine water quality parameters as well as metals. Sampling is monthly, quarterly, semiannually, or annually depending on the river basin. In the Truckee River drainage, periphyton samples are collected from artificial substrates monthly and evaluated for species enumeration, chlorophyll *a*, and ash-free dry weight. Macroinvertebrate samples are collected quarterly and measured for total biomass, species enumeration, and species diversity.

Toxics Monitoring

The State collects fish for tissue and sediment residue analyses on a site-specific basis related to toxics problems. The State also participates in the EPA Toxics Monitoring Network and collects water, sediment, and/or fish tissues at 17 sites statewide

LAKE MONITORING PROGRAM

The State currently does not have a statewide lake monitoring program. The EPA as part of the National Eutrophication Survey, however, monitored nine of the State's lakes and determined eutrophic conditions of these lakes for Nevada

The State currently samples five important lakes and reservoirs for the purpose of providing background data for a lake's data base that will be used in management of these State waterbodies. The lakes and reservoirs sampled include Big and Little Washoe Lake, Rye Patch, and Wildhorse and Wilson Reservoirs These lakes and reservoirs will be surveyed a minimum of every 2 years, three times during the year of the testing (spring, summer, and fall). Nevada is currently in the process of applying for a Clean Lakes grant to support further lake assessments

NH RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State conducts water quality studies of a number of rivers throughout the State Station types include 4 National Water Quality Surveillance System (NWQSS) stations, 11 primary monitoring network stations, and 38 other fixed stations. Specific parameters sampled vary according to station type, but typically include sampling routine water quality parameters and metals.

Biosurvey Program

The State does not have a well-defined biological sampling program for rivers and streams relative to NPS pollution assessment. No biological monitoring was conducted in lotic waters

LAKE MONITORING PROGRAM

Lake Surveys

Approximately 40 to 50 lakes and ponds if the State are routinely sampled. Each lake is sampled twice during the year: once during the winter and once during the summer. The main purpose of winter sampling is to determine the phosphorus levels during a time of low biological production. Oxygen depletion under the ice and types of plankton present are also monitored. The plankton analyses involve phytoplankton identification (to genus), percent abundance, and cell counts.

Summer sampling consists of evaluating various physical, chemical, and biological parameters during a time of maximum biological production. Physical/chemical measurements include water transparency, conductivity, color, alkalinity, pH, and nutrients. Chlorophyll a analyses are made from phytoplankton samples. During the summer, the identity and shoreline location of major growths of vascular plants and macroscopic algae are noted. Subjective evaluation of the abundance of each plant in the lake as a whole is determined using the terms "sparse, scattered, common, abundant, and very abundant." Unknown samples are collected for identification.

Acid Rain Studies

The Water Supply and Pollution Control Commission (WSPCC) samples 20 accessible lake outlets twice a year (spring and fall) and 30 inaccessible ponds (by helicopter) once a year (spring) for acid rain parameters to provide short- and long-term trend information on acid rain effects

MT RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

Short-term intensive and synoptic water monitoring surveys are emphasized rather than long-term, fixed-station, and fixed-frequency monitoring Fixed-station monitoring is conducted on the Clark Fork River principally by the USGS The current network consists of 32 mainstem, tributary, and effluent stations. Sampling is conducted 16 times per year—monthly from August through March and twice monthly from April through July.

Clark Fork River Trend Monitoring

Once each year in August, biological samples consisting of four modified Hess quantitative macroinvertebrate (stream insect) samples and one periphyton (algae) composite sample are collected at each river station

A study of the distribution and abundance of fish and other biological communities in the Clark Fork River has been initiated as part of the Clark Fork River Basin Project

Toxics Monitoring

Sampling of sediment and fish tissue for residue analyses of metals, PCBs, PCPs, and chlorinated hydrocarbons is conducted on a site-specific basis

LAKE MONITORING PROGRAM

Flathead Lake Monitoring

The State contracted the University of Montana to monitor the amounts of algal nutrients and algal growth in Flathead Lake to evaluate eutrophication problems.

NE RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Program

The State maintains, in cooperation with the USGS, a 58-station ambient monitoring network. Routine water quality parameters are sampled monthly. Additionally, at 15 of the 58 stations, metals are monitored quarterly

River Inventory and Classification Program

Direct assessments of aquatic life use support are made using fish and invertebrate data collected as part of a stream inventory and classification program. A total of 140 sites were combined to represent Eastern Nebraska warmwater streams (Corn Belt Region).

The macroinvertebrate community metrics include total number of taxa, total number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa, percent tolerant taxa, total number of intolerant taxa, and a biotic index based on Chutter (1972) Fish data are evaluated by species composition (including total number of species, number of benthic insectivores, number of sunfish species, number of native Cyprinid species, percent tolerant species, and the number of intolerant species), trophic composition (including percentage of omnivores, insectivores, and carnivores), fish condition (including percentage of individuals as hybrids and percentage of individuals with anomalies), and abundance Two indices were used to evaluate the stream segments: the Index of Biotic Integrity (IBI) for fish developed by Karr et al. (1986) and an Invertebrate Community Index (ICI) modified after an index used by the Ohio EPA (1987, Volume III).

Toxics Monitoring

The State, in cooperation with the EPA, collects fish at 15 locations as part of the Regional Ambient Fish Tissue Analyses Program. Whole fish residue analyses are conducted by Region 7 for 140 toxic pollutants.

LAKE MONITORING PROGRAM

No ambient monitoring is conducted to gather water quality data on lakes and reservoirs; however, the State currently conducts special monitoring studies as appropriate and will monitor 62 lakes in 1989 and 1990 for various physical, chemical, and biological parameters as part of its State Lake Water Quality Assessment program A Trophic State Index based on the method of Carlson (1977) was calculated for 23 lakes based on mean summer Secchi disk transparency.

Eleven lakes have been submitted as candidates for Section 314 Phase I studies using FY89 funding

MS COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Ambient Biological Monitoring

The State does not currently sample for macroinvertebrates in estuarine/coastal waters Periphytometers are used for sampling.

Intensive Surveys

The State conducted several intensive surveys from 1985-1987, including the following survey that involved an NPS pollution assessment:

• Water Quality Survey at Ocean Springs Harbor--Benthic community structure, phytoplankton community structure, chlorophyll a, b, c, and phaeopigments were sampled.

MO RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State's ambient water quality monitoring network of 30 stations comprises stations operated solely by the US Geological Survey (USGS) and stations operated cooperatively by USGS and the State

Rapid Stream Assessments

The State conducts qualitative macroinvertebrate sampling (rapid stream assessments) in streams for NPS studies associated with coal mines, barite mines, lead-zinc mines, sawdust piles, and animal waste facilities. The rapid stream assessment technique was used in 165 studies from 1986-1987 to evaluate NPS problems.

Special Studies

Preliminary fish fauna studies are also conducted in NPS treatment watersheds prior to Best Management Practices (BMP) implementation.

Toxics Monitoring

The State collects fish at 27 sites annually at stations operated cooperatively by the State and EPA or solely by the EPA for the Regional Ambient Fish Tissue Analyses Program; EPA Region 7 performs residue analyses for 130 toxic pollutants. The State conducts fish tissue analyses for chlordane, PCBs, and other pesticides at 10 to 20 short-term monitoring sites.

LAKE MONITORING PROGRAM

Special Studies

Major activity in this program has involved a study of sedimentation rates, sediment quality, and the predator-prey fish dynamics in Lake Taneycomo and monitoring fish tissue in several urban lakes for pesticide contamination.

Lake Assessments

The State will conduct a major monitoring program in 1989-1991 for 90 lakes statewide using Section 314 and 205(j) funding Physical, chemical, and biological parameters will be sampled, and the study will focus on NPS loading rates and in-lake effects.

MS RIVER MONITORING PROGRAM

Ambient Biological Monitoring

The State maintains an ambient fixed-station water monitoring program (including physical/chemical parameters and biological and fish tissue stations.) A network of 24 primary stations is sampled once every other month The network includes unpolluted streams used for baseline assessments and some streams below discharges from which long-term trends can be established or improvements noted. In addition, the State uses water quality data collected at 22 USGS stations primarily in the Tennessee-Tombigbee Waterway and from 8 NASQAN program stations.

The State collects periphyton using periphytometers at 18 ambient monitoring stations annually For periphyton, chlorophyll a, biomass (as ash-free weight), and counts and identification are conducted Macrophyton are collected at specific stations, and identification of species is made; in some cases, standing crop and percent coverage are determined Macroinvertebrates currently are sampled using a "modified" rapid bioassessment technique and species diversity are determined The State is using a multihabitat, qualitative sampling method for macroinvertebrates and is applying and testing many of the metrics presented in EPA's Rapid Bioassessment Protocols. The State performs fish population assessments at five sites per year, and species identification is conducted

Toxics Monitoring

The State conducts ambient monitoring of fish tissue for metals and chlorinated hydrocarbons at 25 sites per year. The fish are collected during the fall because residue levels are generally higher then. Three species are collected and a whole fish composite sample is analyzed for each species

LAKE MONITORING PROGRAM

Intensive Surveys

The State conducted several intensive surveys from 1985-1987, including the following survey that involved an NPS pollution assessment:

• Water Quality Survey of Roosevelt State Park--Fish population balance and lake fertility were assessed

MN LAKE MONITORING PROGRAM (cont)

(cont)

Regional Lake Sampling Program

The State collects samples from 50 to 150 lakes per year throughout the State This sampling effort evaluates the range of conditions and patterns in lake water quality in Minnesota Trophic status is assessed using Carlson's Trophic State Index (TSI). This index was developed from the interrelationships of summer Secchi disk transparency and epilimnetic concentrations of chlorophyll *a* and total phosphorus. About 100 lakes are monitored for water quality; about 35 lakes are monitored annually for acid deposition effects.

The trophic state of each lake was assessed using Carlson's TSI. This index was developed from the interrelationships of summer Secchi disk transparency and epilimnetic concentrations of chlorophyll a and total phosphorus:

- TSI < 50 = fully supporting swimmable and aesthetic uses (oligo-mesotrophic)
- TSI 51-59 = supporting but threatened (mildly eutrophic)
- TSI 60-65 = partially supporting but impaired (eutrophic-hypereutrophic)
- TSI > 65 = nonsupporting (hypereutrophic)

Toxics Monitoring

The State is called upon routinely to assist in development of a sampling program for lakes impacted by sanitary landfills, hazardous waste sites, and related issues. Monitoring is conducted on a site-specific basis Water, sediment, and fish tissues may be sampled for toxic compounds (mercury, PCBs, and dioxins). Residue analyses are conducted in fish fillets only. Over the last 10 years, fish samples have been collected from 228 lakes and from 5 locations on Lake Superior. Nearly half of the State's large lakes (>5,000 acres) and a number of small lakes (<5,000 acres) have been sampled.

Survey of Monitoring in NPS Programs

State

MI LAKE MONITORING PROGRAM

(cont)

- Oligotrophic lakes = TSI < 39
- Mesotrophic lakes = TSI 39-48
- Eutrophic lakes = TSI > 48

Inland Lakes Management Unit Lake Monitoring

Approximately 60 lakes were to be sampled in 1988 during spring overturn and summer stratification periods. Parameters to be monitored were not specified

National Surface Water Survey (NSWS)-Phase I

In the fall of 1984, 153 lakes in the upper peninsula were sampled to assess surface water pH levels

National Surface Water Survey (NSWS)-Phase II

Michigan State University (under EPA contract) conducted fish surveys of 49 NSWS lakes in the upper peninsula Information on size, composition, and growth rate of fish communities in relation to lake acidity was evaluated, and index species (perch, sucker, pike, and bass) were collected for mercury analyses. Benthos, zooplankton, and phytoplankton were collected, but they were not evaluated because of a lack of funding.

Toxics Monitoring

The State also collects fish and sediment samples from upper peninsula lakes for metal residue analyses, particularly mercury.

MN RIVER MONITORING PROGRAM

Water Quality Assessments

The State currently uses water quality criteria that are specific to each ecoregion in Minnesota for assessments of NPS pollution impacts on water quality. Several water quality parameters are monitored: nitrate-nitrite, total ammonia, total phosphorus, total suspended solids, conductivity, pH, temperature, fecal coliform, turbidity, and 5-day BOD. In addition, one or two reference watersheds have been identified for each ecoregion. These reference sites are relatively unimpacted by pollutants from all sources.

Benthic Macroinvertebrate Sampling Program

The State conducted benthic macroinvertebrate community assessments between 1976-1979 but currently does not have an active program. The State is planning to develop instream criteria and a comprehensive biological survey program using the EPA's Rapid Bioassessment Protocols.

Fish Community Sampling Program

The State (Department of Natural Resources) occasionally conducts fish community sampling as part of use attainability studies. The State is interested in developing fish community biocriteria based upon the ecoregional approach and using the Index of Biotic Integrity (IBI). Efforts have been initiated to collect fish community data from reference sites throughout the State. Fishery surveys have been completed in 11 of the 12 reference watersheds.

Toxics Monitoring

Fish are sampled from 50-75 sites annually and analyzed for mercury, PCBs, and dioxins in the fillets only Over the past 10 years, 101 river locations have been sampled.

LAKE MONITORING PROGRAM

Citizen Lake Monitoring Program (CLMP)

Approximate 285 lakes are monitored through this program. Citizen monitors collect weekly transparency measurements of their lake during the summer.

MA **RIVER MONITORING PROGRAM** (continued)

(cont)

For the MRB, the members of a 100-organism subset of a larger sample are identified to the genus or species level The taxonomic data are then compiled to determine the status of various criteria used to rank water quality. These criteria include: species richness; distribution "balance"; EPT value (number of taxa in Ephemeroptera, Plecoptera, Trichoptera); percent contribution, pollution tolerances, and feeding habits of the five numerically dominant species; and Hilsenhoff Biotic Index (HBI).

The MRB is conducted at up to 25 sampling sites per year in conjunction with comprehensive water quality surveys Results are used to supplement traditional physicochemical analyses by demonstrating actual instream impacts of pollutants, as well as assessing ambient water quality and habitat conditions throughout a particular watershed From 1984 through 1986, a total of 59 sites were assessed using this technique

Microbiological Monitoring

Microbiological monitoring includes both the maintenance of a small support laboratory for algal identifications and chlorophyll determinations, and the assessment of bacterial indicators of water pollution Data from riverine waters are used to identify waterbodies exhibiting improved or deteriorated water quality conditions over time Algal indicators of the presence of elevated metals levels, nutrient enrichment, or other contaminants (e.g., oil and grease) are cited in the interpretive information provided to the water quality analysts. Approximately 300 chlorophyll analyses and 250 algal identifications and counts are conducted annually.

In the past 2 years, several bacteriological indicators including, but not limited to, the source differentiation of the fecal streptococci bacteria were used to assess water quality conditions and determine sources of fecal contamination in the North River, Westport River, and Wareham River coastal drainage areas. Source differentiation of the fecal streptococci bacteria provides a means for determining the source of elevated bacteria counts. The kinds of sources that can be distinguished by this method are: insects, birds, warm-blooded animals, and decaying vegetation. Identification of the type of source will aid in the establishment of mitigative measures for controlling nonpoint sources of fecal contamination.

MA LAKE MONITORING PROGRAM

(cont)

Clean Lakes and Great Ponds Monitoring

The State conducts statewide lake monitoring once per year, generally during the summer A lake or pond is classified according to the lake classification system after a baseline limnological survey of the waterbody has been conducted. This survey is generally conducted in 1 day and consists of bathymetric mapping of the waterbody; physical, chemical, and biological sampling of the open water areas, tributary stream(s), and outlet; and a quantitative and qualitative mapping of the aquatic macrophyton community in the waterbody. The purpose of this survey is to classify the waterbody by its trophic status and identify any point and nonpoint sources of pollution.

