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Iowa's Water Monitoring Plan

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I. Introduction

Iowa is blessed with generally clean air, fertile soil, and abundant water resources. All are linked and each is vital to both our state's economic vitality and our citizens' quality of life.

Recent interest in water monitoring by citizens, the governor, and the state legislature has significantly increased financial resources directed at monitoring within the state. It also represents an opportunity to review our monitoring program and take a fresh look at why we monitor, what we monitor and how we monitor. A review of historical monitoring efforts for the state is provided in this plan.

This plan is different in several ways from earlier plans that the Iowa DNR of Natural Resources (DNR) has developed. First, it is comprehensive and includes all surface water and groundwater resources. Earlier plans have focused on specific water resources. Second, the plan actively involved stakeholders and professionals outside of the DNR from the beginning. This process yielded new ideas about priorities and how monitoring should be conducted. In the end, it developed a consensus on the goals and monitoring program elements and provided an aggressive approach to water quality monitoring in the state.

The proposals offered in this plan should guide development of monitoring activities for the DNR through the next decade. The recommendations are comprehensive, but will require adaptation as circumstances evolve and as budgets allow development to take place. Neither the recommendations nor their implementation can be static. The DNR encourages continued dialogue directed at refining the goals and at implementing our monitoring program in creative, cooperative, and cost-effective ways. Although there is a real need for consistency in monitoring, evolving needs and priorities, new technologies and improved understanding will dictate that this plan evolve. Consistency and flexibility may appear incongruent, but they must be a part of the plan if this monitoring program is to improve and remain viable.

Authority

Chapter 455B of the Code of Iowa designates the Iowa DNR as the state agency responsible for management of the water resources in Iowa. The federal Clean Water Act requires states to conduct water quality monitoring (Section 106) and to report every other year on the degree to which state surface waters meet federally approved water quality standards (Section 305(b)). These requirements have been the basis for the routine water quality monitoring efforts conducted historically and currently in the state of Iowa.

Past DNR Ambient Monitoring

Surface water monitoring began in the early 1970s as a network of stations on Iowa rivers located upstream and downstream from Iowa's larger urban areas. In the mid-1980s, DNR reviewed and revised its surface water monitoring strategy (Drustrup, 1986). The revised monitoring program, implemented in October 1986, was designed to improve monitoring of ambient conditions away from direct urban influences. Sixteen fixed stations, located throughout the state and representing basins of different sizes, were monitored monthly for common anions and cations, nutrients, and bacteria. In 1995, common pesticides were added at these stations from April through October. In addition, the 1986 re-design added 44 fixed stations that were monitored for common anions and cations, nutrients, and bacteria. However, these sites were measured quarterly every four years in a rotational scheme so that only 11 sites were measured in any one year. All of this data was curated in the U.S. Environmental Protection Agency's (EPA) STORET database system. Funds for this monitoring came from EPA and amounted to about $123,000 annually. For the past six years, biological monitoring has been conducted to develop reference sites throughout each of Iowa's seven ecoregions. EPA provided all of the biological monitoring costs, about $50,000 annually. Prior to FY2000, there were no state dollars devoted to ambient surface water monitoring.

In fiscal year (FY) 2000, state funds were appropriated to support monitoring. This allowed all 60 fixed sites (monitored since 1986) to be monitored monthly for common parameters and common pesticides throughout the year. In addition, all priority pollutants will be measured in both spring and fall, at both high and low flows. This would represent the first uniform, statewide monitoring for a wide range of water quality parameters in Iowa. Further, other monitoring is being expanded in FY2000. Ten cities will be monitored, upstream and downstream and at both low flow and high flow, for nutrients and all priority pollutants. Biological monitoring is being conducted at 40 potentially impaired water bodies, 16 long-term fixed station monitoring sites, and at 30 reference sites. Ambient surface water monitoring for FY2000 will cost about $600,000 including about $430,000 in state infrastructure funds. Additionally, the citizen monitoring program begun by DNR in 1998 is being supported more broadly as part of a DNR strategy to involve more Iowans in understanding and protecting all their natural resources, but especially their water resources. A total of $150,000 of infrastructure funds is supporting citizen monitoring efforts.

Stream gaging is the only component of surface water monitoring that has been supported in the past by state general funds. A cooperative stream-gaging program has been conducted between Iowa and the U.S. Geological Survey for decades. Gaging data are published annually by the USGS and instantaneous discharge data are available on the Internet from the USGS. Monetary support has varied somewhat during the past 30 years, but currently about $77,000 in state general funds help to support 16 stream gages. These funds are matched dollar for dollar by the USGS.

Groundwater has been monitored for many years as a part of a cooperative program with the USGS and the University Hygienic Laboratory (UHL). The details of the water quality program have varied through time. Since 1990, the program has focused on contaminants in raw water from 45–90 municipal wells annually. The DNR contribution of $40,000 annually came from the state general fund. UHL contributed $30,000 in analytical costs up until FY2000. USGS matched both the cash and in-kind services dollar for dollar. Similarly, groundwater levels each year have been measured quarterly at 200 wells over the past decade. The DNR contribution is $40,000 (state general fund) and it has been matched dollar for dollar by the USGS. The total groundwater monitoring program has been about $220,000 annually, of which about $80,000 came from the state general fund.

Ambient water quality monitoring, stream gaging, groundwater quality monitoring and groundwater level monitoring programs cost $1,065,000 in FY2000. Of the total, $157,000 is from the state general fund and $580,000 is from infrastructure funds. The state contribution represents an increase of about $580,000 in FY2000 over FY1999, and is entirely for surface water quality monitoring.

Based on current requests from the governor, the contribution of state funds is expected to rise by about $500,000 beginning in FY2001.

Water Resources of Iowa

Iowa's water resources are very extensive and quite diverse. Their value is nearly inestimable. They are important for human health, economic vitality, quality of life, and the maintenance of both aquatic and terrestrial ecosystems.

Table 1 summarizes the scope of Iowa water resources and is suggestive of the complexity of our resources and their value. It reflects the hydrologic cycle, which connects all of our water resources. That cycle also connects our water resources to our activities on the land. It is impossible to make direct measurements on all of these resources and describe their nature. Obviously these resources must be sampled, and these samples must represent the resources as a whole. A consistent, multifaceted approach is required to gain a relatively complete picture. This plan identifies how we will accomplish the sampling and what we will do with the data.

Table 1. Summary of Iowa Water Resources.