Although a host of physical, chemical, and biological parameters is measured during the normal lake survey, only six critical parameters are employed in the lake classification priority system. The six parameters include: hypolimnetic dissolved oxygen, Secchi disk reading, phytoplankton count (chlorophyll a), total ammonia and nitrate-nitrogen, total phosphorus, and aquatic macrophyton. Toxics may also be monitored in water, sediment, fish tissue, and macrophytes

The most recent survey data are used, and the priority listing is updated annually The optimum season for collecting lake data is mid- to late summer, or during peak biological production Unfortunately, this cannot always be achieved; thus, spring or autumnal data have to be used in the lake classification system.

Microbiological Monitoring

Microbiological monitoring includes both the maintenance of a small support laboratory for algal identifications and chlorophyll determinations, and the assessment of bacterial indicators of water pollution. The algal counts and chlorophyll results are used by the Lakes Section in a scoring system for determining the trophic status of lakes and ponds. Algal indicators of the presence of elevated metals levels, nutrient enrichment, or other contaminants (e.g., oil and grease) are cited in the interpretive information provided to the water quality analysts. Approximately 300 chlorophyll analyses and 250 algal identifications and counts are conducted annually.

OH GREAT LAKES MONITORING PROGRAM

(cont)

The Heidleburg Water Quality Laboratory Study made a comprehensive evaluation of physical (sediment) and chemical (nutrient and pesticide) characteristics of NPS runoff in selected streams and river basins in the Lake Erie drainage basin. The results were published in Lake Erie Agro-Ecosystem Program: Sediment, Nutrient, and Pesticide Export Studies (Baker, 1987)

Biocriteria for river mouths, harbors, and nearshore areas on Lake Erie are currently under development

INLAND LAKES MONITORING PROGRAM

The State currently has no statewide routine lake monitoring program, and historical data are very limited.

Citizen Monitoring

The State is developing a citizen lake monitoring program with the Northeast Four-County Regional Planning Commission

Proposed Lake Condition Index

The State has proposed the use of a Lake Condition Index (Ohio LCI) composed of 13 parameters that were selected to provide a holistic evaluation of lake conditions. These parameters include both monitored and evaluated biological, chemical, physical, and aesthetic information. The biological parameters include Index of Biological Integrity (IBI) for fish, nuisance growths of macrophytes, fecal coliform bacteria contamination, primary productivity based on chlorophyll *a*, and fish tissue contamination. For the biological parameters, monitoring deta are available primarily for the nuisance growths of macrophytes, fecal coliform, and primary productivity based on chlorophyll *a* values. The chemical parameters include nonpriority pollutants, priority organics, priority metals, nutrients based on spring total phosphorus, sediment contamination, and acid mine drainage. For the chemical parameters, monitoring data are available primarily for nonpriority pollutants, priority metals, total phosphorus, and acid mine drainage. The physical parameter, volume loss due to sedimentation, has been monitored for some lakes, and the public perception of lake condition (aesthetics) when monitored is a measure of eutrophication based on chlorophyll *a*

OK RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring and Toxics Monitoring Network

The State maintains an ambient trend monitoring network of 100 stations. This includes 22 CORE stations (which are part of EPA's National Water Quality Assessment Network) and 78 rotating toxics stations that combine water, sediment, and fish tissue monitoring for organochlorine pesticides, PCBs, and metals.

Intensive Survey

Stream monitoring activities are primarily directed toward water column chemistry, fish, benthic macroinvertebrates, periphyton, and phytoplankton population analyses. Periphyton and phytoplankton surveys are used specifically to evaluate NPS impacts. The State is also conducting the 14-day Selenastrum capricornutum algal bioassay test to identify NPS toxicity. A diversity index for macroinvertebrates and algae has been included in the Oklahoma Water Quality Standards, although it has not as yet been used in a regulatory setting.

LAKE MONITORING PROGRAM

Toxics Monitoring

Lake monitoring activities are primarily directed toward analyses of sediment and fish tissue for toxic residues The Oklahoma Department of Health samples specific lakes every 3 years during the summer for toxic substances. The State also monitors six reservoirs for toxics in fish tissue.

Routine Lake Surveys

The Conservation Commission has initiated a small lakes monitoring program that includes quarterly sampling of 138 sites on 100 lakes for turbidity, conductivity, temperature, and chlorophyll a analysis Carlson's Trophic State Index (TSI) is used to evaluate trophic classification.

Survey of Monitoring in NPS Programs

State

PA LAKE MONITORING PROGRAM (continued)

(cont)

Lake Management Program

The State samples specific lakes once during the spring, summer, and fall for the following chemical/physical parameters: total phosphorus, chlorophyll a concentrations, Secchi disk transparency, and other nutrients Only lakes with point source dischargers are surveyed

PA RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a fixed-station trend monitoring network for chemical parameters that also assesses biological communities at 166 stations. At a minimum, biological sampling consists of qualitative benthic macroinvertebrate sampling at each river station between August 1 and October 31 each year. Quantitative invertebrate sampling and qualitative or quantitative fish sampling are optional.

Intensive Surveys

The State conducts 100-150 use attainment studies and biological assessments associated with river and lake investigations. The scope of these investigations includes physiochemical water quality parameters, flow measurements, qualitative and quantitative measurements of aquatic vascular plants, algae, bacteria, benthic invertebrates, and fish

Toxics Monitoring

The State collects fish for residue analyses of various pollutants at 28 CORE stations. Both whole fish and fillets are sampled at half the CORE stations each year. White suckers are the target species.

Fish tissues are also monitored in the ORSANCO Lock Chamber Study on three rivers, and adult coho salmon are monitored during their spawning run at one river station. Fish tissue analyses for the salmon study are performed by the U.S FDA laboratory in Minneapolis as part of the Great Lakes International Surveillance Plan.

LAKE MONITORING PROGRAM

Intensive Surveys

The State conducts 100-150 use attainment studies and biological assessments associated with lake and river investigations. The scope of these investigations includes physiochemical water quality parameters, flow measurements, qualitative and quantitative measurements of aquatic vascular plants, algae, bacteria, benthic invertebrates, and fish

Water Quality Network

The State maintains a trend monitoring network for chemical parameters that also assesses biological communities at 166 stations annually (some of these stations are located on lakes). A qualitative plankton sample is collected from August 1 to October 31 each year in addition to the monthly physical/chemical water quality data

MI RIVER MONITORING PROGRAM

Ambient Water Quality Network

The State collects water samples at approximately 60 stations to monitor chemical-specific parameters Monthly sampling is conducted at 16 river tributaries to the Great Lakes, at 22 river stations above and below major urban areas, and at 2 stations on the Detroit River An additional 20 stations are sampled on the Detroit River from April through November. Water samples are analyzed monthly for routine water quality parameters at all stations. Sampling for metals is conducted at different frequencies for the different waterbodies monitored

Benthic Macroinvertebrate Program

Benthic macroinvertebrates are collected at approximately 100 sites annually as part of 20-30 facility-related site visits and 6-10 intensive surveys. There is no active fixed-station biosurvey network. Natural substrates are sampled using dipnets and the organisms are identified to order, suborder, and family Pollutant-sensitive taxa are identified to species These data are evaluated by the number of taxa, relative abundance, and indicator types. Habitat evaluations are made at each site.

Fish Community Sampling Program

Fish communities are sampled at sites similar to those sampled for benthos, but sampling depends on access and is limited to wadeable streams Electroshocking is used for sampling and data are evaluated for the number of taxa, relative abundance, and indicator species.

Toxics Monitoring

The State collects fish for analyses of metals, pesticides, PCBs, and other toxics. The chemical analyses performed are determined on a site-specific basis. In 1987, approximately 1,900 fish from 99 sites statewide were collected and 1,300 residue analyses were performed

LAKE MONITORING PROGRAM

Citizen Monitoring

Volunteer monitoring of transparency is conducted at 160-175 lakes annually From 1974-1982, chlorophyll a was also measured. Lakes (over 50 acres) are classified by their physical, chemical, and biological characteristics into three trophic categories. The Trophic State Index (TSI) is a measure of a lake's biological productivity, including nutrient levels, organic matter content, and water transparency. The State uses the TSI developed by Carlson (1977), which is derived from calculations based on Secchi disk transparency, chlorophyll a, or total phosphorus values and can range from 0 to 100. The higher the number, the higher the lake productivity.

MA COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Coastal Surveys

A recent activity of the State has involved increased concern with coastal pollution. Major coastal areas of concern include such highly polluted regions as Boston Harbor, Salem-Beverly Harbor, and New Bedford Harbor, as well as relatively unpolluted areas such as Buzzards Bay, Cape Cod, and the Islands. The polluted areas are monitored to assess improvement in water quality when water pollution control measures are instituted. Unpolluted areas, on the other hand, must be carefully monitored to gain the knowledge necessary for their continued preservation. During both 1986 and 1987, nine coastal surveys were conducted.

Special Studies

A second major activity of the State has been the special studies conducted in Buzzards Bay as part of the EPA Bays Program. The overall objective of this work is to combine monitoring with detailed investigations into the mechanisms and processes that control the fates and effects of pollutants entering coastal waters. These studies will be useful not only in expanding the State's understanding of marine pollution and the means to monitor it, but will also provide information for making more meaningful management decisions

Microbiological Monitoring

Microbiological monitoring includes both the maintenance of a small support laboratory for algal identifications and chlorophyll determinations, and the assessment of bacterial indicators of water pollution. Data from coastal waters are used to identify waterbodies exhibiting improved or deteriorated water quality conditions over time. Algal indicators of the presence of elevated metals levels, nutrient enrichment, or other contaminants (e.g., oil and grease) are cited in the interpretive information provided to the water quality analysts. Approximately 300 chlorophyll analyses and 250 algal identifications and counts are conducted annually.

OR RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains an ambient fixed-station river water quality monitoring network consisting of 87 stations (47 are sampled 10 to 12 times per year; 40 are sampled four to six times per year during spring and summer) that monitor 22 water quality parameters. The U.S. Bureau of Reclamation (USBR), under contract to the EPA, samples seven sites monthly in two river basins. Ambient water quality sampling in the Tualatin River basin was conducted biweekly as a joint effort of the Department of Environmental Quality (DEQ) and the Unified Sewerage Agency (USA) of Washington County. DEQ monitored 15 stations, and USA monitored 14 stations

Tualatin River Study

The State conducts Winter Wet Weather Surveys of water quality (two samplings per day in the morning and evening) for routine water quality parameters in the Tualatin River Basin. Sampling was initiated prior to major storm events when NPS (urban and agricultural runoff) and sewer overflows would be expected to be highest. Monitoring continued through the peak of the hydrograph.

The State conducts summer Low Flow Diurnal Surveys of routine water quality parameters, particularly dissolved oxygen (DO) at 6-10 key sites in the lower Tualatin River Basin Continuous DO monitoring is conducted at two sites Sampling is conducted three times each summer for 3-4 days. The State collects and analyzes chlorophyll a concentrations during the summer. Algal samples are identified and enumerated.

Willamette River Study

The State also conducts Low Flow Diurnal Surveys in sensitive reaches of the Willamette River

Toxics Monitoring

The State annually conducts statewide edible fish/shellfish tissue sampling at 12 sites to screen for bioaccumulation of selected chlorinated pesticide organics and metals. Sediment sampling is conducted annually or biennially at 12 sites for a larger number of organics and metals.

LAKE MONITORING PROGRAM

The State does not routinely monitor lakes The Department of Environmental Quality is looking into the possibility of developing a citizen monitoring network of lakes in Oregon as a means of developing trend data

OR LAKE MONITORING PROGRAM (cont)

(cont)

Special Lake Studies

The following special lakes studies were conducted during 1986-1987.

A biological survey of Tryon Creek State Park was conducted to evaluate suspected adverse effects from urban runoff. This survey used the EPA's Rapid Bioassessment Protocol for sampling benthic macroinvertebrates. Protocol III (field assessment followed by laboratory analysis of collected samples) was followed. Artificial substrate sampling was also conducted.

A biological survey of Devils Lake was conducted as part of the Phase II Clean Lakes Restoration Program Changes in fish populations and macrophyte abundance were documented in addition to changes in water quality parameters before and after implementation of the Phase II Clean Lakes Restoration Program. Fish were identified to species, and scales were collected for determining the age class.

A biological survey of Sturgeon Lake was conducted to monitor changes in salmonid populations and resident fish populations before and after implementation of a Phase II Clean Lakes Restoration Program.

COASTAL/ESTUARINE MONITORING PROGRAM

Coquille Basin Study

The State is planning a basinwide study of the coastal Coquille Basin. Monitoring emphases in the agriculturally dominated lower reaches of the basin will be directed at determining the impact and sources of bacterial contamination on commercial oyster fisheries. In the upper reaches, where forestry practices are of concern, the State will be evaluating biological and habitat assessment techniques.

Toxics Monitoring

The State annually conducts statewide edible fish/shellfish tissue sampling at 12 sites to screen for bioaccumulation of selected chlorinated pesticide organics and metals. Sediment sampling is conducted annually or biennially at 12 sites for a larger number of organics and metals.

Fecal Coliform Monitoring Program

The State conducts periodic sampling on three Oregon estuaries (Tillamook, Yaquina, and Coos Bay) four to six times per year for bacteriological analyses at 70 sites

PR RIVER MONITORING PROGRAM

Water Quality Monitoring Network

The Commonwealth maintains a permanent water quality monitoring network (PWQMN) consisting of 57 stations on 25 major river basins islandwide for conducting bimonthly routine water quality analyses and semiannual metals analyses Pesticide monitoring is conducted at selected stations.

The Commonwealth currently does not conduct biosurveys to evaluate water quality The main thrust of the monitoring is directed toward use of fixed-station monitoring of water quality parameters including metals and organics

Toxics Monitoring

Toxics monitoring has been associated primarily with the analyses of metals in the water column at established PWQMN stations. Special monitoring for pesticides, volatile organics, and acid/base/neutral fractions of priority pollutants has also been initiated at selected stations. Sediment contamination was monitored at 16 stations for a variety of toxics

LAKE MONITORING PROGRAM

Ambient Water Quality Network

The Commonwealth maintains a water quality monitoring network that samples six lakes three times per year during the spring, summer, and winter The chemical/physical parameters sampled include: total phosphorus, chlorophyll *a*, chlorophyll *b*, Secchi disk transparency, other nutrients, and toxic substances (in the water column).

Intensive Water Quality Study

Samples of lake water and sediment were collected to evaluate point source and NPS pollution to Cidra Lake

COASTAL MONITORING PROGRAM

The Commonwealth relies on a special monitoring network of 59 coastal PWQMN stations to evaluate routine water quality parameters, including sanitary pollution problems and heavy metal concentrations

RI RIVER MONITORING PROGRAM

Biosurveys

The State conducts biosurveys coinciding with USGS fixed-station trend monitoring stations. Three Fullner multiplate artificial substrate samplers (containing 14 plates each) are placed at 17 sites statewide to evaluate the instream macroinvertebrate communities Species composition, diversity, and the physiological condition of natural aquatic communities are assessed. Macroinvertebrates (mostly aquatic insect larvae) are enumerated and classified according to their tolerance of organic wastes and are scored as tolerant, facultative, or intolerant. Beck's Biotic Index is calculated for each station, as are the total number of organisms and total number of taxa. These surveys allow the State to inventory native invertebrate populations while protiling population changes on a year-to-year basis.