Category	Category Described or Subdivided	Measure; Units	Pop. Served with Drinking Water
Area of Iowa	Total Area	56,275 sq. mi.	
	Land Area	55,965 sq. mi.	
	Water Area	310 sq. mi.	
Average Rainfall	Total Amount	32 in.	
Average Evapotranspiration	Total Amount	26 in.	
Average Direct Surface Runoff	Total Amount	3.5 in.	
Average Groundwater Recharge	Total Amount	2.5 in.	
Average Stream Discharge	Total Interior Stream Discharge	6 in. (18,000,000 ac ft/year)	
Rivers and Streams	Total Mileage	71,665 mi.	21.4%
	Intermittent Streams	42,957 mi.	
	Perennial Streams	26,630 mi.	
	Ditches	1,418 mi.	
	Border Rivers	660 mi.	
Lakes	Total Area	145 sq. mi.	2.9%
	No. of Significant Publicly Owned Lakes	115	
Flood Control Reservoirs(4)	Total Area	64 sq. mi.	1.2%
Wetlands	Total Area	79 sq. mi.	
Aquifer Storage	Total, All Aquifers	>100,000,000 ac ft.	74.7%
	Alluvial Aquifers	~25,000,000 ac ft.	22.9%
	Drift Aquifers and Pennsylvanian	~10,000,000 ac ft.	12.5%
	Dakota Aquifer	~3,000,000 ac ft.	6.1%
	Mississippian Aquifer	~25,000,000 ac ft.	3.8%
	Silurian-Devonian Aquifer	~55,000,000 ac ft.	15.4%

	Cambro-Ordovician Aquifer	~15,000,000 ac ft.	14.0%

Table 2 represents the surface water resources classified by use that the 305(b) report assesses. Although a subset of all resources, even these are a significant task to characterize accurately.

Table 2. Summary water bodies and water body subsegments designated for beneficial uses in the *Iowa Water Quality Standards* (September 1996; IAC 1996).

Water body Type and Use Designation	No. of water bodies or water body subsegments	Total Size
RIVERS AND STREAMS	**1,068**	**12,185.9 miles**
Class A	93	2,276.4 miles
Class B	1,068	12,185.9 miles
Class B(WW)	259	5,069.4 miles
Class B(CW)	108	480.4 miles
Class B(LR)	701	6,636.0 miles
Class C	18	285.8 miles
High Quality (HQ)	50	342.0 miles
High Quality Resource (HQR)	109	1529.2 miles
LAKES	**279**	**47,603 acres**
Class A	163	44,903 acres
Class B	278	47,600 acres
Class B(LW)	271	44,866 acres
Class B(WW)	6	2,732 acres
Class B(CW)	1	2 acres
Class C	54	20,350 acres
High Quality (HQ)	7	10,249 acres
High Quality Resource (HQR)	5	8,571 acres

FLOOD CONTROL RESERVOIRS	**4**	**40,850 acres**
Class A	4	40,850 acres
Class B(WW)	4	40,850 acres
Class C	1	11,000 acres
High Quality Resource (HQR)	1	11,000 acres
WETLANDS	**88**	**27,273 acres**
Class A	10	6,296 acres
Class B(LW)	88	27,273 acres
Class C	1	308 acres
High Quality Resource (HQR)	5	2,033 acres
Use designations: Class A = primary body contact (swimmable) recreation; Class B = aquatic life uses, Class B (WW) = significant resource aquatic life, Class B (CW) = coldwater aquatic life, Class B (LR) = limited resource aquatic life, Class B (LW) = aquatic life of lakes and wetlands, Class C = source of a potable water supply. River and stream water bodies are divided into subsegments for purposes of Section 305(b) reporting. High Quality (HQ) and High Quality Resources (HQR) waters also designated for Class A, B, and/or C uses.		

Advisory Committees

The DNR does not manage and protect Iowa's resources alone. About 90 percent of our land is privately owned, and it is the citizens who manage, develop, and control our private lands who make most of the decisions about Iowa's resources. Similarly, others outside of DNR manage much of our public lands. These people were invited to provide their ideas, set priorities, and discuss how DNR should proceed in monitoring our water resources. Two advisory groups functioned in this endeavor. The DNR takes full responsibility for this plan, but the plan was developed in dialogue with many important groups and individuals. The insights and ideas that these people provided improved this plan. Their continued active interest can help implementation of this plan and can make this plan evolve and improve. The names of individuals participating in these groups are listed below. The DNR is indebted to these individuals for sharing their time in this endeavor.

Water Monitoring Advisory Task Force

A Water Monitoring Advisory Task Force was formed to provide the DNR with priorities for monitoring based on diverse, public needs. Dr. Cheryl Contant (Georgia Institute of Technology) facilitated meetings with the advisory task force in September 1999, November 1999, and January 2000. This committee provided the DNR with their ideas about monitoring and their priorities for monitoring. The task force was chaired by Dr. Dennis Keeney (Leopold Center for Sustainable Agriculture) and Dr. L.D. McMullen (Des Moines Water Works). The DNR thanks these gentlemen for their time and efforts in coordinating this task force. The task force members were:

1. Marty Adkins, Natural Resources Conservation Service
2. Chris Bair, Trees Forever
3. Roy Bardole, Iowa Soybean Association
4. Sue Behrns, Iowa Waste Reduction Center
5. Dean Berchenbriter, Iowa Rural Water Association
6. Dave Bierl, U.S. Army Corps of Engineers
7. Don Brazelton, Iowa Association of County Conservationists
8. Joel Brinkmeyer, Iowa Cattlemen's Association
9. LeRoy Brown, Natural Resources Conservation Service
10. Dan Bruene, Conservation Districts of Iowa
11. Michael Burkart, USDA-Agricultural Research Service, Soil Tilth Laboratory
12. Ken Choquette, Iowa DNR of Health
13. Lyle Cowles, U.S. Environmental Protection Agency
14. Del Christensen, Trees Forever
15. Mark Dickey, Iowa Rural Water Association
16. Mark Duben, Consulting Engineers Council of Iowa
17. John Dunn, American Water Works Association
18. Jack Dutra, Agribusiness Association of Iowa
19. Jim Ellerhoff, Pesticides Bureau, IA Dept of Agriculture and Land Stewardship
20. Andrea Fogue, Iowa League of Cities
21. Chris Friedrich, Iowa Water Well Association
22. James Gray, Aventis CropScience
23. Jim Gulliford, Soil Conservation Service, IA Dept of Agriculture and Land Stewardship
24. J.L. Hatfield, USDA-Agricultural Research Service, Soil Tilth Laboratory
25. Robert Haug, Iowa Association of Municipal Utilities
26. Susan Heathcote, Iowa Environmental Council
27. Gayl Hopkins, Iowa Corn Growers Association
28. Steve Kalkhoff, United States Geological Survey
29. Dennis Keeney, Leopold Center for Sustainable Agriculture
30. Rick Kelley, University of Iowa Hygienic Laboratory
31. Anne Kimber, Iowa Association of Municipal Utilities
32. Linda Kinman, Iowa Association of Water Agencies
33. Bill Kinney, Iowa Water Pollution Control Association
34. Chad Kleppe, Iowa Soybean Association
35. Bill Koellner, U.S. Army Corps of Engineers
36. Lisa Lemke, Iowa DNR of Health
37. L.D. McMullen, Des Moines Water Works
38. Rob Middlemis-Brown, United States Geological Survey
39. Don Miller, U.S. Environmental Protection Agency
40. Gerald Miller, Iowa State University
41. Robert Mulqueen, Iowa State Association of Counties
42. Peggy Murdock, Sierra Club, Iowa Chapter
43. Tom Neumann, American Water Works Association
44. Molly Arp Newell, Iowa Groundwater Association
45. Don Pauken, Iowa Association of Business and Industry
46. Darlene Peta, League of Women Voters
47. Ted Peyseur, Iowa Water Pollution Control Association
48. Richard Porter, Iowa Corn Growers Association
49. Justin Rewerts, Iowa Water Well Association
50. Dave Riley, Center for Health Effects of Environmental Contamination
51. Rick Robinson, Iowa Farm Bureau
52. Tom Rodd, Izaak Walton League of Iowa
53. Jim Rost, Iowa DNR of Transportation
54. Maryann Ryan, Iowa Water Pollution Control Association
55. Jeannette Schafter, U.S. Environmental Protection Agency