Toxics Monitoring

The State contracts with USGS to collect monthly samples at six fixed water quality monitoring stations for routine water quality parameters. Water samples are monitored for 15 metals and 17 pesticides twice yearly during low and high flow periods, and sediment residue analyses are performed yearly for 17 organochlorine pesticides during low flow periods.

The State maintains a supplemental monitoring program consisting of six stations that are sampled once per year during low flow periods (August or September). Samples are analyzed for conventional pollutants and selected metals

LAKE MONITORING PROGRAM

The State does not currently have a statewide lake monitoring program

COASTAL/ESTUARINE MONITORING PROGRAM

Biosurveys

The State samples water every other week in Upper Narragansett Bay and other areas for the "brown tide" organism Aureococcus anorexefferens, "red tide" dinoflagellate species, and other problem phytoplankton species Species identification is performed by the University of Rhode Island

Numerous biological surveys of Narragansett Bay are currently being conducted as part of the Narragansett Bay Project funded by the EPA's National Estuary Program to assess impact of toxics, land use impacts, nutrient enrichment, and the health and abundance of living marine resources

Survey of Monitoring in NPS Programs

State

RI COASTAL/ESTUARINE MONITORING PROGRAM

(cont)

Toxics Monitoring

The State collects shellfish at 14 monitoring stations in Narragansett Bay for bacteriological and metal analyses
SC RIVER MONITORING PROGRAM

Water Quality Monitoring Network

The State maintains biological sampling stations on various river basins throughout the State as part of the fixedstation water quality monitoring network. Biological monitoring that is conducted at 78 stations includes identification and enumeration of phytoplankton, aquatic macroinvertebrates, and fish. Data are analyzed for taxa richness, diversity, equitability, and similarity. The State is currently assessing many of the new biometrics presented in EPA's Rapid Bioassessment Protocols.

Toxics Monitoring

Toxics monitoring is conducted as an integral part of the State's fixed station water quality monitoring network consisting of 185 primary stations, 358 secondary stations, 187 sediment stations, and 78 biological stations Primary stations are sampled monthly year round for routine water quality parameters, quarterly for metals, and annually for pesticides, PCBs, and other organics. Secondary stations are sampled monthly from M_{2} to October Sediment stations are sampled annually in environmental sink areas. Biological stations are sampled for residue analyses of finfish and shellfish tissue once per year.

LAKE MONITORING PROGRAM

Clean Lakes Program (Inactive)

The State conducted a lake classification survey from 1980-1981 of 40 lakes and reservoirs The lakes were sampled once per season (fall, winter, spring, and summer) Trophic states was determined using the National Eutrophication Survey (NES) index and Carlson's Trophic State Index (TSI) The NES index is a six parameter percentile index that uses data for total phosphorus, inorganic nitrogen, Secchi disk depth, chlorophyll a, dissolved oxygen, and dissolved phosphorus. The Carlson index is a single parameter TSI that may be based on either chlorophyll a, Secchi disk depth, or total phosphorus. The NES index and Carlson index were both used to rank the 40 public lakes.

Ambient Monitoring Program

The State maintains an ambient monitoring program for evaluating lakes. Sampling is conducted once per month at 50 lake stations year-round. The following water quality parameters are sampled: total phosphorus, Secchi disk transparency, other nutrients, and toxics (water, sediment, and fish tissue).

Survey of Monitoring in NPS Programs

State

SC COASTAL/ESTUARINE MONITORING PROGRAM

(cont.)

Water Quality Monitoring Network

The State monitors tidal saltwater areas primarily through use of 63 fixed monitoring stations and through sanitary surveys conducted to determine shellfish harvest classifications.

Biosurveys

The State conducts some coastal/estuarine biosurveys that involve qualitative, multihabitat sampling. These data are analyzed for species composition and taxa richness.

SD RIVER MONITORING PROGRAM

Biosurveys

The State conducts fish surveys to assist in the evaluation of the impact of wastewaters and to evaluate fishery classification of questionable stream segments. The fish surveys are qualitative in nature and are used in conjunction with water quality survey data to evaluate improvement/degradation of water quality for fish habitat and diversity. Fish are captured, identified, measured, assessed for health status, and returned to the stream.

The State also monitors changes in macroinvertebrate community structure and diversity.

Toxics Monitoring

The State maintains a fixed-station water quality monitoring network consisting of 89 stations. Stations located on waterbodies receiving mine drainage are sampled for 10 metals.

The State collects fish for residue analyses of pesticides, metals, and selected organic contaminants once per year.

LAKE MONITORING PROGRAM

The State does not have a biological sampling program per se, but biological surveys are sometimes included as part of special studies

For lakes and reservoirs, algal surveys are conducted that include either chlorophyll a concentration or algal cell identification and enumerations.

TN RIVER MONITORING PROGRAM

Ambient Water Quality Network

The State maintains a fixed-station ambient water quality monitoring network for monitoring routine water quality parameters and metals, PCBs, and pesticides in water and sediment. Macroinvertebrates are sampled at 20 of these 86 ambient water quality monitoring stations. The sampling methodology comprises qualitative, multihabitat sampling using Surber samplers or artificial substrate samplers (Hester-Dendy multiplate samplers), and macroinvertebrates are identified to the lowest taxa. A diversity index is calculated as part of the analyses, and taxa richness, equitability, and evenness are also evaluated. The State will continue to monitor the biological integrity of streams on a rotating basis for all ambient stations. Expansion of the ambient biological monitoring system was planned for 1988. The State is currently evaluating the applicability of rapid bioassessment protocols for their macroinvertebrate sampling program.

Intensive Survey Program

The State conducts instream biological assessments of rivers impacted by both point and nonpoint sources of pollution. Macroinvertebrate and/or lish populations are sampled in these studies to determine the health of the aquatic community.

Toxics Monitoring

The State maintains a fixed-station ambient water quality monitoring network consisting of 86 sites that are monitored quarterly for metals and annually for PCBs and pesticides in the water column and sediments

Currently, the fish tissue residue sampling concentrates on those areas with known toxics problems Additional sites are monitored as deemed necessary. Residue analysis is conducted on a composite fish sample where fillets of five fish are blended together, then analyzed as one sample. At each site, five gamefish, five rough fish, and five catfish are collected

LAKE MONITORING PROGRAM

Intensive Survey Program

The State conducts instream assessment of lakes impacted by both point and nonpoint sources of pollution Sediment and fish tissue are often monitored for toxics. Sedimentation studies, bacteriological surveys, and routine water quality assessments may also be part of these studies.

TX RIVER MONITORING PROGRAM

Ambient River Monitoring Program

The State maintains a Stream Monitoring Program that collects surface water quality data from 667 sites statewide Sampling includes physiochemical, biological, and hydrological data at varying frequencies. Sample frequency for water quality parameters, nutrients, solids, and fecal coliform collection are as follows: 54 sites are visited monthly; 311 sites, quarterly; 151 sites, biannually; 138, annually; and 13 sites, every 2 yr.

Unclassified Waterbody Surveys

Unimpacted, unclassified streams are selected in defined aquatic ecoregions that exhibit similar land surface form, land use, natural vegetation, and soil type. Intensive field surveys are conducted when critical summertime low-flow conditions and elevated water temperatures exist. Parametric coverage common to these surveys includes field measurements, water chemistry, bacteriological analyses, and stream flow. Benthic macroinvertebrate and fish communities are also sampled.

Special Monitoring for Acid Rain Effects in Streams

Special monitoring for assessing potential acid rain effects in streams was initiated in 1985 Dissolved aluminum is a potential source of toxicity for aquatic biota resulting from increased acidity. Calcium along with pH and alkalinity is incorporated in the Calcite Saturation Index for measuring the buffering capacity of waters. Aluminum and parameters for the Calcite Saturation Index are measured at 17 sites in East Texas during routine quarterly monitoring

Intensive Surveys

Intensive surveys are conducted to assess both point source and NPS water quality problems. Parametric coverage common to most intensive surveys includes water chemistry and hydraulic measurements. Sampling of biological communities and sediment chemistry is periodically included in the parametric coverage. The following biological parameters may be sampled: algal growth potential, benthic invertebrates, macrophytes (vascular aquatic plants), nekton (fish, shellfish), and phytoplankton (drifting microscopic plants) or periphyton (attached microscopic plants).

Toxics Monitoring

Toxics monitoring is directed at three media: water, sediments, and fish tissue. Water samples are collected annually for metal analyses at 66 sites and for organics at 24 sites. Sediment samples are collected annually at 200 sites for metals and at 157 sites for organics. Fish tissue samples are collected at 32 stations annually for metal and organic analyses.

UT RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State collects water quality monitoring data at 99 STORET and 23 WATSTORE stations located statewide The stations are located in areas that best rellect ambient water quality, point source discharges, and, in some cases, above and below specific discharges.

Biosurveys

The State currently conducts biosurveys to evaluate water quality on a site-specific basis Approximately 10-20 special studies per year of macroinvertebrate and fish communities are conducted to determine beneficial use assessments and water quality impairment. Macroinvertebrates are monitored using both artificial substrates and Surber samplers. The species identification work is contracted to the U.S. Forest Service Laboratory in Provo, UT, which uses a Biological Condition Index (BCI) to evaluate the data. The Division of Wildlife Resources conducts all fisheries evaluations.

Habitat evaluation procedures have been used for some water quality problem evaluations.

Toxics Monitoring

The State collects fish for tissue residue analyses as required on a site-specific basis.

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LAKE MONITORING PROGRAM

The State currently has no lake monitoring program

LAKE MONITORING PROGRAM

TX (cont)

Lake Trophic State

Each significant lake is routinely monitored to assess the overall condition of the waterbody and to determine shortor long-term water quality trends. Carlson's Trophic State Index (TSI) is used to classify lakes according to trophic conditions This TSI is based on Secchi disk depth (m), concentration of chlorophyll *a* (mg/m³), and total phosphorus (mg/m³) when applied to each reservoir

Intensive Surveys

Intensive surveys are conducted to assess both point source and NPS water quality problems. Parametric coverage common to most intensive surveys includes water chemistry and hydraulic measurements. Sampling of biological communities and sediment chemistry is periodically included in the parametric coverage. The following biological parameters may be sampled: algal growth potential, benthic invertebrates, macrophytes (vascular aquatic plants), nekton (fish, shellfish), and phytoplankton (drifting microscopic plants) or periphyton (attached microscopic plants)

Special Studies

The State has been involved in a year-long study of the Eagle Mountain Reservoir. Water samples were collected at the surface and bottom of the reservoir for analyses of nutrients, mineral and salt content, turbidity, oxygendemanding materials, and chlorophyll a. Secchi disk and bacteriological samples were also collected. The study was directed at determining the relative impacts of point source and NPS pollutants.

Statewide Monitoring Network

The State monitors specific lakes once each quarter year-round in every third year. The following water quality parameters are assessed: total phosphorus, chlorophyll a, Secchi disk transparency, other nutrients, and toxics (water, sediment, and lish tissue).

COASTAL/ESTUARINE MONITORING PROGRAM

Estuarine waterbody segments are evaluated for the occurrence, extent, and severity of hypoxia possibly related to pollution and are evaluated for the occurrence, extent, and severity of problems associated with excessive algal production Parameters measured include dissolved oxygen, chlorophyll a, inorganic nitrogen, total phosphorus, and orthophosphorus Several estuaries are being studied as part of intensive surveys

VT LAKE MONITORING PROGRAM (continued)

(cont)

Cooperative Bacteriological Sampling Program

A limited number of lakes are sampled during July and August each year for near shore fecal coliform bacteria levels Local volunteers are used to collect water samples

Acid Precipitation Program

Chemical and biological data are collected on lakes located in low alkalinity regions to monitor effects of acid deposition. Over 200 lakes were surveyed during the winters of 1980-1982.

Long-Term Lake Monitoring Program

Thirty-six lakes identified in the Acid Precipitation Program are now included in the Long-term Lake Monitoring Program Twelve lakes are sampled four times per year every year for chemical parameters, and the remaining 24 lakes are sampled four times per year every other year. Biological sampling including fish and macroinvertebrate populations is conducted on some of the lakes. Toxics are monitored in fish tissues.

Spring Phosphorus Program

This program collects total phosphorus and Secchi disk transparency data from up to 75 lakes sampled once each spring shortly after ice-out. Since 1977, 195 lakes have been evaluated with a core group of 36 lakes having 10 or more years of data.

The trophic condition of 130 lakes was determined using water quality data on average summer Secchi disk transparency, average summer chlorophyll a concentration, and average spring phosphorus concentrations

VT RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State does not maintain a fixed-station monitoring network for sampling routine water quality parameters in the water column

Ambient Biological Monitoring Network

The State maintains an ambient biomonitoring network of fixed stations to assess long-term water quality trends through changes in the aqualic macroinvertebrate fauna. A total of 45 sites are evaluated for taxa richness, community diversity, and other macroinvertebrate parameters. Fish populations are also sampled at selected stations to provide a more complete evaluation of alterations in the aquatic community. Since 1986, the State has been developing a modification to the Index of Biotic Integrity to evaluate health of stream fish communities Individual metrics are currently being analyzed with respect to Vermont's ecoregions.

Toxics Monitoring

The State collects fish at five sites per year for chemical residue analyses of metals and PCBs.

LAKE MONITORING PROGRAM

The State conducts monitoring activities to support lake and pond management programs, including those described below.

Citizen Monitoring Program

Summer chlorophyll a, total phosphorus, and Secchi disk data for 60 lakes and 28 stations on Lake Champlain are collected weekly by citizen volunteers.

Aquatic Plant Survey Program

Detailed qualitative aquatic macrophyte surveys are conducted on selected lakes and Lake Champlain's shoreline Species density is mapped for each lake.

Statewide Milfoil Watchers Program

Surveys of lakes infested with or threatened by Eurasian milloil are conducted to document the spread of this nuisance plant

VA RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a fixed-station water quality monitoring network of 398 stations sampled monthly for approximately 14 chemical and physical parameters. This network currently focuses on monitoring of major industrial and municipal discharges. The State Water Control Board (SWCB) maintains, as part of the Chesapeake Bay Program, a system of 60 water quality monitoring stations in the tributaries, estuaries, and main lines of the James, Rappahannock, Pamunkey, and Mattaponi Rivers, with the remaining 28 located in the larger tributaries. All fall line stations are sampled by USGS. The 28 tributary stations are sampled by SWCB; 8 main bay stations are sampled by Old Dominion University; and 20 stations are sampled by VIMS. Sampling frequency is biweekly for all tributary and main bay stations during the summer (April through October) and monthly during the winter (November through March). Sediment sampling is conducted at all stations annually to determine concentrations of metals and toxic organic chemicals.

Biological Monitoring Network

The State maintains a 175 fixed-station trend monitoring network for macroinvertebrate sampling. Sampling is conducted semiannually during the spriffig and fall. Four major groups of macroinvertebrates are evaluated: aquatic insects, molluscs, crustaceans, and annelids. A qualitative evaluation of community structure (e.g., presence/ absence, relative abundance, and distribution) provides the basis for the biological analyses of water quality. After the benthic macroinvertebrate community is evaluated, an overall water quality rating of Good, Fair, or Poor is assigned to each station. Like water quality monitoring data, the biological data are used in identifying and ranking Virginia's priority waterbodies

Toxics Monitoring

The State maintains a 40-station CORE Fish Tissue Monitoring Program in which replicate composites of edible fillets of predator (sport/commercial) fish are collected for human health concerns and one whole body bottom-feeding fish composite is collected for assessing ecosystem trends. Residue analyses are conducted for metals and organic compounds

VA LAKE MONITORING PROGRAM

(cont)

Statewide Lake Monitoring

The State conducts a lake monitoring program on 15-20 lakes each year to provide a 5-year cycle of lake data for each public lake in excess of 25 acres. The following parameters are monitored at all lakes: DO depth profile, temperature depth profile, Secchi depth, pH, complete nitrogen series (TKN, NH₃, NO₃, NO₂), low-range total phosphorus, fecal coliform, chlorophyll a, and algae. The following additional parameters are also monitored: alkalınity, hardness, conductivitý, orthophosphorus, total organic carbon (TOC), metals (in water and sediment), and pesticides/herbicides in water and sediment.

Special Lake Studies

Special lake studies are performed annually between April and October on five large impoundments. Sampling is conducted every other month, and the following water quality parameters are evaluated: total phosporus, chlorophyll a, Secchi disk transparency, other nutrients, and toxic substances (sediments).

COASTAL/ESTUARINE MONITORING PROGRAM

Benthic sampling is conducted as part of the State Water Control Board water quality monitoring network by Old Dominion University at 16 Chesepeake Bay stations four times per year.

Plankton samples are also collected in the Chesapeake Bay by Old Dominion University. Sampling frequency is biweekly for all tributary and main bay stations during the summer (April through October) and monthly during the winter (November through March).

VI RIVER MONITORING PROGRAM

The Territory does not conduct monitoring of rivers because there are no perennial streams

LAKE MONITORING PROGRAM

The Territory does not conduct monitoring of lakes because there are no perennial lakes.

COASTAL MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The Territory maintains a fixed-station water quality monitoring network of 94 stations where routine water quality parameters are monitored.

Intensive Surveys

The Territory has been active since the late 1970s in conducting intensive surveys in marine waters surrounding the three islands Many of the surveys have evaluated the effects of construction activities (e.g., extension of an airport runway and associated landfill operations) on inshore seagrass and coral reef communities. The studies usually monitor optical properties of the water and sediment input as well. Three marine studies conducted by the Territory are listed below.

Long-Term Monitoring of Coral Reef Transects in Salt River

This project involves assessing the changes in the percent of live and dead coral over time. Changes in the percent of live coral can reflect environmental stress from terrigenous runoff and hurricane storm damage.

Study of Coral Recruitment Patterns at Salt River Submarine Canyon

This project involves assessing the recruitment of juvenile coral at various depths and surveying fish and sea urchin populations

Teague Bay Sea Urchin Study

This project was designed to analyze the effects of sea urchin mortality on a patch reef in St. Croix.

Survey of Monitoring in NPS Programs

State

Survey of Monitoring in NPS Programs

VI COASTAL MONITORING PROGRAM (continued)

(cont)

Toxics Monitoring

The Territory does not conduct routine toxics monitoring of water, sediment, or fish tissue. A few intensive studies have been conducted intermittently as deemed necessary to evaluate toxic problems on the three islands. Sediment samples in a 1982 study on St. Croix monitored priority pollutants and metals. A 1986 survey by the Territory assessed metal residues in sediment at the Hess Oil Virgin Islands Corporation.

WA RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a fixed-station monitoring network The 77 freshwater stations are located statewide and are sampled monthly for routine water quality parameters. Twenty-one of these stations are operated by USGS

METRO Water Quality Monitoring

The Municipality of Metropolitan Seattle (METRO) conducts water quality sampling on rivers using fixed monitoring stations. In addition to routine water quality parameters and metals, METRO evaluates benthic community structure and evaluates habitat suitability for salmonids in 25 rivers.

Cook Creek Project

The State monitored effects on the aquatic community of point source and NPS pollution. Water quality, benthic macroinvertebrates, and fish population data suggested that a wastewater treatment plant, nonpoint sources, or irrigation management practices continue to degrade river quality.

Watershed Planning Program

The Puget Sound Water Quality Authority developed a cooperative watershed management program that ranked watersheds in each of the 12 Puget Sound counties. Action plans to reduce NPS pollution in each watershed were developed and implemented by public groups. These watershed plans included specific Best Management Practices (BMP) for farmers and land use regulations. Water quality data have been collected to assess the effect of improvements, but data analyses have not yet been completed.

Toxics Monitoring Program

Toxics monitoring in fresh waters is conducted as part of the State's fixed-station monitoring network composed of 77 stations. At 20 of these freshwater stations, fish tissues are analyzed for selected heavy metals and other toxic substances.

WA LAKE MONITORING PROGRAM

(cont)

Acid Deposition Monitoring

The State monitors acid deposition in lakes. Precipitation chemistry, lake and watershed sensitivity, and general ecological effects (forests, human health, aquatic life, and waterfowl) are evaluated. Annual studies are conducted in sensitive alpine lakes in the Cascade Mountains.

METRO Water Quality Monitoring

METRO conducts water quality sampling on lakes for conventional water quality parameters and metals. In addition, METRO evaluates habitat suitability for salmonids and benthic community structure in 27 lakes.

COASTAL/ESTUARINE MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a fixed station monitoring network comprising 53 marine stations that are sampled monthly from April to November.

Puget Sound Sediment Study

The State has initiated a marine benthic sediment monitoring network in Puget Sound This effort will involve evaluating the condition of sediments at approximately 15 sites throughout the Sound. The evaluation will use a "triad" approach of chemical analyses, sediment toxicity-tests, and inventories of the resident macroinvertebrate communities.

WA COASTAL/ESTUARINE MONITORING PROGRAM (continued)

(cont)

Puget Sound Ambient Monitoring Program

The State has initiated a comprehensive monitoring program for Puget Sound that integrates data collected on sediment, water quality, fish, and macroinvertebrates Finfishes are monitored by the Department of Fisheries Near shore habitat monitoring is conducted by the Department of Natural Resources, and intertidal shellfish monitoring is conducted by the Department of Natural Resources, and intertidal shellfish monitoring is conducted by the Department of Natural Resources, and intertidal shellfish monitoring is conducted by the Department of Social and Health Services. Marine sediment quality monitoring will be conducted by the Washington Department of Ecology and the Puget Sound Authority. The monitoring includes evaluation of macroinvertebrate community structure, exposure of the sediments to bioassay organisms, and chemical analyses of sediments for toxics. A total of 119 fixed stations are sampled in this program

Benthic macroinvertebrates are collected using a modified van Veen sampler and are identified to species or the lowest taxonomic unit possible. The community analyses include: number of taxa and abundance; mean and standard deviation for the number of taxa and abundance; Infaunal Trophic Index; Shannon-Wiener diversity; an equitability measure; numerical dominance; and abundance of pollution sensitive and pollution tolerant species Sediment bioassays are conducted on sampled sediment using a 10-day amphipod bioassay (*Rhepoxynius abronius*), a 48-hr larval bivalve testing using the Pacific oyster (*Crassostrea gigas*) or Blue Mussel (*Mytilus edulis*), and a sediment Microtox^R bioassay. Sediments are analyzed for 13 metals, volatile organic compounds, base/neutrals, and acid extractables.

Toxics Monitoring Program

Toxics monitoring in marine waters is conducted as part of the State's fixed-station monitoring network composed of 53 stations. At 20 of these marine stations, fish tissues are analyzed for selected heavy metals and other toxic substances.

WA COASTAL/ESTUARINE MONITORING PROGRAM (continued)

(cont)

Puget Sound Estuary Program

Washington State is one of the States receiving money for protection of its estuaries via the National Estuary Program Projects completed under this program include work on point source and NPS pollution, contamination in urban and nonurban bays, pesticides, a shellfish risk assessment, and spatial and temporal trends in water quality in Puget Sound Also, historical environmental data were compiled in the Puget Sound Environmental Atlas and sample collection and analysis protocols were designed to ensure comparability of data that are collected under different studies Citizen groups were involved in most projects

Storm Drain Monitoring Program

As part of the EPA Puget Sound Estuary Program, a four-phase approach was developed to identify the sources of toxic contaminants to storm drains and to monitor the effectiveness of source controls. The four-phase approach includes a preliminary investigation, initial screening, contaminant tracing, and confirmation. In-line sediment samples were collected from low-energy sections of the drainage systems (e.g., manholes) to screen for contamination. This program approach was used to identify sources, determine contributions from sources permitted by the National Pollutant Discharge Elimination System (NPDES), and document source contaminant loading conditions. The Municipality of Metropolitan Seattle (Metro) also has conducted storm drain sediment sampling efforts; these have identified facilities and properties that contribute contaminants to marine and freshwaters via discharges through storm drain outfalls.

WV RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains an ambient fixed-station monitoring network consisting of 27 sites sampled monthly statewide for routine water quality parameters. Eight of the 27 sites are Ohio River stations sampled by ORSANCO

The State implemented a regional "mininetwork" that focuses on water quality in small watersheds, rather than in major rivers providing monthly data for a continuous 12-month period for each watershed. When fully under way, 60 to 80 sites within six watersheds will be sampled annually.

Biological Monitoring Network

The State maintains a long-term biological network consisting of 42 sites at which aquatic invertebrates are collected annually using multiplate samplers. A number of these sites overlap with the 27 long-term water quality monitoring network sites. Phytoplankton samples are collected at 4 of the 42 stations.

The State in cooperation with the U.S. Fish and Wildlife Service is conducting a survey and inventory of freshwater mussel populations statewide

Toxics Monitoring Program

During each year as part of the fish tissue sampling program, samples for metals and pesticide analyses are collected from 20 to 25 sites (two samples per site, each composed of five fish) from sites throughout the State

Special Studies

Special studies (e.g., Kanawha River fish and sediment dioxin study) are conducted as needed. The State conducted intensive survey work on the Kanawha River on physical measurements, metals, and inorganic constituents. Also, the incidence of tumor formation (with the liver as the target organ) in resident fish populations was evaluated by histological analyses

LAKE MONITORING PROGRAM

The State does not currently have a routine lake monitoring program. Lake fishery surveys that include some basic water quality parameters and information on physical conditions have been collected by State fisher_biologists. The State also monitors for toxic substances in fish tissues.

The trophic condition of the State's public lakes has never been officially documented or scientifically determined

WI RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains a network of ambient stream monitoring stations that measure water quality parameters in major river basins monthly. Of the 48 stations, 29 are part of the national ambient monitoring program. Selected stations monitor chlorophyll *a*, BOD, COD, hardness, and five metals in addition to routine water quality parameters. Stations tributary to the Great Lakes monitor calcium, sodium, sulfate, silica, and lead. A trend analysis of these data was conducted after the stations were grouped into four ecoregion categories.

Biological Monitoring Program

The State routinely collects biological survey data for use classification, water quality standards evaluations, evaluation of management actions, and NPS assessments. Macroinvertebrate and fish populations are the principal groups surveyed, although periphyton and bacteria are also sampled in some situations. The State conducts natural substrate sampling for macroinvertebrates with D-frame dipnets and uses Hilsenhoff's Biotic Index to evaluate macroinvertebrate community quality. Macroinvertebrate species identifications are performed by a local university laboratory. A detailed habitat description is used to discern water quality and habitat impacts. Fish communities are sampled by the Bureau of Fisheries Management, but no details are available on the program specifics.

Acid Stream Studies

The State conducts a survey of selected low acid neutralizing capacity (ANC) streams relative to potential effects of acid deposition. The study is particularly concerned with episodic snowmelt events and heavy rain events on sensitive streams.

Toxics Monitoring Programs

The State maintains an extensive fish collection program in which 500 flesh samples are examined for PCBs, 45 for chlordane and dieldrin, 10 for toxaphene, and 1,200 for total mercury. Some samples are examined for more than one of the above or for other toxics (e.g., dioxins and furans) as required Surveillance sampling involves collection of three to five whole fish of the same size that are composited into a single sample or may include one or two large fish. Top-level predator species or fish with high fat content are selected. If surveillance sampling finds high concentrations of toxicants, followup intensive sampling of a larger number of species and sized individuals occurs

State	Bioassay testing	Biosurveys
NE	All major industrial and municipal facilities are being required to conduct acute bioassay tests of effluents	Dischargers are not required to conduct biosurveys
	once per year using Ceriodaphnia and fathead minnows	The State monitors fish and macroinvertebrate
	(Pimephales promelas). These tests are conducted for	communities at 140 reference sites from eastern
	24 hr using 100% effluent If mortality is > 10%, then	Nebraska (Corn Belt Region) warmwater streams. An
	plans for a toxicity reduction evaluation must be	Index of Biotic Integrity (IBI) and an Invertebrate
	developed	Community Index (ICI) modified after an index used in
		Ohio were used to evaluate use support Explanations
	The State currently has no whole effluent bioassay	for observed community impairment are based on a
	testing capabilities	review of potential point source discharges upstream of the sample site, habitat quality ratings, and field recon-
	The EPA checks six facilities per year using acute static renewal toxicity tests with <i>Daphnia</i> sp. and fathead minnows	naissance.

State	Bioassay testing	Biosurveys
NV	One municipal permittee is required to conduct effluent toxicity testing using quarterly static 96-hr renewal tests with Lahontan cutthroat trout fry (Salmo clarki). Reissued municipal permits will include requirements for acute 48-	Some municipal permits require macroinvertebrate and periphyton assessments at several sites in the receiving waterbody
	hr static renewal tests with <i>Ceriodaphnia dubia</i> and acute 96-hr static renewal tests with fathead minnows (<i>Pimephales promelas</i>).	The State conducts water quality field studies on a site- specific basis. Some of these studies have involved the collection of macroinvertebrate and periphyton data as well as chlorophyll a measurements.
	Currently, the State does not have the capabilities to	
	conduct whole effluent toxicity testing.	The Nevada Department of Wildlife does conduct biosur- veys throughout the State for fisheries management pur-
	The EPA-Duluth Laboratory has conducted toxicity testing for the State at several major municipal dischargers and found significant chronic toxicity	poses.

Biosurveys State **Bioassay testing** Some dischargers have been required to perform MO Specific industrial and municipal permits require the permittee to conduct acute bioassay toxicity testing instream biological assessments of macroinvertebrates, and/or perform instream bioassay testing Testing is at one upstream and one or two downstream locations performed on 100% effluent for 24 hr using fathead from a point source. minnows (Pimephales promelas) as the test species Greater than 10% mortality results in reopening of the The State conducts qualitative macroinvertebrate sampling (rapid stream assessments) in streams in the permit for revisions to existing limits. Some permits also vicinity of 100-200 facilities per year These studies are require bioassay testing using effluent diluted to the expected low flow concentration to be found in the receiving waterbody after mixing. problems through visual observation of the stream and

The State has initiated chronic Ceriodaphnia dubia and fathead minnow (Pimephales promelas) tests of some industrial and municipal effluents for compliance monitoring and conducts instream bioassay testing as appropriate

quick and inexpensive methods for determining potential an evaluation of the benthos A determination of the level of wasteload allocation modeling and further chemical sampling is made based on the biosurveys

State	Bioassay testing	Biosurveys
MT	As part of an agreement with EPA Region 8, the State has initiated requirements for major industrial and	Several industrial permits require instream biosurveys
	municipal facilities to conduct acute and chronic bioassay toxicity testing, as appropriate Dischargers are required to conduct acute 48-hr static renewal tests using	The State conducts four instream biosurveys per year associated with sewage treatment facility upgrading Algae, primary productivity, chlorophyll a and macroin-
	fathead minnow (<i>Pimephales promelas</i>) Chronic 7-d	vertebrates are assessed.
	tests may be required with these two species under some circumstances	Trend monitoring in the Clark Fork River Basin is conducted at 32 sites where algae and macroinverte- brate communities are examined once a year in August
	The State has the capability of conducting chronic 7-d Ceriodaphnia bioassays. The State has conducted both ambient toxicity stream profiles and effluent screening tests on a limited site-specific basis	
	The EPA and State cooperatively conducted <i>Ceriodaphnia</i> , fathead minnow (<i>Pimephales promelas</i>), and rainbow trout (<i>Salmo gairdneri</i>) bioassays on a municipal waste treatment facility.	