56. Jeff Schnell, Iowa Pork Producers
57. Sherry Timmons, Iowa DNR of Economic Development
58. Kevin Vinchattle, Iowa Poultry Association
59. Mary Weaver, Iowa DNR of Health
60. Peter Weyer, Center for Health Effects of Environmental Contamination
61. John Whitaker, Iowa's Farmers Union
62. Wendy Wintersteen, Iowa State University - Extension Office
63. Roger Wolf, Raccoon River Watershed Project

Technical Advisory Committee

This group of water resource professionals met monthly from July (1999) through January (2000). They provided the DNR with information about priorities, but also suggested methods for monitoring. In addition, they provided contacts with many of the existing monitoring programs in Iowa.

1. Michael Burkart, USDA-Agricultural Research Service, Soil Tilth Laboratory
2. Lyle Cowles, U.S. Environmental Protection Agency
3. John Downing, Iowa State University
4. Vince Dwyer, Des Moines Water Works
5. Bernie Hoyer, Iowa DNR of Natural Resources
6. John Glenn, Rathbun Rural Water Association
7. Steve Kalkhoff, U.S. Geological Survey
8. Dennis Keeney, Leopold Center for Sustainable Agriculture
9. Rick Kelley, University Hygienic Laboratory
10. Dean Lemke, Iowa DNR of Agriculture, Division of Soil Conservation
11. Roger Link, Natural Resources and Conservation Service
12. Kurt Pontasch, University of Northern Iowa
13. Pete Weyer, Center for Health Effects of Environmental Contamination

DNR Planning Committee

In addition to the advice obtained from outside groups, many individuals within DNR provided valuable ideas and insights. These people include: Don Bonneau, Jim Brown, Keith Dohrmann, Bernie Hoyer, Rich Leopold, Bob Libra, John Olson, Jack Riessen, Bob Rowden, John Schmidt, Lynette Seigley, Mary Skopec, Arnie Sohn, Michele Wilson, Tom Wilton, and Joe Zerfas.

II. Plan Recommendations

Mission

Conduct an ongoing assessment of the condition of Iowa's surface water and groundwater resources and report the results to the public so that appropriate information is available to guide resource management policies and decisions.

Goals

1. Define the condition of Iowa's water resources.

2. Characterize existing and emerging problems by type, magnitude, and geographic extent.

3. Provide information for designing and implementing abatement, control, and management programs.

4. Measure changes and identify trends in water resource quality.

5. Provide information to evaluate program effectiveness.

6. Report information in useful formats to inform Iowa's citizens about their water resources.

7. Involve Iowa citizens in monitoring to increase their appreciation and understanding of their water resources.

Principles

1. Water resources are a complex and interrelated system. Monitoring should be a comprehensive activity directed at all water resource types and designed to enhance understanding of each resource. This includes inland natural rivers and streams, channeled streams and ditches, border rivers, natural and artificial lakes, natural and artificial wetlands, water tables, tile water, alluvial and bedrock aquifers, and even the water that falls as rainwater. Monitoring must be designed to reflect diverse uses, including drinking water, recreation, industrial-municipal processing and support of aquatic life.

2. The monitoring system must be based on science, but guided by common sense. The monitoring design must recognize the realities of how our hydrologic systems work. Science is required so that the results can be generalized and applied to locations where direct monitoring results are absent. Science requires data to be shared, made public, and interpreted fairly without bias. People must have confidence in the results. Common sense requires the program to be responsive to a variety of needs and to be fiscally responsible. Common sense dictates that the monitoring program must cooperate with other programs in data collection activities and through the sharing of results. These processes should avoid needless duplication and generally improve the design of all monitoring.

3. All of Iowa's waters are important. Monitoring should be directed throughout the state to attempt to characterize the water conditions throughout the entire state.

4. Ambient water quality is the primary condition that this monitoring program should assess.

5. The characterization of safe and healthy water resources is equally as important as the characterization of contaminated resources.

6. The monitoring network should be used to determine changes in water quality and trends, as well as to identify existing and emerging issues.

7. The data included in the monitoring network should include as much information as possible from other organizations that are currently collecting and analyzing samples. The monitoring program needs to cooperate with existing monitoring programs; coordinate data collection and data management.

8. The monitoring program must be sustainable and continue uninterrupted to maximize its long-term utility and meet its goals.

9. The program must be flexible. It must adapt as we learn from the monitoring experience, and conduct monitoring more efficiently, effectively, and economically. It must adjust to changing identified needs, adjust to new techniques, and adjust to new products.

10. Monitoring is a component of a larger water resources program that should include broad goals, research, education, problem assessment, pollution prevention, regulation, cleanup and local watershed activities.

11. Under this program at this time, the following should be considered when setting priorities and allocating financial and human resources for monitoring. None were identified as low priority.

Very High Priority
Interior Rivers

High Priority
Groundwater including aquifers and water tables
Follow-up and Verification
Biological Monitoring
Lakes Small Streams
Border Rivers

Moderate Priority
Identifying and Evaluating Impaired Waters
Targeted Sources
National Pollutant Discharge Elimination System (NPDES) Assessments
Baseline Biological Inventories
Fish Tissue Analysis
Unique Chemicals and New Issues
Citizen Monitoring
Beaches
Wetlands
Rainwater

12. Data collection is the primary purpose of a water-quality monitoring network. However, collection of data must be accompanied with other essential program elements. None of the following were identified as low priorities. The priorities of program elements:

Very High Priority
Data Collection
Data Management
Coordination of Efforts and Data

High Priority
Access to Data
Interpretation of Data
Public Information
Verification and Follow-Up of Potential Problems

Moderate Priority
Citizen Monitoring

III. Data Collection Designs

Ambient Conditions of Interior Streams

The objective is to develop a monitoring network that can describe and measure water quality geographically throughout all of Iowa and can identify possible differences among watersheds and among ecoregions. In addition, the network should be capable of documenting total loading of nutrients and synthetic organic compounds from Iowa to the Mississippi-Missouri River system. To do this, the network should represent water quality from all Iowa river basins and allow for regional representation of water quality. In addition, water quality must be measured from a variety of basin sizes, each representative of different ecoregions.