State	Bioassay testing	Biosurveys
MN	Bioassay toxicity testing is required on specific major industrial and municipal permits Either acute static 24-hr	Dischargers are not required to conduct biosurveys.
	fathead minnow (Pimephales promelas), Ceriodaphnia	The State is beginning to develop a biosurvey program;
	dubia, and Daphnia magna) or flowthrough 96-hr fathead	however, it does not currently conduct biosurveys
	minnow toxicity tests using whole effluent and serial dilu- tions are required	associated with point source discharges
		The State is planning to develop m croinvertebrate
	For 15-20 facilities, acute static 48-hr fathead minnow, Ceriodaphnia dubia, and Daphnia magna toxicity tests	instream biocriteria and a comprehensive biological survey program adapting EPA's Rapid Bioassessment Protocolo, The State is also interested in developing tigh
	The State also conducts onsite flowthrough 96-hr (defini- tive) fathead minnow toxicity tests using a mobile bioassay laboratory and/or conducts 7-d chronic static renewal tests with Ceriodaphnia dubia and fathead minnows.	community biocriteria based on the ecoregion approach using Karris Index of Biological Integrity (IBI) metrics. Collection of fish community data from reference sites statewide has been initiated.
	In addition, two site-specific tests are employed in water- quality-limited situations to modify effluent standards using both a 96-hr fathead minnow and <i>Daphnia magna</i> test	

consecutive tests

The State currently operates a mobile bioassay laboratory for conducting onsite toxicity testing.

State	Bioassay testing	Biosurveys
MS	Only specific industrial permits require testing, which includes a chronic 7-d Ceriodaphnia and 7-d fathead	Dischargers are not required to conduct biosurveys
	minnow (<i>Pimephales promelas</i>) test. Tests are performed quarterly for the first year and semiannually thereafter.	The State collects periphyton using artificial substrate samplers at 18 ambient monitoring stations and per- forms fish population assessments at 25 sites per year. The State collects macroinvertebrates using a modified
	The State conducts effluent bioassay tests to screen industrial and municipal discharges for acute toxicity using a two-tiered approach. The first step is to conduct a static 24-hr toxicity screen in 10% wastewater using fat- head minnows or water fleas (<i>Daphnia magna</i> or <i>D. pulex</i>) in freshwater effluents, and mysid shrimp (<i>Mysidopsis bahia</i> or <i>M. almyra</i>) in saltwater applications. If 90% or more of the test organisms survive the 24-hr screening period, the waste is considered nontoxic. Should a facility's effluent be found nontoxic on two consecutive tests as required in its NPDES permit	rapid bioassessment technique. A multihabitat qualita- tive sampling method is used. These data are used in trend assessment and to evaluate water quality below dischargers For periphyton, chlorophyll a, biomass (as ash free weight) and counts and identification are conducted. For macrophyton, identification of species is made, and in some cases standing crop and percent coverage are determined. For macroinvertebrates, identification and species diversity are determined; for fish, identification of species is made
	further toxicity testing on the effluent may be suspended. If the screening test shows the waste to be texic, as evi- denced by tess than 90% survival of the test organisms, a static 96-hr "definitive test" is conducted immediately to measure the acute toxicity of the effluent. Bioassays are required quarterly, and toxicity reduction evaluations are required when instream toxicity is indicated by two	The State is applying and testing EPA's Rapid Bio- assessment Protocols.

State	Bioassay testing	Biosurveys
ΜΑ	Specific industrial and municipal dischargers are required to conduct toxicity testing using a static 48-hr	Dischargers are not required to conduct surveys
	Daphnia pulex and fathead minnow (Pimephales promelas) test or appropriate marine species toxicity test	The State collects macroinvertebrates at 25 stations per year by a rapid 5-min kick sampling technique and identifies the first 100 organisms to genus or species level. The taxonomic data are then compiled to deter-
	For large marine dischargers, a three-species chronic toxicity test is required monthly (less frequently on smaller dischargers) using the sheepshead minnow (Cyprinodon variegatus), the mysid shrimp (Mysidopsis bahia), and the red algae (Champia parvula).	mine the status of various criteria used to rank water quality: species richness, distribution (balance), EPT val- ues (number of taxa in Ephemeroptera, Plecoptera, and Trichoptera), percent contribution of pollution tolerances, feeding habits of the five numerically dominant species,
	The State uses the Microtox ^R assay for screening of 30- 50 freshwater and marine effluents per year. This toxicity testing method is currently the only in-house testing capability The State currently owns a mobile bioassay laboratory.	and Hilsenhoff Biotic Index (HBI). Some of these survey address point source discharges, while others are associated with special studies.
	The EPA Laboratory in Lexington and private contractors conduct acute toxicity testing using daphnids and fathead minnows and chronic tests using <i>Ceriodaphnia</i> and fathead minnows	
	Marine bioassay testing is conducted by a contractor using <i>Mysidopsis bahia</i> . In addition, caged blue mussel (<i>Mytilus edulis</i>) bioaccumulation studies are being conducted Marine sediment elutriate bioassays are being evaluated for use by the State.	

State	Bioassay testing	Biosurveys
MI	Specific industrial and municipal permits require acute static 96-hr fathead minnow (<i>Pimephales promelas</i>)	Dischargers are not required to conduct biosurveys
	toxicity tests	The State conducts 20-30 facility-related site investiga- tions (two to three stations per site) and 6-10 intensive
	The State conducts acute static 48-hr fathead minnow toxicity tests, acute static renewal 48-hr fathead minnow toxicity tests, and onsite acute flowthrough 96-hr fathead minnow tests using a mobile bioassay laboratory. Effluent bioassays are conducted at approximately 50 sites per year	biosurveys (five to six stations per site) of fish and mac- roinvertebrates to evaluate water quality condition in areas of environmental concern. Selected locations are determined primarily in accordance with discharger per- mit reissuance schedules. Only natural substrates are sampled for macroinvertebrates using dipnets, and the organisms are usually identified to order, suborder, and
	The State also has capabilities to conduct caged-fish bioassays.	family. Pollution-sensitive taxa are identified to genus Data are evaluated for the number of taxa, relative abun- dance, and indicator organisms. Habitat evaluations are made at each site
		Fish communities are sampled at macroinvertebrate

sites, but sampling is dependent on access and wadability of the stream. Fish are collected by electroshocking, and data are evaluated for the number of taxa, relative abundance, and indicator species.

State	Bioassay testing	Biosurveys
ME	Specific industrial and municipal dischargers have bioassay testing requirements Toxicity problems	Dischargers are not required to conduct biosurveys
	identified through State-conducted toxicity testing or instream biosurveys require the discharger to conduct	The State evaluates water quality conditions using macroinvertebrates collected in rock substrate baskets at 20 50 sites particulate and leads at each site)
	the chronic 7-d Ceriodaphnia toxicity test (quarteriy), the 14-d brook trout (Salvelinus fontinalis) growth study (quarterly), and an acute Daphnia test (monthly)	Sampling site locations have been designated to evalu- ate point source dischargers and nonpoint source (NPS) problems This program primarily will address NPS pol-
	The State conducts acute and chronic Ceriodaphnia effluent toxicity tests at approximately 15 locations per	lution problems in the future.
	year through the use of a mobile bioassay laboratory Facilities due for permit renewal are primary candidates for this testing	Toxicity problems are identified through State-conducted instream macroinvertebrate community assessments For example, benthic community structure and function were evaluated by the State in a pilot study of metal contamination in Boothbay Harbor
		The use of biological monitoring techniques has identi- fied some problem waters that, through the collection of dissolved oxygen data, were thought to have acceptable water quality.

State	Bioassay testing	Biosurveys
MD	Specific industrial and municipal dischargers are required to conduct a one-time static 96-hr renewal test	Dischargers are not required to conduct biosurveys
	with a locally important fish and invertebrate species	Benthic macroinvertebrate assessments are made through a network of trend monitoring stations
	will require a chronic 7-d Ceriodaphnia and fathead	intoligh a network of trend monitoring stations
	minnow (<i>Pimephales promelas</i>) test quarterly for the first year. For estuarine dischargers, mysid shrimp (<i>Mysidopsis bahia</i>) and sheepshead minnows (<i>Cyprinodon variegatus</i>) are the test species that are routinely used.	As part of Intensive Studies, before and after monitoring assesses changes in water quality resulting from upgrades of municipal wastewater treatment facilities or industrial facilities Benthic macroinvertebrate community structure and diversity are also assessed in these studies.
	The State conducts acute static <i>Daphnia</i> and fathead minnow toxicity tests of approximately 50 facilities per year The State is developing treshwater 7-d chronic toxicity testing capabilities using the fathead minnow and <i>Ceriodaphnia</i> and is currently conducting saltwater 7-d chronic toxicity testing using <i>Mysidopsis bahia</i> and the	

State	Bioassay testing	Biosurveys
KY	 Specific industrial and municipal permits require acute or chronic toxicity testing of their final effluent. All majors that discharge into 7Q10 low flow streams and have an effluent volume 1% or greater than the receiving stream must perform chronic 7-d <i>Ceriodaphnia</i> and 9-d embryo-larval fathead minnow (<i>Pimephales promelas</i>) toxicity tests bimonthly for 1 year and semiannually thereafter Any discharger with an effluent less than 1% of the available dilution must perform quarterly acute, static renewal 96-hr fathead minnow and 48-hr <i>Daphnia sp.</i> toxicity tests The State conducts acute and chronic toxicity tests using fathead minnows and daphnids. During 1986-1987, the State conducted acute and chronic toxicity tests on 46 point source dischargers and on instream_locations above and below those sources. The State currently operates a mobile bioassay laboratory. Toxicity assessments of sediment were made at 66 sites with 96-hr fathead minnow sediment-elutriate and/or 9-d embryo-larval solid-phase sediment toxicity tests. A toxic response was measured at 10 sites that did not show water column toxicity. 	Dischargers are not required to conduct biosurveys The State collects biological data from 33 fixed stations in 10 watersheds Algae, macroinvertebrates, and fish are collected on an annual basis and are used for making biological assessments for those streams Because of inherent variability in biological data, there are no set criteria by which to judge community structure values at all sites Intensive instream surveys of fishes and macroinverte- brates are made to evaluate site-specific water quality problems. The State is currently evaluating the use of EPA's Rapid Bioassessment Protocols in its monitoring program

State	Bioassay testing	Biosurveys
LA	Specific industrial and municipal facilities are required to conduct acute static 48-hr <i>Daphnia</i> toxicity tests. If greater than 80% mortality results in 100% effluent, the discharger must perform a 48-hr static renewal test. EPA	Specific industrial dischargers are required to do bio- logical assessments upstream and uownstream of discharges using fish and macroinvertebrates
	Region 6 requires that both industrial and municipal majors conduct chronic bioassay testing using the 7-d <i>Ceriodaphnia</i> and 7-d fathead minnow (<i>Pimephales</i> <i>promelas</i>) test. In marine waters, 7-d mysid shrimp (<i>Mysidopsis bahia</i>) and 7-d sheepshead minnow	The State conducts intensive surveys that provide physical, chemical, and biological data (nektonic and/or planktonic samples) necessary to develop wasteload allocations and calibrate and verify mathematical models
	(Cyprinodon variegatus) tests are required Acute bioassay testing with these species is required in some situations in place of chronic testing.	The State also conducts two to three studies per year associated with use attainability on streams impacted by point sources; these studies include chemical, physical, and biological sampling. Fish and macroinvertebrates
	The State has the capability to conduct chronic 7-d Ceriodaphnia and 8-d embryo-larval fathead minnow and sheepshead minnow tests and acute 48-hr Daphnia pulex toxicity tests	are collected for biological community assessment Common biological indices (e.g., Index of Biotic Integrity [IBI], community loss, and species diversity) are evalu- ated.
	The chronic toxicity tests are conducted og ambient waters as well as effluents. Intensive instream chronic bioassay tests have also been conducted.	

LA LAKE MONITORING PROGRAM

(cont)

Lake Condition Index (cont)

The Association of Louisiana Bass Clubs was selected to represent the main user population of the State's lakes, and members were asked to rate the water quality and fishing conditions of 30 freshwater lakes Concurrently, the State conducted a 6-month statewide sampling program of the lakes to obtain a more comprehensive quantitative data base to ensure proper lake indexing. The condition index system is based on continuous probability distributions for perceived water quality and fisheries conditions.

Special Lake Studies

The State conducts special studies of specific lakes. Sampling is conducted monthly on a year-round basis for the following parameters: total phosphorus, chlorophyll a, Secchi disk transparency, other nutrients, and toxic substances (water, sediment, and fish tissue). The State also conducts special studies associated with use attainability, which include chemical, physical, and biological considerations. Biological information consists of flora and fauna data and types of land use.

COASTAL/ESTUARINE MONITORING PROGRAM

Intensive Surveys

The State conducts intensive surveys of estuarine areas A full range of water quality parameters is sampled Also sampled, as appropriate, are chlorophyll a and light-dark bottle tests. Biological samples including nekton or plankton may be collected for specific analyses or diversity observations.

Use Attainability Studies

The State conducts use attainability studies for (1) site-specific criteria development, (2) biotoxicity evaluations, (3) determining species diversity or population data, or (4) obtaining data to support pesticide or priority pollutant programs.

Toxics Monitoring

The State collects ambient water, fish and shellfish tissue, and sediments for analyses of toxic substances, including pesticides and other organic pollutants. Currently, emphasis on toxics monitoring is directed to areas of known contamination.

LA RIVER MONITORING PROGRAM

Ambient Water Quality Network

The State maintains a long-term surface water quality network consisting of 136 fixed stations The basic network consists of 44 benchmark water quality monitoring stations with 20 years of sampling data. The remaining 101 stations were established to address data needs in high-priority areas. Conventional water quality parameters and six metals are assessed monthly.

Special River Studies

The State conducts special studies of specific rivers. Sampling is conducted monthly on a year-round basis for the following parameters: total phosphorus, chlorophyll a, Secchi disk transparency, other nutrients, and toxic substances (water, sediment, and fish tissue). The State conducts two-three special studies per year associated with use attainability, which include chemical, physical, and biological sampling. These special studies are usually associated with point source discharges. Fish and macroinvertebrates are collected for biological community assessments. Common biological indices are evaluated (Index of Biotic Integrity, community loss, and species diversity).

Use Attainability Studies

The State conducts use attainability studies for (1) site-specific criteria development, (2) biotoxicity evaluations, (3) determining species diversity or population data, or (4) obtaining data to support pesticide or priority pollutant programs.

LAKE MONITORING PROGRAM

Lake Condition Index

In Louisiana, many lakes are considered eutrophic due to their shallow depths and high nutrient levels. Due to a mild climate and lengthy growing season, the State's lakes have a high level of primary productivity. Most trophic indexes also classify the State's lakes as eutrophic; however, these lakes are highly productive and support diverse productive fisheries. A condition index system was studied by the State to reflect measurable water quality parameters as well as desired resource use. Several water quality parameters that could be quantitatively related to the impairment resulting from eutrophication were examined. Total Organic Carbon (TOC) was chosen as the best single parameter representing overall lake quality because (1) TOC is an excellent measure of biomass and is readily comparable to conventional productivity measurements; (2) TOC is independent of cell condition and species distribution; and (3) TOC is an estimate of general nutrient enrichment and suspended organic material. Secchi disk depth was also identified as having potential for development of a condition index for Louisiana's lakes

ME LAKE MONITORING PROGRAM (continued)

(cont)

Clean Lakes Program

There are lakes that have recently been maintained as part of 314 projects in the State They include Webber Pond, Cochnewagon Lake, and Threemile Pond, Sabattus Pond, Salmon Lake, and Sebasticook Lake All of these lakes are monitored intensively on a regular basis for transparency, chlorophyll, nutrients, dissolved oxygen, temperature, pH, alkalinity, and phytoplankton composition. Additional parameters are included in specific projects Improvements in water quality have occurred on all lake restoration projects. The State has also secured a 314 grant for a lake protection project in the Long Lake (Bridgton) Watershed

Diagnostic Study Lakes

Recent trends of declining water quality have been evident on several lakes, including China Lake, Cross Lake, and Chickawaukie Lake Diagnostic studies are being conducted on these lakes, as well as on some chronically productive lakes not previously diagnosed (i.e., Long Lake) to determine the nature of their problems, significant external sources of nutrients, the extent of internal loading, and the feasibility of potential solutions. The vulnerability index, in combination with the volunteer monitoring program, has identified more lakes in need of diagnostic analysis

Special Study Lakes

The State monitors a number of lakes to provide answers to specific questions. For example, the Department of Marine Resources has a program of reestablishing historical alewife runs. They plan to stock alewives in several productive lakes in Central Maine as part of their comprehensive program. The Lake Studies Section is monitoring zooplankton and phytoplankton populations at Lake George in Canaan to determine if this stocking of efficient planktivores will encourage development of colonial blue green algal blooms through depletion of the zooplankton community

Acid Rain Surveys

The State has participated in and initiated a number of studies on the effects of acid rain on Maine lakes

Complaint Response and Investigations

Each summer, the State receives some complaints of water quality problems in lakes. Many of these require spotcheck sampling and some require followup monitoring

ME RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Program

The State maintains an ambient water quality monitoring program that includes sampling for bacteria, dissolved oxygen, and temperature. Rivers, streams, and brooks in the Preliminary Water Quality Assessment Program are monitored at each station, and a minimum of five sample sets are collected between May 15 and September 30 with one of the sample sets being collected during runoff conditions. DO sampling is conducted at 7Q5 flows for three consecutive days as part of the assessment of attainment for the dissolved oxygen water quality standards program In the Annual Assessment of Attainment Program, a 5-yr plan is developed that identifies stations that should be sampled every year and other stations that should be sampled 1 year out of every 5 yr. Between 80 and 160 stations are sampled each year. Of these, 20 to 25 are sampled every year, and 60 to 140 are sampled every 5 yr.

Biosurveys

The State of Maine has enacted a biologically based water classification system and associated aquatic life standards for freshwater streams and rivers. The State conducts a statewide biological monitoring program using macroinvertebrates as the primary indicators of biological integrity. Sampling locations are selected to represent the range of water quality conditions in the State (e.g., different sized streams with and without discharges) and to provide information on the presumed worst-case condition of all rivers and streams known to be significantly affected by human activity. Macroinvertebrates are collected in rock substrate baskets at 30 to 50 sites annually (three replicates per site) The program currently has designated sites to evaluate point and NPS pollution problems; however, sites will address NPS problems in the future. The State is currently developing numeric and descriptive criteria necessary to identify the biological classification attained.

Toxics Monitoring

The State monitors fish tissue for priority pollutants as part of its toxics control program.

LAKE MONITORING PROGRAM

Volunteer Lake Monitoring Program

Volunteers are trained and provided with equipment to sample Secchi disk transparency, and in some cases chlorophyll a and total phosporus biweekly for 5 months during the open water season. The purpose of this program is to provide a continuous baseline of data on a large number of lakes, the baseline is used to identify trends of improving or declining water quality. In recent years, the program has included 250 to 300 monitors, but the quality of data received has been highly variable. The State now plans to focus its efforts on improving the quality of sampling by reliable monitors and limiting expansion of the program to those lakes identified as vulnerable by Maine's recently developed vulnerability index.

MD RIVER MONITORING PROGRAM

Ambient Water Quality Network

The Maryland Geological Survey within the Department of Natural Resources, monitors water quality in conjunction with the USGS at live National Stream Quality Accounting Network (NASQAN) stations (Choptank River, Susquehanna River, Patuxent River, and two sites on the Potomac River).

Intensive Survey Program

Most of the intensive monitoring studies using changes in the benthic macroinvertebrate community are "before and after" studies associated with municipal or industrial facilities; however, several studies are under way to monitor water quality impacts due to NPS agricultural runoff. These programs measure changes in water quality parameters only

Benthic Macroinvertebrate Program

Benthic macroinvertebrates are collected at 116 stations throughout the State Samples are collected biennially from 88 stations; half of these (44) are sampled 1 year, and the other half are sampled the following year. The remaining 28 stations are sampled annually as part of the CORE monitoring network. Benthic samples are collected between June and August using multiplate sampling devices (placed in the field for 6 weeks) or a Surber sampler Specimens collected are identified to the lowest taxonomic level, and the community structure and diversity are determined

Phytoplankton Program

Surface grab samples are collected twice each month between March and October and once each month during the rest of the year in the mainstem of the Chesapeake Bay (3 stations), the Choptank, Chester, and Patapsco Rivers (1 station each), as well as in the Potomac and Patuxent River estuaries (11 and 4 stations, respectively) At one tributary of the Severn River, phytoplankton are collected 80 times per year Phytoplankton are identified into major groups (green, blue-green, etc.), and dominant species are identified to their lowest taxonomic level.

Potomac River Assessment

Two interstate programs assess water quality in the Potomac River basin by utilizing water quality data collected by the States in the basin Data from a number of Maryland sampling stations in the CORE network and part of the Chesapeake Bay Tributary Monitoring Program are used in both monitoring networks
ME **COASTAL/ESTUARINE MONITORING PROGRAM**

(cont.)

Much of the marine/estuarine sampling is concerned with bacteria levels in shellfish propagation areas. Sampling for dissolved oxygen (DO), conductivity, and temperature has determined that DO levels are very near the saturation point in most of Maine's near shore waters. However, where DO depression has been documented (usually in harbors with restricted water circulation), monitoring for DO, salinity, and temperature is conducted by the Department of Environmental Protection (DEP) during the summer.

The State plans in the luture to develop the specific numeric and description criteria necessary to identify the biological classification attained by marine/estuarine waters This system will be similar to the biologically based water classification system developed for rivers.

MD Toxics Monitoring

(cont)

Fish are collected at 33 of the 37 ambient trend monitoring network stations for residue analyses of organic compounds and metals. Both whole fish and fillets are sampled.

LAKE MONITORING PROGRAM

The State does not currently conduct routine statewide lake monitoring; however, several special studies are conducted on a site-specific basis.

Warm and Cold Water Fisheries Program

The DNR's warmwater and coldwater fisheries programs routinely monitor certain water quality aspects as part of the freshwater fisheries programs. Water quality at a selected number of lakes is monitored each year as part of a systematic survey of the State's waters; temperature, conductivity, pH, and alkalinity are usually recorded during the spawning season or high stress, low-flow summer periods. This information is not entered into the State's Water Quality File, but is usually summarized in fisheries reports. Known, native, and recreational trout populations are monitored, and assessments of both warmwater and coldwater fisheries habitats are conducted throughout the year Similar monitoring of basic water quality-parameters occurs during most collection efforts such as the anadromous fish surveys in the spring, the assessment of the striped bass young-of-the-year index during the summer, and the oyster spat survey during the fall.

COASTAL/ESTUARINE MONITORING PROGRAM

Chesapeake Bay Program

This program is designed to monitor "key" physical, chemical, and biological components that are likely to be sensitive indicators of water quality trends in the Chesapeake Bay The program is multidisciplinary and includes direct measurements of the physical/chemical environment (including nutrient levels and toxic substances), measurements of point source and NPS pollutant loadings, biological indicators of short-term and long-term changes in water quality (zooplankton and benthos), and measured rates of important ecosystem processes such as phytosynthesis, metabolism and material flux. A rigorous QA/QC program ensures the high quality and reliability of the data collected and includes extensive documentation and justification of the testing and measurement procedures During the first 3 to 5 years, the monitoring program has been defining baseline conditions. Changes in water quality, biota, and ecosystem processes in later years will be analyzed and used to assess the effectiveness of the various Chesapeake Bay initiatives. Several elements of the Chesapeake Bay Monitoring Program are outlined below.

MD **RIVER MONITORING PROGRAM** (continued)

(cont)

Potomac River Assessment (continued)

The Interstate Commission on the Potomac River Basin (ICPRB) describes water quality throughout much of the river basin using data collected by the District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia. Physical and chemical data from 38 Maryland stations in the mainstem river and its tributaries are incorporated into the ICPRB's Baseline Water Quality Monitoring Network Benthic community structure and diversity data collected by the State are also used by the ICPRB in its assessment.

Acid Mine Drainage Monitoring

The Bureau of Mines of the Department of Natural Resources (DNR) monitors water quality above and below active coal mines in Western Maryland to determine water quality impacts. The Bureau also has instituted a monitoring program to evaluate the effectiveness of experimental man-made wetlands in reducing the water quality impacts of acid mine drainage from abandoned mines.

Power Plant Research Program

The Power Plant Research Program within the DNR has a number of water quality monitoring programs in place designed to determine the impacts of current or predicted power plant operations on water quality Between 1985 and 1987, several NPS problems were studied, including: effect of acid precipitation on coastal streams and anadromous fish populations, effects of heavy metals leached into waters from coal wastes on fish, and a study of toxic materials in Chesapeake Bay region

Warm and Cold Water Fisheries Program

The DNR's warmwater and coldwater fisheries programs routinely monitor certain water quality aspects as part of the freshwater fisheries programs. Water quality at a selected number of streams is monitored each year as part of a systematic survey of the State's waters; temperature, conductivity, pH, and alkalinity are usually recorded during the spawning season or high stress, low-flow summer periods This information is not entered into the State's Water Quality File, but is usually summarized in fisheries reports. Known, native, and recreational trout populations are monitored, and assessments of both warmwater and coldwater fisheries habitats are conducted throughout the year Similar monitoring of basic water quality parameters occurs during most collection efforts such as the anadromous fish surveys in the spring, the assessment of the striped bass young-of-the-year index during the summer, and the oyster spat survey during the fall.

MD ESTUARINE MONITORING PROGRAM (continued)

(cont)

Chesapeake Bay River Input Program--To quantify the river-borne loads of various pollutants entering the Chesapeake Bay, four major tributaries were chosen to represent the range of different sources of runoff contribution to the Bay (Susquehanna, Potomac, Patuxent, and Choptank Rivers) One fall line station in each river is part of the USGS National Stream Quality Accounting Network (NASQAN) and provides long-term records of water quality data. Because most runoff and associated pollutants are carried by storms, this project emphasizes storm event sampling, although base flow samples will also be collected monthly. This program focuses on quantifying the major nutrient species and sediment loads entering the Bay and provides quarterly samples for metals analysis.

Phytoplankton Program

Surface grab samples are collected twice each month between March and October and once each month during the rest of the year in the mainstem of the Chesapeake Bay (3 stations), the Choptank, Chester, and Patapsco Rivers (1 station each), as well as in the Potomac and Putuxent River estuaries (11 and 4 stations, respectively). At one tributary of the Severn River, phytoplankton are collected 80 times per year. Phytoplankton are identified into major groups (green, blue-green, etc.), and dominant species are identified to their lowest taxonomic level.

SAV Monitoring Program

The DNR conducts and assists in resource monitoring and research programs, including submersed aquatic vegetation (SAV) These programs include a ground survey program, an SAV-water quality survey and revegetation program in cooperation with Harford Community College on the Susquehanna, Elk, and Sassafras Rivers, and with the University of Maryland on the Choptank River. Annual fisheries surveys include white and yellow perch surveys in the Choptank River, juvenile and adult herring surveys, shad surveys, estuarine juvenile finfish, and an adult striped bass survey.

Power Plant Research Program

The Power Plant Research Program within the DNR has a number of water quality monitoring programs in place designed to determine the impacts of current or predicted power plant operations on water quality Between 1985 and 1987, several NPS problems were studied, including: effect of acid precipitation on coastal streams and anadromous fish populations, effects of heavy metals leached into waters from coal wastes on fish, and a study of toxic materials in Chesapeake Bay region

MD COASTAL/ESTUARINE MONITORING PROGRAM (continued)

- (cont)
- Chesapeake Bay Benthic Program--Benthic biota samples are collected 10 times each year at 70 stations in the mainstem Chesapeake Bay and its tributaries. Physical and chemical data including sediment type and near-bottom water quality are monitored each time benthic samples are collected. Benthic invertebrates are identified to the lowest taxonomic level and counted, and the biomass of the numerically dominant species is also determined. Samples of key organisms from some of the 70 benthic stations sampled are analyzed for metals and organic compounds that represent a subset of EPA's priority pollutants and that are both stable and persistent in the environment.
- Chesapeake Bay Sediment Toxicant Monitoring Program--Surface sediment samples (three replicates) were collected at each of the 22 Chesapeake Bay mainstem stations. In 1986, this effort was transferred to the tributary network, and 37 of the 55 tributary stations now are sampled once per year. In addition, nine samples are collected in Baltimore Harbor once per year. Particle size distribution, percent moisture, total organic carbon, and selected metals and organic compounds are determined.
- Chesapeake Bay Plankton Program--Sampling for phytoplankton and zooplankton occurs simultaneously with physical and chemical sampling at 14 stations in the mainstem Chesapeake Bay and tributary sampling network Sampling frequency for phytoplankton is twice each month between April and September and once each month between October and March; for zooplankton, samples are collected once each month

Phytoplankton samples are assessed for species composition, *in situ* flourometry and productivity Replicate composite samples are collected both above and below the pycnocline by pump and are analyzed Chlorophyll concentrations are determined by *in situ* flourometry of surface waters while the sampling vessel is in transit between stations. In addition, flourometry is also used to determine the vertical profile of chlorophyll concentrations at each station. Finally, composite samples collected by pump above the pycnocline are analyzed for algal productivity using a radioactive tracer technique in a constant light incubation chamber

Zooplankton samples are assessed for species composition. Replicate composite samples collected above and below the pychocline using both pumps (microzooplankton) and plankton nets (mesozooplankton) are analyzed

 Chesapeake Bay Living Resources Program--This program is designed and implemented by the DNR's Tidewater Administration in conjunction with other agencies and is designed to investigate the relationship between habitat quality and the abundance and reproductive success of economically important species in the Chesapeake Bay Composite water samples are collected from stations in the Choptank River and Upper Bay and analyzed for a variety of water quality constituents. Phytoplankton, zooplankton, and fish larvae are also collected and identified. An oyster habitat monitoring project also has been initiated on the Choptank River to determine the relationship between oyster survival habitat and water quality conditions

MA RIVER MONITORING PROGRAM

Synoptic Surveys

The synoptic surveys include sampling physical, chemical, and biological parameters River stations are located at dams, above and below discharges, at tributaries, and at impoundments. These locations are chosen to assess the water quality and effects of point and nonpoint sources and natural changes. Biological sampling includes chlorophyll a, coliform bacteria, phytoplankton, benthic invertebrates, fish, and Microtox evaluations. These surveys are generally one-day, one-run surveys of grab samples only. The State conducts 20-30 synoptic surveys per year

Intensive Surveys

The intensive surveys include sampling physical, chemical, and biological parameters. Intensive surveys are conducted periodically to update old data and to sample rivers before and after a major upgrading of a treatment plant or the addition of a new discharge. Biological sampling includes chlorophyll *a*, coliform bacteria, phytoplankton, benthic macroinvertebrates, fish, and Microtox^R evaluations. These surveys consist of round-the-clock sampling for 2 or 3 consecutive days for a period of 1 to 2 weeks of the summer. Intensive surveys are generally conducted during low-flow conditions, and samples are usually composited. The State conducts five-seven intensive surveys per year.