Chemical Monitoring

Eight digit hydrologic unit code basins (HUC 8 basins) would be used to isolate Iowa's interior streams into unique regions. These would be used as accounting units for describing water quality among unique regions. Smaller basins (HUC 11 and 14 basins) would also be used to describe water quality and ascertain stream characteristics and differences among streams from different ecoregions. Figure 1 [missing] illustrates the HUC basin concept for Iowa. Figure 2 [missing] illustrates the ecoregions for the state.

1. Monitor 20 sites along interior streams near their junction with the Mississippi or Missouri rivers or near where they exit to the State of Missouri. These sites would measure most Iowa runoff, including runoff from our largest basins, such as the Des Moines, Iowa, and Cedar rivers, and also the HUC 8 basins that discharge directly to the Mississippi and Missouri rivers. Ideally, sampling would be driven by flow characteristics through the year, but monthly monitoring is adequate for the larger river basin monitoring sites. Analytes measured should include all common parameters and common herbicides (Appendix A) monthly, and other priority pollutants (SC3 and 4, Appendix A) during spring and fall.

2. An additional 40 sites from Iowa watersheds would be selected for monitoring. These would include HUC 8 basins and other groups of HUC 11 basins, especially where those were previously monitored by DNR. Sites would be selected primarily to establish a uniform geographic coverage of Iowa's landscape. Common water quality parameters and common pesticides would be monitored routinely throughout the year, about 12 to 24 times, and all priority pollutants would be measured in the spring and fall. Existing monitoring sites could meet many of the needed sampling locations. Some sites might require establishment of a new stream gage.

3. A complete chemical monitoring record should be developed for at least one HUC 11 and one HUC 14 basin from each of the seven ecoregions. This represents a minimum of 14 smaller watersheds that should be monitored. It is critical to develop a long-term record of chemical variability at smaller watershed sizes. It is in these smaller watersheds that the impacts of preventive and cleanup activities may be most effectively measured and assessed, and it is these sized basins that local watershed groups will most likely be working. Larger basins are established to efficiently look at the aggregate impacts of land management and ecoregion characteristics on water quality; smaller basins provide the opportunity to look at hydrologic processes in relation to land management and ecoregion characteristics. HUC 17 basins are even better places to assess processes and the impact of land management and ecoregions characteristics, but this is not proposed for this monitoring effort at this time. It is expected that 24 - 52 samples on an annual basis would be required to assess each of these smaller basins. Sampling would be based on variable stream flow characteristics. Each site would be monitored for common parameters each time and immune-assay techniques should be employed routinely for selected common herbicides. All sites would be measured for common herbicides during

spring and fall samplings, and all priority pollutants should be measured occasionally during runoff events.

4. Suspended sediment stations should be established in each ecoregion at three basin sizes: HUC 8, 11, and 14. Sediment is a major contaminant of Iowa streams. We must establish a baseline understanding of this crucial contaminant at all stream scales. This would entail establishing 21 sediment sites.

5. Urban nodes along the course of our largest rivers would further partition the state's interior into definable subbasins for water quality. Upstream and downstream sampling should be a mode of sampling these urban sites. Sampling of 15 cities (30 sites) would add significant understanding about the contribution of urban sources to our total loading of streams. Monitoring might be monthly at these sites, but sampling designed to assess variability should be emphasized as a part of this monitoring. Monitoring of these urban sites should include metals as well as nutrients and priority pollutants.

6. Over a five-year period, fish flesh analysis should be conducted in association with HUC 8 and urban sites to obtain a relatively uniform measure of fish flesh conditions. Sampling would occur once at each site. Analysis should be from three species commonly eaten, for example, a game fish, pan fish, and catfish.

Table 3. Summary of Proposed River and Stream Monitoring

Sampling Sites	Frequency; Parameters	Cost Estimates
Chemical/Physical Monitoring		
20 HUC 8 units at junction w/ Mississippi or Missouri rivers	Monthly (12-24 times) common parameters, common herbicides spring and fall, priority pollutants	$124,000 - $254,000 annually
40 HUC 8 or combined HUC 11 units	Monthly (12-24 times) common parameters, common herbicides spring and fall priority pollutants selected runoff events, priority pollutants	$268,000 - $508,000 annually
Border Rivers Upstream, Downstream	Monthly (Apr–Oct; winter) common parameters, common pesticides	$16,000 annually
Border rivers, Big Sioux	Monthly (12-24 times) common parameters, common herbicides spring and fall, priority pollutants	$13,000 annually
HUC 11 & HUC 14 watersheds in each of 7 ecoregions; 14 watersheds (minimum)	Weekly (26-52 times) common parameters, common herbicides	$182,000 - $364,000 annually
HUC 8, HUC 11, HUC 14 watersheds in 7 ecoregions; 21 Total	Daily suspended sediment	$315,000 annually

Urban Sites: 15 cities upstream and downstream; 30 sites	Monthly common parameters, common herbicides, priority pollutants Quarterly: metals	$306,000 annually
Fish flesh at HUC 8 and urban sites (up to 90 sites)	One time in 5 years Angler-targeted fish species	$15,000 annually
Biological Monitoring		
Probabilistic Survey: 30 sites, random selection, each ecoregion	One time (may be repeated in 7 years on rotational basis): Macroinvertebrates, streambank assessment, fish, common parameters	$116,000 annually
Fixed Biological Sites: 30 statewide	Annually Macroinvertebrates, streambank assessment, fish, common parameters	$116,000 annually
Rapid Biological Assessments of 400 HUC 11 basins; 80 per year	Annually Rapid Biological Assessments	$24,000 annually
Reference Sites; 30 per year out of 100 sites	Annually Macroinvertebrates, streambank assessment, fish, common parameters	$116,000 annually
Detailed Biological Assessments of 400 HUC 11 basins; 40/year	Not recommended until Rapid Biological Assessments completed	
Baseline - Mollusks, Amphibians	One-time Sponsored Inventories	$50,000 annually
Stream Gaging		
Currently 16 Stations; (Potential for 16 Additional Stations)	Continuous Stream Discharge	$88,000 annually (possible added $88,000 annually; (state general fund; USGS match); one-time construction costs: $240,000)
New Methods		
Strip Technology		$25,000 initially
Developmental Studies	Various focused studies	$100,000 annually
Public Assurance	Various exotic analyses	$100,000 annually

Verification Monitoring		
Follow-Up Monitoring	Various monitoring	$50,000 annually
Targeted Monitoring		
Three HUC 14 Basins (Urban, CAFO, Manure)	Discharge based sampling (52/year) common parameters, priority pollutants	$133,000 Aanually
Wastewater Assessments (30 sites, up/downstream)	One-time biological assessment	$210,000 annually
Impaired Waters	One-time biological assessment	$116,000
Total Stream Monitoring		**$2,565,000-$3,119,000 Annually**

Biological Monitoring

1. Probabilistic Survey: Biological monitoring, including complete site characterization, macroinvertebrate community inventories, and fish species inventories, should be conducted on 30 randomly selected stream segments in each ecoregion. This will provide a totally unbiased assessment of the aquatic environment. Chemical characterization should be conducted in conjunction with the biological survey. Sampling should be conducted region by region over a seven-year period.