Fish Toxics Monitoring

The State collects lish at 10 sites per year for residue analyses of pesticides, metals, PAHs, and PCBs Fish surveys have been restricted to waterbodies where wastewater discharge data or water quality studies have indicated potential toxic problems Because of limited resources, human health concerns have thus far received highest priority and, therefore, fish tissue analysis has been restricted to edible fish fillets Fish are visually examined for tumors, lesions, or other indications of disease and approximate age is determined. Samples may be analyzed for specific toxicants or for a broad spectrum of metals, pesticides, or organic chemicals

Rapid Bioassessments

The Macroinvertebrate Rapid Bioassessment (MRB) technique involves the use of semiquantitative sampling methods designed to minimize laboratory time requirements for taxonomic identification and enumeration of aquatic macroinvertebrates. The MRB provides standardized procedures for assessing the impacts of organic and toxic pollutants on aquatic invertebrates; it also provides the basis for making relative comparisons pertaining to water quality conditions between sampling stations and/or to document long-term trends at fixed sites.

MD ESTUARINE MONITORING PROGRAM (continued)

(cont.)

Toxics Monitoring

Shellfish (oysters and soft shell clams) are collected from shellfish harvesting waters in the spring and fall for analyses of contamination by metals and pesticides.

Citizen Monitoring Programs

The Citizens Program for the Chesapeake Bay and the Anne Arundel County Office of Planning and Zoning have established monitoring efforts in the Choptank River and in the West and Rhode Rivers, respectively

The Chesapeake Bay Foundation coordinates a Citizen's Submersed Aquatic Vegetation (SAV) Hunt program with the DNR and the U.S. Fish and Wildlife Service. This program is designed to verify SAV abundance and determine species composition in areas of the Bay that have been photo-mapped. Volunteers are provided with SAV identification guides and data sheets. SAV beds are located at low tide, and identification and verification samples are taken

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WI LAKE MONITORING PROGRAM (cont)

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LAKE MONITORING PROGRAM

Long-Term Ambient Monitoring

In 1986, the State initiated a long-term monitoring program of 50 lakes statewide The program was started to detect trends in physical, chemical, and biological parameters over a 10-yr period and to evaluate the impacts of land use activities on lakes. Sampling is conducted five times per year. The chemical/physical parameters sampled include total phosphorus, chlorophyll a, Secchi disk transparency, other nutrients, bacteria, and toxics (fish). The biological parameters sampled include fish, macroinvertebrates, plankton, and macrophytes

Acid Lakes Program

The State in cooperation with the USGS is monitoring water quality parameters in three lakes in northern Wisconsin and in adjacent ground water

Trophic State Classification Program

The Trophic State Index (TSI) is correlated with water clarity, phosphorus, and chlorophyll a measures to evaluate the degree of eutrophication. Data are derived from sampling of water quality parameters and from LANDSAT data

Citizen Monitoring Program

In 1986, the State initiated the Self-Help Monitoring Program. Volunteer-collected water quality data (Secchi disk transparency) on 129 lakes in 39 counties statewide have been assembled. Sampling is conducted 4 to 25 times each year for transparency.

WY RIVER MONITORING PROGRAM

Ambient Monitoring Network

The State obtains water quality data from a fixed-station surface water monitoring network operated by the USGS at sites above and below selected dischargers rather than monitoring NPS pollution. The State Water Quality Agency conducts no instream biological monitoring. The State Fisheries Agency provides information used in the classification of State waters.

Toxics Monitoring

The State, through the Wyoming Game and Fish Department, conducts fish sampling for residue analyses

LAKE MONITORING PROGRAM

The State does not currently have an active lake monitoring program for assessing pollution problems.

Survey of Monitoring in NPDES Programs (continued)	
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State	Bioassay testing	Biosurveys
NH	Some industrial and some municipal facilities require acute static toxicity testing with two species (Daphnia	Dischargers are not required to conduct biosurveys
	sp.) and fathead minnows (Pimephales promelas)	The State does not conduct biosurv_ys relative to point source dischargers
	The State conducts acute Daphnia pulex toxicity tests at	
	about 40 facilities per year and concurrently a similar toricity test is conducted upstream and downstream	
	from the discharge During FY88, the State comple-	
	mented its acute toxicity screening program by adding	
	Chronic toxicity testing capabilities using <i>Ceriodaphnia</i>	
	only for whole effluent screening but for instream investi-	
	gations during low flow conditions	

State	Bioassay testing	Biosurveys
NJ	Toxicity testing is required at selected industrial and	Dischargers are not required to conduct biosurveys

municipal facilities using acute static renewal fathead minnow (Pimephales promelas) tests in freshwater and sheepshead minnow (Cyprinodon variegatus) or mysid shrimp (Mysidopsis bahia) tests in seawater. Testing is generally conducted guarterly, but may be required monthly in cases where complex wastewaters are discharged Some permits require 7-d fathead minnow or 21-d Daphnia sp. tests on complex industrial wastewaters

The State conducts on-site acute toxicity tests with bluegills (Lepomis macrochirus) and fathead minnows using a mobile bioassay laboratory. Chronic bioassay testing has not been initiated

Ames/Salmonella testing is conducted where effluents show potential for mutagenicity.

The emphasis in State monitoring has been on point sources.

Intensive studies at four to six sites per year are conducted to assess macroinvertebrate, fish, and periphyton communities.

Fixed-station ambient biomonitoring is conducted at 14 stations (periphyton community) and 18 stations (macroinvertebrate community); however, this is not conducted every year.

State	Bioassay testing	Biosurveys
NY	Specific industrial and municipal permits require acute static renewal toxicity tests using <i>Daphnia</i> and fathead	Dischargers are not required to conduct biosurveys.
	minnows (<i>Pimephales promelas</i>) and may require chronic bioassay testing on a site-specific basis	The State collects macroinvertebrates at 38 trend monitoring sites and at 50 special survey sites per year. The State has been using macroinvertebrates to assess
	The State conducts chronic 7-d Ceriodaphnia tests on 50 ambient receiving water sites per year using a mobile bioassay laboratory.	water quality since 1972 and has conducted <i>in situ</i> monitoring of toxic substances with these organisms. The State's Stream Biomonitoring Unit has developed a computerized data storage system for handling macroin-
	The State conducts both acute and 7-d chronic Ceriodaphnia tests on six water samples collected as part of the Rotating Intensive Basin Study (RIBS) program.	vertebrate survey data. Using dBase III, the system will manage the storage, retrieval, and manipulation of data and should be adaptable to uploading into EPA BIOS.
		Macroinvertebrates are collected two to six times at each Rotating Intensive Basin Study (RIBS) site and are analyzed for community structure (species richness, dominance, biotic index) The macroinvertebrate monitoring involves six multiplate collections on large
		streams or two rapid bioassessments (kick samples) on small tributaries.

State	Bioassay testing	Biosurveys

NM Specific industrial and municipal permits may require acute 48-hr static and 7-d chronic toxicity testing EPA Region 6 requires that major industrial and municipal facilities conduct chronic bioassay testing using the 7-d *Ceriodaphnia* and 7-d fathead minnow (*Pimephales promelas*) test. Acute bioassay testing with these species is required in some situations in place of chronic testing.

The State does not currently conduct bioassay toxicity testing but obtains some assistance from the Regional Laboratory.

Dischargers are not required to conduct biosurveys

The State conducts 12 instream water quality studies at approximately 40 sites per year where quantitative and qualitative macroinvertebrate community structure is examined. Macroinvertebrate community structure is analyzed using the Winget and Mangum (1979) Biotic Condition Index (BCI) and the Shannon-Wiener diversity index. These studies include both point and nonpoint source pollution problems. Fish sampling is incorporated through assistance provided by the New Mexico Department of Game and Fish.

State	Bioassay testing	Biosurveys
ND	Specific major industrial and municipal facilities are required to conduct acute 48-hr static renewal toxicity	Dischargers are not required to conduct biosurveys
	testing using Ceriodaphnia and acute 96-hr static renewal toxicity test using fathead minnows (<i>Pimephales</i> <i>promelas</i>) The State anticipates including a requirement either for acute or chronic effluent testing in all major permits reissued in 1989	The State currently does not conduct biosurveys.
	The State is developing its toxicity testing capability to include both acute and chronic Ceriodaphnia and fathead minnow tests.	
	During 1987, EPA's Duluth mobile bioassay laboratory conducted bioassay testing at 19 stations on the Red River and on eight treatment plant effluents. <i>Ceriodaphnia</i> and fathead minnows were utilized in acute and chronic toxicity tests. Algal bioassays were	

State Bioassay testing

NC Specific industrial and municipal facilities require bioassay toxicity testing Requirements currently are placed on all industrial, major municipal facilities, and minor municipals with pretreatment facilities either upon permit reissuance or new permit application When wastewater flow exceeds 1% of receiving water 7Q10 flow, the chronic 7-d *Ceriodaphnia dubia* test is required. Where waste stream flow rates are less, an acute static *Ceriodaphnia dubia* or *Daphnia pulex* test may be used.

> During 1986 and 1987, the State performed 1,226 acute toxicity tests, 169 chronic studies, and 19 on-site toxicity evaluations. The on-site toxicity evaluations generally consist of a battery of tests including a flowthrough 96-hr fathead minnow (*Pimephales promelas*) study, a three brood *Ceriodaphnia* reproduction test, two or more acute static *Ceriodaphnia* toxicity tests, and extensive chemical sampling The on-site toxicity evaluations are conducted using a mobile bioassay laboratory.

Biosurveys

Dischargers are not required to conduct biosurveys

Macroinvertebrate communities are assessed at 100 trend monitoring stations (80 freshwater and approximately 10 estuarine sites) and at 60 special study sites per year Macroinvertebrates assessments are made using kick nets, sweep nets, chironomid collections, and visual inspections Water quality is assessed by determining total taxa richness, taxa richness of pollution-intolerant groups, and indicator assemblages Estuarine macroinvertebrates are collected using a timed effort employing sweep nets and fine mesh samplers In addition, sediment grabs are evaluated for their infaunal community Water quality is assessed by determining taxa richness and species composition The State is currently evaluating the applicability of EPA's Rapid Bioassessment Protocols for their monitoring program

Phytoplankton are evaluated at six sites from two lakes (monthly) selected from a 40-lake monitoring network

The State conducts special before and after studies at point source dischargers that include physical, chemical, and biological sampling.

State	Bioassay testing	Biosurveys
ОК	Specific industrial and municipal permits require an acute 48-hr Daphnia toxicity test EPA Region 6 requires that	Dischargers are not required to conduct biosurveys
	both industrial and municipal majors conduct chronic bioassay testing using the 7-d Ceriodaphnia and 7-d fathead minnow (<i>Pimephales promelas</i>) test. Acute bioassay testing with these species is required in some situations in place of chronic testing depending on the dilution the waste receives in the receiving waterbody	The biosurveys the State conducts involve fish, benthic macroinvertebrates, and periphyton population analyses.
	The State has conducted acute 96-hr <i>in situ</i> toxicity tests of ambient water with sensitive indigenous lish, but has no capabilities for conducting effluent toxicity tests using EPA-recommended methods.	

State	Bioassay testing	Biosurveys

OH Specific industrial and municipal facilities require monthly acute static 96-hr fathead minnow (*Pimephales promelas*), acute static 96-hr Selenastrum capricornutum, and acute static 48-hr Ceriodaphnia dubia tests, or quarterly chronic 7-d Ceriodaphnia and fathead minnow tests.

The State conducts both acute static 48-hr Ceriodaphnia dubia and acute static 96-hr fathead minnow tests three times per year at 18-20 facilities and conducts 7-d Ceriodaphnia dubia and fathead minnow chronic tests as needed

The State does not operate a mobile laboratory

Dischargers are not required to conduct biosurveys

The State has developed biological criteria for its rivers and streams using a biosurvey/ecoregion approach A set of least-impacted reference sites across the State and within each of the five Ohio ecoregions were carefully selected and sampled for fish, macroinvertebrates, and water column and sediment chemistry. Based on these results, criteria for three biological indices were derived: the Index of Biotic Integrity (IBI) for fish, the Modified Index of Well-Being (IwB) for fish, and the Invertebrate Community Index (ICI) for macroinvertebrates

Macroinvertebrate community monitoring is conducted at sites associated with both point sources (20 dischargers per year) and nonpoint sources of pollution as part of the Intensive Biological and Water Quality Survey Program (10-15 river basins per year), and at 29 fixed stations (of which 10 are sampled annually and the others are sampled on a rotating basis of 5 per year) At these stations, macroinvertebrates are collected using both natural (dipnets and hand picking) and modified Hester-Dendy multiplate artificial substrate samplers over a 6-week period from June to September

The State uses an invertebrate ICI based on ecoregions to assess water quality and compliance with standards Habitat evaluations are also made at each site

Fish populations are collected using electrofishing and seining techniques two or three times per year from June to October at the same sites as the benthos for the intensive surveys Water quality and standards compliance are determined using the IBI and the IwB for each ecoregion A detailed qualitative habitat evaluation index covering seven major characteristics of microhabitats is used to assist with biocriteria application

WA COASTAL/ESTUARINE MONITORING PROGRAM (continued)

(cont)

Puget Sound Ambient Monitoring Program

The State has initiated a comprehensive monitoring program for Puget Sound that integrates data collected on sediment, water quality, fish, and macroinvertebrates. Finfishes are monitored by the Department of Fisheries Near shore habitat monitoring is conducted by the Department of Natural Resources, and intertidal shellfish monitoring is conducted by the Department of Natural Resources, and intertidal shellfish monitoring is conducted by the Washington Department of Ecology and the Puget Sound Authority. The monitoring includes evaluation of macroinvertebrate community structure, exposure of the sediments to bioassay organisms, and chemical analyses of sediments for toxics. A total of 119 fixed stations are sampled in this program.

Benthic macroinvertebrates are collected using a modified van Veen sampler and are identified to species or the lowest taxonomic unit possible. The community analyses include: number of taxa and abundance; mean and standard deviation for the number of taxa and abundance; Infaunal Trophic Index; Shannon-Wiener diversity; an equitability measure; numerical dominance; and abundance of pollution sensitive and pollution tolerant species Sediment bioassays are conducted on sampled sediment using a 10-day amphipod bioassay (*Rhepoxynius abronius*), a 48-hr larval bivalve testing using the Pacific oyster (*Crassostrea gigas*) or Blue Mussel (*Mytilus edulis*), and a sediment Microtox^R bioassay Sediments are analyzed for 13 metals, volatile organic compounds, base/neutrals, and acid extractables.

Toxics Monitoring Program

Toxics monitoring in marine waters is conducted as part of the State's fixed-station monitoring network composed of 53 stations. At 20 of these marine stations, fish tissues are analyzed for selected heavy metals and other toxic substances.