2. Fixed biological sites: Thirty sites from around the state should be visited annually to assess changes in conditions overall throughout Iowa's aquatic environment. Such assessments should help establish variability and may identify early trends.

3. HUC 11 sites: Each HUC 11 basin (approximately 420 total) should be visited by a rapid assessment biological team over a five-year period. Rapid aquatic biological assessment identifies macroinvertebrates to the family level, only. Identifications and quantification is conducted mainly in the field, thus reducing costs and speeding up results. These would provide a needed census-type assessment of stream conditions throughout Iowa and provide a global picture of stream conditions that might alert us to special problems that should be investigated.

4. Reference sites: Currently there are about 100 reference sites for biological assessments scattered throughout Iowa. More may become established through time. Thirty sites should be revisited annually on a rotational basis in an attempt to calibrate biological conditions, year to year, and to assess change through time.

5. Consideration should be given to conducting detailed biological assessments at HUC 11 watersheds on a rotational basis. Visits to 40 watersheds per year would result in complete coverage over a ten-year period.

6. Conduct or sponsor baseline inventories and surveys of mollusks and amphibians. These should be conducted by ecoregions in association with rotational sampling.

Stream Gaging

The U.S. Geological Survey operates a network of 130 gaging stations on streams throughout the state. For years, DNR has cooperated in this network, and currently provides state matching funds for 16 stream gages. These gages are the backbone of any water quality monitoring system. Beginning in FY2001, DNR funds for these gages will be a part of the water monitoring budget. Support for this gaging network is expected to continue for at least this number of gages. Stream gaging stations should be located at each fixed monitoring site. If the monitoring design requires additional gages, the financial resources for gaging will have to increase. There may be a few required at HUC 8 sites, but most would be required at the HUC 11 or HUC 14 sites. It is estimated that a maximum of 16 new gages would be required if sites selected include ones currently being used for some project areas.

Developmental Program

Research is clearly not the focus of this monitoring program. However, it is impossible to conduct such a program without recognizing what we don't know and how vital some limited research is to make scientific interpretations and/or improve our monitoring design. Furthermore, our monitoring program must adjust to changes in chemical usage, processing technologies, scientific discoveries elsewhere, or simply adapting new available technologies. Following are a few of the types of developmental research our monitoring program must include.

1. **New Technology.** Strip technology is being used widely to measure various chemical parameters, especially in medicine. It is employed to measure specific parameters quickly without the use of laboratory analysis. It has not been widely employed for environmental studies, although it is available for such parameters as nitrate and phosphorus, and could become available for many more parameters. Side-by-side comparisons between strip technology employed in the field and conventional laboratory analysis should be conducted to assess the accuracy of the technology under field conditions. The technology holds promise for cost containment and for citizen monitoring efforts.

2. **Follow-Up Monitoring.** All monitoring discovers both the expected and the unexpected results. Unexpected contaminants might be found, high contaminant levels might be found, or unusually low contaminant levels might be found. Some subsequent sampling for verification must follow some unexpected results, along with some investigation to determine what factors might have caused the results. Is there a special contaminant source or land-use factor? Is there a special sampling problem? Might there be a laboratory problem? Most follow-up sampling would be conducted as a part of scheduled, routine sampling. However, it is quite possible that special monitoring would be necessary in addition to routine follow-up sampling if contaminants are found that are of a very high level. These may be directed toward finding sources of contaminants or verifying the existence of specific contaminants. These should not be confused with the extensive monitoring that should be done specifically to develop Total Maximum Daily Loads (TMDLs) or similar regulatory functions. Monitoring for the TMDL program is anticipated to be a part of DNR's TMDL program.

3. **Public Assurance and Early Warning Program.** Testing for non-standard analytes should be a part of the monitoring program. Analytes might include pesticide metabolites, new pesticides, hormones, pharmaceuticals, pathogens, and tracers such as caffeine. We must keep up with new technologies and we must remain vigilant in order to function both as a public reassurance program and as an early warning program. Both special targeted sampling sites and ambient sites might be utilized as part of these assessments. Cooperation with appropriate parties both for sampling and analysis would be a necessary part of this program.

4. **Developmental Studies.** There is a definite need to conduct special monitoring studies to evaluate techniques and improve our data collection procedures or to develop an improved understanding so that we might better interpret results. These might include conducting activities such as special short-term assessments of variability, comparisons of analytical techniques or sampling techniques, or developing relationships between biological and chemical monitoring results. Assessments of variability are especially important as we are implementing an improved monitoring program. For example, we wish to assess variability of priority pollutants at one or more sites through the spring runoff season or throughout the year. Such information is simply not readily available, but it is necessary to interpret the information we are now obtaining from limited sampling.

Targeted Monitoring of Interior Streams

1. Assessments of specific environments should be a part of this program. Specifically, we should establish detailed monitoring of HUC 14 watersheds associated with urban source, animal and wildlife, and concentrated confined animal feeding operation (CAFO) source environments. Documentation of these sources in Iowa is essential for understanding overall water quality. Such monitoring can be conducted in conjunction with other institutions that are working to understand these environments and the impacts they have on our overall water quality.

2. Biological assessments of streams should be conducted before facilities with existing wastewater permits are reauthorized. Thirty randomly selected facilities should be assessed both upstream and downstream using biological techniques to evaluate the impacts these facilities have on our aquatic environment. Such assessments could reassure the public or result in recommendations for further improvements in the existing facilities.

3. Sites identified on the potentially impaired water list (303(d)) should have biological monitoring techniques employed on them as a preliminary step to evaluation and development of a cleanup plan. As a start, thirty sites per year should be evaluated using macroinvertebrate biological techniques, combined with a chemical water quality analysis.

Ambient Conditions of Border Streams

Rather minimal monitoring is recommended at this time for our border rivers in spite of the importance of these resources to Iowa. Monitoring that is proposed should be coordinated with monitoring conducted by adjacent states and federal agencies. Iowa's influence on these rivers is real, but water quality in these rivers is a function of other states, too. It is recommended that Iowa actively encourage federal agencies, especially the Corps of Engineers, U.S. Geological Survey, U.S. Fish and Wildlife Service, and the U.S. Environmental Protection Agency to increase their monitoring activities. Monitoring the Mississippi and Missouri rivers is a challenging task, and it should be an interstate or federal task.

1. Upstream sites: Sites are proposed for monitoring near New Albin on the Mississippi River and near Sioux City on the Missouri River. Monthly samples (April-October) for the common parameters and for the common herbicides should be obtained, along with a winter sample. These sites should describe the basic quality of water coming to Iowa on these two rivers.