State Bioassay testing Biosurveys

OR Under old permit requirements, one municipal and most industrial dischargers are required to conduct effluent toxicity testing that usually consists of two acute static 96-hr bioassay tests per year using rainbow trout (Salmo gairdneri), Ceriodaphnia, or fathead minnows (Pimephales promelas)

> Under new permit requirements, dischargers must conduct chronic bioassays monthly for a 5-month period under low flow conditions using two species for the first year. After the first year, the most sensitive species is tested monthly for 3 months under low flow conditions

> The State conducts acute 96-hr toxicity tests for evaluating effluent toxicity using *Daphnia magna*, *Hyallela azteca*, *Gammarus sp.*, or fathead minnows The State also screens major dischargers (both industrial and municipal) for toxicity using a 21-d *Daphnia magna* or 7-d *Ceriodaphnia* test and a chronic fathead minnow test each year. The State screens some effluents using the Microtox^R test.

Each year, approximately 8 chronic 14-d algal assays (Selanastrum capricornutum) are conducted to evaluate the effects of different nutrient loads

Caged salmonid fish or caged invertebrate studies upstream and downstream from potential pollutant sources are also conducted. The State also has some capabilities to perform freshwater sediment bioassays using *Chironomus*. Dischargers are not required to conduct biosurveys

Biological sampling has been a relatively small part of the State's surface water monitoring program Macroinvertebrate community assessments are conducted upstream and downstream from dischargers as part of mixing zone studies. The macroinvertebrate community assessment evaluates changes in community composition that cannot be attributed to habitat differences

WV RIVER MONITORING PROGRAM

Ambient Water Quality Monitoring Network

The State maintains an ambient fixed-station monitoring network consisting of 27 sites sampled monthly statewide for routine water quality parameters. Eight of the 27 sites are Ohio River stations sampled by ORSANCO

The State implemented a regional "mininetwork" that focuses on water quality in small watersheds, rather than in major rivers providing monthly data for a continuous 12-month period for each watershed. When fully under way, 60 to 80 sites within six watersheds will be sampled annually.

Biological Monitoring Network

The State maintains a long-term biological network consisting of 42 sites at which aquatic invertebrates are collected annually using multiplate samplers. A number of these sites overlap with the 27 long-term water quality monitoring network sites. Phytoplankton samples are collected at 4 of the 42 stations.

The State in cooperation with the U.S. Fish and Wildlife Service is conducting a survey and inventory of freshwater mussel populations statewide

Toxics Monitoring Program

During each year as part of the fish tissue sampling program, samples for metals and pesticide analyses are collected from 20 to 25 sites (two samples per site, each composed of five fish) from sites throughout the State

Special Studies

Special studies (e.g., Kanawha River fish and sediment dioxin study) are conducted as needed The State conducted intensive survey work on the Kanawha River on physical measurements, metals, and inorganic constituents. Also, the incidence of tumor formation (with the liver as the target organ) in resident fish populations was evaluated by histological analyses.

LAKE MONITORING PROGRAM

The State does not currently have a routine lake monitoring program. Lake fishery surveys that include some basic water quality parameters and information on physical conditions have been collected by State fisher_biologists. The State also monitors for toxic substances in fish tissues.

The trophic condition of the State's public lakes has never been officially documented or scientifically determined

State	Bioassay testing	Biosurveys
RI	Effluent bioassay testing is required for most major industrial and municipal dischargers and may be placed	Dischargers are not required to conduct biosurveys
	on minor permittees as appropriate. A static 48-hr Daphnia sp. test and a static 96-hr fathead minnow (<i>Pimephales promelas</i>) test on whole effluents are required semiannually.	The State conducts biosurveys coinciding with USGS trend monitoring stations. Fullner multiplate (14 plate) artificial substrate samplers are placed at 17 sites to evaluate the instream macroinvertebrate communities.
	Ambient bioassay testing is conducted by the State in cooperation with EPA Region 1 at various times for both	Species composition, diversity, and the physiological condition of natural aquatic communities are assessed
	acute and chronic toxicity. Acute tests use Daphnia pulex or Ceriodaphnia as the test species, while chronic testing is conducted with Ceriodaphnia	Macroinvertebrates (mostly aquatic insect larvae) are classified according to their tolerance of organic wastes and are scored as tolerant, facultative, or intolerant
	Acute marine bioassay testing using the mysid shrimp (Mysidopsis bahia) is conducted with the assistance of the EPA Narragansett Laboratory.	Numerous biological surveys are being conducted of Narragansett Bay as part of the Narragansett Bay Project funded by EPA's National Estuary Program to assess impacts of toxics, nutrient enrichment, land use impacts, and the health and abundance of living marine resources.

State	Bioassay testing	Biosurveys
NE	All major industrial and municipal facilities are being required to conduct acute bioassay tests of effluents	Dischargers are not required to conduct biosurveys
	once per year using Ceriodaphnia and fathead minnows	The State monitors fish and macroinvertebrate
	(Pimephales promelas) These tests are conducted for	communities at 140 reference sites from eastern
	24 hr using 100% effluent. If mortality is $>$ 10%, then	Nebraska (Corn Belt Region) warmwater streams An
	plans for a toxicity reduction evaluation must be	Index of Biotic Integrity (IBI) and an Invertebrate
	developed	Community Index (ICI) modified after an index used in
		Ohio were used to evaluate use support Explanations
	The State currently has no whole effluent bioassay	for observed community impairment are based on a
	testing capabilities	review of potential point source discharges upstream of the sample site, habitat quality ratings, and field recon-
	The EPA checks six facilities per year using acute static renewal toxicity tests with <i>Daphnia</i> sp. and fathead minnows	naissance.

Bioassay testing

SC Old permits require that specific industrial facilities conduct biomonitoring: either (1) a flowthrough 96-hr test with bluegill sunfish (*Lepomis macrochirus*) or a 48-hr *Daphnia sp.* or mysid shrimp (*Mysidopsis bahia*) test on whole effluents with some permits in addition requiring instream biological assessments; or (2) instream biological assessments only. New permits no longer require biosurveys to be conducted Bioassay requirements are dependent on the amount of dilution afforded the effluent. If the instream waste concentration (IWC) is greater than 100:1, then only acute 48-hr testing is required; if the IWC is less than 100:1, then chronic testing is required. In some specific cases, both acute and chronic testing may be required.

One permit also contains requirements for fish flesh tainting, fish avoidance, and instream caged organism assessments

All major municipal and minor municipal dischargers with significant industrial contribution will be required to conduct chronic 7-d *Ceriodaphnia* effluent testing as permits are reissued Future permit requirements will be directed toward an increased use of chronic *Ceriodaphnia* tests and a decreased use of instream biological assessments

The State currently operates a mobile bioassay laboratory; however, its use will gradually be phased out. With this shift in test emphasis, the State will be conducting acute and chronic 7-d *Ceriodaphnia* tests on effluents transported to the central State Laboratory in Columbia, SC. **Biosurveys**

Currently, some industrial permits require only instream biological assessments, and some require instream assessments coupled with bioassay tests of whole effluent. In the future, there will be a decreased emphasis on biosurveys in new permits and in renewals of older permits

Biological monitoring by the State at fixed stations includes identification and enumeration of phytoplankton, aquatic macroinvertebrates, an,' fish. Biosurvey data evaluations include taxa richness, diversity, equitability, and similarity. In addition, the State is currently assessing many of the new metrics presented in the EPA's Rapid Bioassessment Protocols

The State conducts special water quality studies, including "before and after" studies, model verification studies, or assessments of known water quality problem areas, including population dynamics information

The State conducts qualitative multihabitat biosurveys in coastal/estuarine areas Biosurvey data are analyzed for species composition and taxa richness

State Bioassay testing Biosurveys

MO Specific industrial and municipal permits require the permittee to conduct acute bioassay toxicity testing and/or perform instream bioassay testing Testing is performed on 100% effluent for 24 hr using fathead minnows (*Pimephales promelas*) as the test species Greater than 10% mortality results in reopening of the permit for revisions to existing limits. Some permits also require bioassay testing using effluent diluted to the expected low flow concentration to be found in the receiving waterbody after mixing.

The State has initiated chronic *Ceriodaphnia dubia* and fathead minnow (*Pimephales promelas*) tests of some industrial and municipal effluents for compliance monitoring and conducts instream bioassay testing as appropriate.

Some dischargers have been required to perform instream biological assessments of macroinvertebrates, at one upstream and one or two downstream locations from a point source

The State conducts qualitative macroinvertebrate sampling (rapid stream assessments) in streams in the vicinity of 100-200 facilities per year. These studies are quick and inexpensive methods for determining potential problems through visual observation of the stream and an evaluation of the benthos A determination of the level of wasteload allocation modeling and further chemical sampling is made based on the biosurveys

State Bioassay testing Biosurveys

TX Specific industrial and municipal dischargers are required to conduct acute static 48-hr Daphnia and/or chronic Ceriodaphnia testing of effluents depending on the amount of dilution afforded the effluent. EPA Region 6 requires that both industrial and municipal majors conduct chronic bioassay testing using the 7-d Ceriodaphnia and 7-d fathead minnow (Pimephales promelas) test. In marine waters, 7-d mysid shrimp (Mysidopsis bahia) and 7-d sheepshead minnow (Cyprinodon variegatus) tests are required. Acute bioassay testing with these species is required in some situations in place of chronic testing depending on the amount of dilution afforded the effluent.

The State does not currently conduct toxicity testing. A contract laboratory conducts acute 48-hr daphnid or chronic 7-d *Ceriodaphnia* tests for ambient waters with salinities less than 5 ppt and conducts acute 48-hr mysid shrimp tests on effluents for ambient waters with salinities greater than 5 ppt. The State also receives some assistance from the Regional Laboratory.

Dischargers are not required to conduct biosurveys

The State conducts instream assessments of macroinvertebrates and lish on 5-10 waterb, dies per year.

Currently, about five field surveys involving 25 ambient sites and 20 facility discharges are conducted per year. During FY89, the State will conduct 15-20 biosurveys that will focus on toxic impacts and incorporate rapid bioassessment methods.

State	Bioassay testing	Biosurveys
MN	Bioassay toxicity testing is required on specific major industrial and municipal permits. Either acute static 24-hr	Dischargers are not required to conduct biosurveys
	fathead minnow (Pimephales promelas), Ceriodaphnia	The State is beginning to develop a biosurvey program;
	dubia, and Daphnia magna) or flowthrough 96-hr fathead minnow toxicity tests using whole effluent and serial dilu- tions are required	however, it does not currently conduct biosurveys associated with point source discharges
		The State is planning to develop macroinvertebrate
	For 15-20 facilities, acute static 48-hr fathead minnow, <i>Ceriodaphnia dubia, and Daphnia magna</i> toxicity tests are performed as part of the Acute Static Screening test. The State also conducts onsite flowthrough 96-hr (defini- tive) fathead minnow toxicity tests using a mobile bioassay laboratory and/or conducts 7-d chronic static renewal tests with <i>Ceriodaphnia dubia</i> and fathead minnows.	instream biocriteria and a comprehensive biological survey program adapting EPA's Rapid Bioassessment Protocols. The State is also interested in developing fish community biocriteria based on the ecoregion approach using Karris Index of Biological Integrity (IBI) metrics. Collection of fish community data from reference sites statewide has been initiated.
	In addition, two site-specific tests are employed in water- quality-limited situations to modify effluent standards using both a 96-hr fathead minnow and <i>Daphnia magna</i> test	

State	Bioassay testing	Biosurveys
VT	There are no requirements for bioassay testing in the NPDES program, however, initiation of bioassay testing is planned	A new program will require indirect dischargers to monitor macroinvertebrates via rock basket substrates upstream and downstream from each discharge with five to eight baskets per site This program provides
	The State is not currently conducting toxicity tests, but future plans include initial State acute toxicity test screen- ing of effluents using a 48-hr <i>Daphnia pulex</i> and a chronic 7-d <i>Ceriodaphnia</i> test. The dischargers	instream biological assessment of discharge effects A program of lish containment monitoring was started in 1986.
	identified in this screening as having toxic effluents would be required to conduct chronic 7-d <i>Ceriodaphnia</i> and tarval fathead minnow (<i>Pimephales promelas</i>) tests.	The State collects macroinvertebrates using Surber samplers at 45 sites in an ambient biomonitoring network (ABN) and evaluates taxa richness, community diversity, and other macroinvertebrate parameters Fish
	The State currently has the capabilities of conducting acute toxicity testing but not for regulatory purposes.	populations are also sampled at selected ABN sites

The State also monitors fish populations at six sites to assess long-term effects of stream acidification on headwater fish populations.

Survey of Monitoring in N	IPDES Programs	(continued)
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State	Bioassay testing	Biosurveys
MA	 Specific industrial and municipal dischargers are required to conduct toxicity testing using a static 48-hr Daphnia pulex and fathead minnow (Pimephales promelas) test or appropriate marine species toxicity test For large marine dischargers, a three-species chronic toxicity test is required monthly (less frequently on smaller dischargers) using the sheepshead minnow (Cyprinodon variegatus), the mysid shrimp (Mysidopsis bahia), and the red algae (Champia parvula) The State uses the Microtox^R assay for screening of 30-50 freshwater and marine effluents per year. This toxicity testing method is currently the only in-house testing capability. The State currently owns a mobile bioassay laboratory. The EPA Laboratory in Lexington and private contractors conduct acute toxicity testing using daphnids and fathead minnows. Marine bioassay testing is conducted by a contractor using Mysidopsis bahia. In addition, caged blue mussel (Mytilus edulis) bioaccumulation studies are being conducted. Marine sediment elutriate bioassays are being evaluated for use by the State 	Dischargers are not required to conduct surveys The State collects macroinvertebrates at 25 stations per year by a rapid 5-min kick sampling technique and identifies the first 100 organisms to genus or species level. The taxonomic data are then compiled to deter- mine the status of various criteria used to rank water quality: species richness, distribution (balance), EPT val- ues (number of taxa in Ephemeroptera, Plecoptera, and Trichoptera), percent contribution of pollution tolerances, feeding habits of the five numerically dominant species, and Hilsenhoff Biotic Index (HBI) Some of these surveys address point source discharges, while others are asso- ciated with special studies.

State Bioassay testing Biosurveys

VA Specific industrial permits and municipal permits with treatment capacity over 5 MGD or pretreatment programs require bioassay toxicity testing that includes a semiannual acute 96-hr, static, or static renewal test using daphnids and fathead minnows (*Pimephales promelas*) or appropriate saltwater species. In some cases, testing frequency may be increased and chronic testing may be required.

> For several dischargers to the lower James River, chronic 7-d *Ceriodaphnia* and fathead minnow tests or chronic tests with the saltwater species (*Mysidopsis bahia*) and the sheepshead minnow (*Cyprinodon variegatus*) are required

The State conducts on-site static acute 48-hr and chronic 7-d testing at specific facilities using two mobile bioassay laboratories: one conducts freshwater bioassays, and the other conducts marine/estuarine tests Species used in the State's bioassay testing program include: fathead minnows, *Ceriodaphnia*, and *Daphnia sp.* for freshwater and *Mysidopsis bahia*, the sheepshead minnow, and the Atlantic silverside (*Menidia menidia*) for marine and estuarine waters. Some dischargers are required to complete receiving water assessments of the macroinvertebrate community, and these instream tests will be increasingly required

The State conducts approximately 20 receiving water assessments per year using macroinvertebrate community studies.

The State maintains a 175-fixed-station trend monitoring network for macroinvertebrate sampling Sampling is conducted semiannually during the spring and fall. Four major groups are evaluated: aquatic insects, molluscs, crustaceans, and annelids. An evaluation of community structure (e.g., presence/absence, relative abundance, and distribution) provides the basis for the biological analysis of water quality. After the benthic macroinvertebrate community is evaluated, an overall water quality rating of good, fair, or poor is assigned to each station Like water quality monitoring data, the biological data are used in identifying and ranking Virginia's priority waterbodies.