2. Downstream sites: Sites are proposed for monitoring near Keokuk on the Mississippi River and near Hamburg on the Missouri River. Monthly samples (April-October) for the common parameters and for the common herbicides should be obtained, along with a winter sample. These sites should describe the basic, aggregate quality of water leaving Iowa on these two rivers.

3. Big Sioux: A single site along the Big Sioux River should be established to define ambient conditions of this river where it borders South Dakota. Common water quality parameters and common pesticides would be monitored routinely throughout the year, about 12-24 times, and all priority pollutants would be measured in the spring and fall. Existing monitoring sites could meet many of the needed sampling locations.

4. Cooperation with adjacent states should be developed to enhance the quality of these border records and/or to offset some of the costs.

Ambient Conditions of Groundwater

The objective is to develop a monitoring network that describes and measures water quality throughout Iowa and characterizes aquifers in different hydrogeological environments.

Public Water Well Monitoring

Public drinking water wells should be sampled annually and should include 45 alluvial or drift groundwater aquifers, 30 shallow bedrock aquifer environments, and 30 protected bedrock aquifers wells. Wells will be selected from among all those available throughout the state. As each well is sampled initially, water from each will be age-dated to assess the well's vulnerability to contamination. Mineral analyses, common water quality parameters, and all priority pollutants should be measured from the single sample. Wells with old dates may not be sampled for priority pollutants.

Dedicated Monitoring Wells (Quality and Water Levels)

1. Dedicated monitoring wells should be developed throughout the state. The target is to develop 60 well-nest sites, or about 180 monitoring wells. These will be developed in all aquifer systems in the regions where commonly utilized. Each nest will be developed at different depths to tap specific aquifers used in the region. In most cases, this will include one or more bedrock sources, but it will also include drift, alluvial, or buried alluvial sources. Annually, five well-nest sites will be developed through contracts with drilling companies. Water will be dated from each well. Annually, each well will have the mineral content analyzed and common parameters assessed. Thereafter, analyses will be based on water age dates: young water will receive the full priority pollutant scan; old waters will be tested for the common parameters only, or not at all. Water levels will be assessed quarterly in each well. Sites will be developed on public lands: parks, right of ways, etc. The initial sites will be developed near larger urban areas that use large amounts of groundwater. The drilling of these wells will develop important information that will go toward overall management of groundwater. Pump tests will assess aquifer properties. These may aid in the development of important groundwater supplies. A continuous rock core will be obtained from each site as a part of a lithologic and stratigraphic reference collection. Similarly, this data will enhance our information about the distribution and variability of rock units throughout the state.

2. Monitor 30 existing alluvial wells for common parameters and priority pollutants annually. These wells include sites drilled previously by the Geological Survey Bureau or the U.S. Geological Survey.

Water Levels, Water Tables

1. Annually, monitor 200 wells quarterly for water levels. Through time, this municipal well network may be reduced because of the dedicated monitoring wells that will be available for measurement.

2. Monitor 50 water table soil wells for water table fluctuations. This would be conducted cooperatively with the Iowa Cooperative Soil Survey (ISU, NRCS, IDALS) and would include soil transects throughout Iowa. Sites would be monitored for about 15 years to determine water table levels for each soil. This should make the detailed county soil surveys much more valuable for purposes of understanding water tables.

Rural Well Water Survey

The relationship between groundwater and well water is always the subject of some debate. This is especially true when well water is obtained from a domestic well source. Regardless, it is clear that private well water is closely related to groundwater. A survey of rural drinking water should be conducted about once each decade because it can provide valuable information about trends in private drinking water quality. These are certainly closely linked to groundwater quality.

1. A private water well survey should be weighted for population so that the work is more applicable to public health studies. The original Statewide Rural Well-Water Survey (SWRL; Kross et al., 1990) design might also be modified to relate to Iowa's Groundwater Vulnerability Map, too (Hoyer and Hallberg, 1991). Data might be collected through our county sanitarians and through DNR's Grants-to-Counties Program.

2. This is the only area where direct information about sites should not be clear and explicit. Locations are very important to data analysis, but locations, names, etc., should not be made directly public along with water quality results. Other health-related surveys might be conducted together with this inventory, and we would not want to jeopardize any confidential health information.

3. Monitoring should include common parameters and common herbicides. Full priority pollutant scans should be conducted on subsets of each stratum.

Table 4. Summary of Proposed Ambient Groundwater Monitoring

Sampling Sites	Frequency; Parameters	Cost Estimates
Public water wells; raw water from 105 public water supply wells	Annual; common parameters Metals, Priority Pollutants One-Time Age Dating of Water	$100,000 annually (state general fund; matched by USGS)
Dedicated monitoring wells Construct 60 well nests (5/year) for a total of 240 wells into different alluvial, drift, and bedrock aquifers	Annual; common parameters Metals, priority pollutants one-time age dating of water Quarterly water levels	$20,000-$160,000 annually; $175,000 annual construction costs for ten years.
Alluvial wells, 30 existing dedicated wells	Annual; common parameters Metals, priority pollutants one-time age dating of water	$30,000 Annually
Private drinking water survey Approx. 500 private water wells	One-time; common parameters, priority pollutants, age dating of water	$150,000

Aquifer water levels; Measure water levels in 200 wells	Quarterly Measure water levels	$40,000 annually (state general fund; matched by USGS)
Soil water tables Monitor water tables in selected, key soils.	Monthly Measure water table levels	$50,000 (in cooperation with IDALS and NRCS)
Total groundwater monitoring		**$565,000-$705,000 annually**

Ambient Conditions of Lakes

Lakes are highly valuable water resources for which significant water quality information is generally lacking. The following recommended steps are designed to enhance the development of useful data.

1. Reproduce the broad comparative studies of lakes throughout Iowa that were done in the 1980s and 1990s (Bachmann et al., 1980; Bachmann et al., 1994). Collect comparable water quality data from a single location three times through the year at about 100 lakes. This should provide a rather broad review of the status of Iowa lakes that is comparable to previous data and can be used to assess change.

2. Monitor 30 Priority Public Lakes in detail for five years. Lakes will be chosen from each eco-region and will include both natural and artificial lakes. Monitoring would occur on six dates (ice-free season) from about six different locations representing the different major environments (e.g., arms, bays) on each lake. Common water quality parameters and common herbicides should be collected with all samples. Priority pollutants (SC3 & 4) should be assessed in the spring and fall annually from a single site per lake. Monitoring should include collection and description of phytoplankton and algae, and information on water clarity (secchi depth). Fish tissue analyses from three commonly consumed species (game fish, pan fish, and catfish) should also be obtained once during the five-year data collection period. After five years, another 30 lakes shall be monitored. After a few cycles, some priority lakes should be revisited as a part of the next cycle of 30 lakes.

3. Five lakes shall be selected for continuous monitoring as outlined above to enable further assessment of variability and as a potential measure of change.

Table 5. Summary of Proposed Lake, Wetland, Beach, Rainwater and Citizen Monitoring

Sampling Sites	Frequency; Parameters	Cost Estimates
Lake survey (after Bachmann); 100+ lakes statewide	One sample point, three times through the year; Common parameters Metals, secchi depth, common pesticides, algae, plankton	$175,000 (one-time cost)
New lake surveys; 30 lakes for five years; six locations/ lake	Six times; Common parameters, metals, secchi depth, common pesticides, algae, plankton; spring, fall (one location/lake), priority pollutants	$560,000

Wetlands	Develop recommendations	$50,000
State beaches	Weekly: E. coli Daily: E. coli at five beaches (June)	$50,000
Rainwater	Four targeted Sites; after rainfall, nutrients, metals, priority pollutants	$50,000
Citizen monitoring support		$150,000
Total lake, wetland, beach, rainwater and citizen monitoring		**$860,000 annually**

Ambient Conditions of Wetlands

1. No monitoring is proposed at this time.

2. DNR should solicit proposals to develop and propose reasonable goals for evaluating wetlands. Following this development, criteria for monitoring wetlands could be proposed and implemented.

Ambient Conditions of State Beaches

1. Monitor E. coli bacteria at five beaches daily in the morning and evening for the period of Memorial Day weekend through the Fourth of July weekend. This should allow a preliminary assessment of variability at Iowa beaches.

2. Monitor all state beaches weekly through the swimming season for E. coli bacteria. Again, this will allow a synoptic look at variability throughout the state.

Rainwater

1. Investigate the record from two existing sites to determine the nature of the record.

2. Select four additional sites. Locate these in conjunction with extant DNR air quality sites, if possible. Select sites in conjunction with a coal-fired power plant, an urban area, an area of concentrated livestock, and a typical rural, agricultural area. Sites might be monitored for nutrients, metals, and priority pollutants when rainfall occurs.

IV. Data Management

The objective of data management is to efficiently move data obtained directly through this monitoring program into usable electronic forms so that both professionals and the public may readily access them. It is desirable that all data be located in one place, but that certainly will not initially occur as our monitoring program is expanded. All data from this program will be placed into a common database that will be readily accessible by professionals and the public.

1. Use STORET, U.S. EPA's national water quality database, as the database. Initially place all data from the fixed sites into STORET. Allow data obtained by contractors to reside wherever it is easiest for the contractor to store the data. Migrate that data to STORET through time.

2. Establish a database for the biological data and develop a common method of reporting biological data.

3. Attempt to migrate 'legacy STORET' data and other data sets to STORET as resources permit.

4. Make data accessible via the World Wide Web. Establish routine summary reporting routines for the Web. Display requested data in context using plotted historic data and/or summarized data from the entire, comparable data set. Use GIS technology to display locations and display summarized data.

5. Citizen data will likely be in a separate database because of rigorous data requirements imposed by STORET.

6. Make citizen monitoring data available with GIS interface in conjunction with a summary of all data or historic data from selected sites.

7. Develop citizen data so that anyone can view, but only citizens with passwords can enter data. Citizens with appropriate certification and appropriately defined projects will be able to enter data. Participants in DNR's Adopt-A-Program (Adopt-A-Stream, -Lake, -Wetland, -Trail, -Park) will be allowed to enter data.

Data Coordination

Data coordination has been identified as a special area of concern by the Water Monitoring Advisory Task Force. DNR proposes the following efforts:

Annual Data Conference. An annual water monitoring conference will be held to review monitoring programs and results. This will provide an opportunity to summarize and review current monitoring results. Perhaps of more value, it will provide an opportunity to discuss what the monitoring might mean, including discussions of trends and geographic differences. It will offer the opportunity to discuss new methods and special needs that stakeholder groups and interested people may identify. The conference will be designed to be informative and allow opportunities for interaction. Monitoring must not be conducted in a vacuum. It will provide a public review of the program, a forum for getting new ideas into the program, and a discussion of emerging issues.

Water Monitoring Advisory Panel. A technical advisory panel will be assembled to review the DNR program, help coordinate it with other monitoring programs, and provide guidance that will keep it active and vital. The DNR benefits by having outside review and guidance. The panel of about 11 members should consist of representatives from academia, government, and special interest groups that are actively involved in monitoring and managing water resources. The panel is expected to meet several times each year.

Comprehensive Review of Monitoring Programs. DNR's monitoring program does not take place in a vacuum. Many organizations are involved to one extent or another in aspects of monitoring. This myriad of unconnected or loosely connected programs constitutes a significant challenge to a comprehensive monitoring program. One of the first tasks facing our Water Monitoring Program will be the development of a practical compilation of monitoring data and data sources. Although these data sources may not constitute a system, it is important to incorporate these pieces into a whole, and to use the information already acquired to guide future monitoring procedures. Information summarized will include: who collects data, where the information is collected, what water quality information is collected, how long was the data collected, and how data is managed. A similar activity is being advocated as a part of the

Healthy Iowa 2010 program. There are many groups out there conducting some monitoring; the data are too valuable to ignore.

Improved Availability of Data

Data which are either not in computer form or are not readily available through a computer system will be evaluated. Some of the most valuable data that is currently in paper form may be digitized and entered in databases. Other data that are in digital form, but are not readily available, may be converted to databases that will make them more readily available to DNR staff and others.

Cooperative Efforts

Where areas of data collection overlap among programs, the state monitoring program should make an effort to work through other programs in a cooperative manner. This would eliminate redundant data collection efforts and lead to better data integration and cooperation among public groups.

Data Interpretation

1. Water quality assessments, known as 305(b) reports, should continue as required by EPA. Similarly, DNR will continue to develop the impaired waters list (303(d)) from our improved monitoring data in conjunction with EPA.

2. Annual summaries of data collected through this program should be assembled. These should describe the results obtained as part of technical documents.

3. Special publications should be directed to investigate special topics. These would include publications directed at subjects such as describing water quality trends, special geographic areas of concern, detection rates, statewide distribution patterns of nutrients, the occurrence of new or unique contaminants, variability of water quality, or historic changes based on the record.
4. Standard statistical procedures will be employed whenever practical to describe water quality.

5. Describe and summarize existing detailed water monitoring records from sources including the Corps of Engineers and water utilities.

6. Describe and summarize existing DNR monthly monitoring sites dating back to 1985.

7. Develop standard large-river biological monitoring techniques and indices.

8. Biological Index: A numerical biological index needs to be established to standardize the many biological observations and make them comparable. Standard metric techniques should be combined to develop such an index. These need to be assessed in relation to chemical monitoring data to discover possible associations.

9. Computerize and summarize historic lake water quality studies, especially those studies by Bachmann.

Public Information

The World Wide Web will be used extensively by the water monitoring program. Available information should include locations of monitoring sites, direct access to databases, graphing of historic records, and interpretive results. The experimental Des Moines Water Works' EMPACT water quality site is a useful model for displaying our monitoring information.

1. Fact sheets will be developed on important aspects of the monitoring program to describe techniques and results.

2. Public information releases will be made as appropriate to increase public awareness.

Citizen and Local Monitoring

It is important for DNR to support individuals, groups, and various assemblages of local groups to learn about their water resources. This may facilitate the development of effective actions designed to protect and restore resources. Empowerment of local actions is a priority. Clearly, if data are to be available at local watershed levels in communities throughout the state, the data will have to be generated through local efforts, either individually or as integrated cooperative efforts. DNR should encourage local monitoring efforts in as many ways as possible.

DNR should support the IOWATER program, which is designed to assist individuals and groups monitor their local water resources. This should be done by developing materials for physical, chemical, and biological assessments of their surface-water resources. IOWATER should be supported and enhanced to provide citizens and groups an opportunity to receive training. IOWATER can provide important training to private individuals, but also to representatives from groups or groups that are forming for the purposes of protecting watersheds. Efforts should include information about necessary equipment and methods, as well as about system dynamics. Financial assistance should be available for local groups that develop plans to monitor local water resources. Assistance in monitoring design and interpretation should also be part of the program. Efforts should also attempt to encourage volunteer and local group coordination throughout Iowa.

Data from citizen and local efforts has value. It is most important locally, where most decisions are made. However, DNR should attempt to provide a way for citizen and local data efforts to be recorded in databases. These should be available for entry by legitimate citizen efforts, and should be available to the public for evaluation.

Appendix A
Chemical Parameters

COMMON PARAMETERS

temperature	dissolved oxygen
pH	specific conductance at 25 degrees C (µmhos)
ammonia nitrogen	nitrate + nitrite nitrogen
total Kjeldahl nitrogen	carbonaceous biochemical oxygen demand (5-day)
total suspended solids	flow
turbidity	dissolved orthophosphate (as P)
total phosphate (as P)	hardness as $CaCO_3$
total dissolved solids	silica
fecal coliform	chlorophyll
enterococci	Escherichia coli

METALS

total antimony	total copper	total selenium
total arsenic	total cyanide	total silver
total beryllium	total lead	total thallium
total cadmium	total mercury	total zinc
total chromium	total nickel	

PRIORITY POLLUTANTS

atrazine	cyanazine (Bladex)	metolachlor (Dual)
alachlor (Lasso)	metribuzin (Sencor)	trifluralin (Treflan)
butylate (Sutan)	desethyl atrazine	desisopropyl atrazine
acetochlor	simazine	carbofuran (Furadan)
terbufos (Counter)	fonofos (Dyfonate)	chlorpyrifos (Lorsban, Dursban)
ethoprop (Mocap)	delta-BHC	alpha-BHC
beta-BHC	aldrin	gamma-BHC (Lindane)
heptachlor	dieldrin	heptachlor epoxide
endosulfan I	endosulfan II	4,4'-DDE
endrin	4,4'-DDT	4,4'-DDD
endosulfan sulfate	chlordane	endrin aldehyde
methoxychlor	aroclor-1221	toxaphene
aroclor-1016	aroclor-1248	aroclor-1234
aroclor-1242	2,4,5-TP (Silvex)	aroclor-1254
aroclor-1260	bentazon (Basagran)	picloram (Tordon)
2,4-D	dicamba (Banvel)	

VOLATILE ORGANICS: Acid Fraction Analytes

phenol	2-chlorophenol	2-methylphenol (o-cresol)
4-methylphenol (p-cresol)	2-nitrophenol	2,4-dimethylphenol (xylenol)
2,4-dichlorophenol	2,4,5-trichlorophenol	2,4-dinitrophenol
2,4,6-trichlorophenol	4,6-dinitro-2-methylphenol	pentachlorophenol
4-nitrophenol	4-chloro-3-methylphenol (p-chloro-m-cresol)	

VOLATILE ORGANICS: Base/Neutral Fraction Analytes

bis(2-chloroethyl)ether	1,3-dichlorobenzene	1,4-dichlorobenzene
1,2-dichlorobenzene	2,2'-oxybis(1-chloropropane)	n-nitroso-di-n-propylamine
hexachloroethane	Nitrobenzene	isophorone
bis(2-chloroethoxy)methane	1,2,4-trichlorobenzene	naphthalene
4-chloroaniline	hexachlorobutadiene	2-methylnapthalene
hexachlorocyclopentadiene	2-chloronapthalene	2-nitroaniline
dimethyl phthalate	acenaphthylene	3-nitroaniline
acenaphthene	Dibenzofuran	2,4-dinitrotoluene
2,6-dinitrotoluene	diethyl phthalate	4-chlorophenyl phenyl ether
fluorene	4-nitroaniline	n-nitrosodiphenylamine
4-bromophenyl phenyl ether	hexachlorobenzene	phenanthrene
anthracene	Carbazole	di-n-butyl phthalate
fluoranthene	Pyrene	butyl benzyl phthalate
3,3'-dichlorobenzidine	benzo (a) anthracene	bix(2-ethylhexyl)phthalate
chrysene	di-n-octyl phthalate	benzo (b) fluoranthene
benzo (k) fluoranthene	benzo (a) pyrene	indeno (1,2,3-cd) pyrene
dibenz (a,h) anthracene	benzo (g,h,i) perylene	

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Monitoring Plan Budget Overview — Revision

Monitoring Plan Budget Overview — Revision					Cost	Percent
Data Collection					**$5,344,000**	**81.7%**
Rivers and Streams			$3,614,000	55.3%		
HUC 8, 11, 14 Basins	$1,126,000	17.2%				
Border Rivers	$29,000	0.4%				
Sediment	$630,000	9.6%				
Urban	$306,000	4.7%				
Biological	$437,000	6.7%				
Discharge	$352,000	5.4%				
New Technology	$25,000	0.4%				
Follow-Up & Verification	$50,000	0.8%				
Special & New Analytes	$100,000	1.5%				
Developmental Studies	$100,000	1.5%				
Targeted	$459,000	7.0%				
Lakes			$735,000	11.2%		
Groundwater			$845,000	12.9%		
Public Water Supply Wells	$200,000	3.1%				
Dedicated Monitoring Wells	$335,000	5.1%				
Alluvial Aquifers	$30,000	0.5%				
Private Wells	$150,000	2.3%				
Aquifer Water Levels	$80,000	1.2%				
Soil Water Table Levels	$50,000	0.8%				
Other			$150,000	2.3%		
Beaches	$50,000	0.8%				
Precipitation	$50,000	0.8%				
Wetlands	$50,000	0.8%				
Data Collection Totals	$5,344,000	81.7%	$5,344,000	81.7%		
Data Management					**$250,000**	**3.8%**
Data Coordination					**$100,000**	**1.5%**
Data Interpretation					**$250,000**	**3.8%**
Public Information					**$125,000**	**1.9%**
Citizen Monitoring (10% of State)					**$470,000**	**7.2%**
Education			$235,000	3.6%		
Mini-grants for Citizens/Local Org.			$235,000	3.6%		
Citizen Monitoring Totals			$470,000	7.2%		
TOTAL					**$6,539,000**	**100.0%**
Iowa Share					$4,964,000	75.9%
Federal Share					$1,575,000	24.1%