

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

Reserve
CGB991
.18N6

NORTHEAST IOWA RIVERS BASIN STUDY



U.S. Department of Agriculture

SOIL CONSERVATION SERVICE
FOREST SERVICE

AD-33 Bookplate
(1-68)

NATIONAL

**A
G
R
I
C
U
L
T
U
R
A
L**



LIBRARY

NORTHEAST IOWA RIVERS BASIN STUDY

Iowa and Minnesota

A WATER AND RELATED LAND RESOURCES STUDY
OF THE NORTHEAST IOWA RIVERS BASIN

S. DEPT. OF AGRICULTURE
INTERNAL AGRICULTURE

SEP 1 1987

FALL

Prepared By:

U.S. Department of Agriculture
SOIL CONSERVATION SERVICE
FOREST SERVICE

In Cooperation With:

Northeast Iowa Conservancy District

Iowa Conservation Commission

Iowa Department of Soil Conservation

Iowa Department of Water, Air and Waste Management

Iowa Geological Survey

Des Moines, Iowa

September 1986

DEC 31 1986

NORTHEAST IOWA RIVERS BASIN STUDY

TABLE OF CONTENTS

	Page
PREFACE	1
NEED FOR STUDY	1
AUTHORITY	1
USDA RESPONSIBILITIES	1
SPONSORING AND COOPERATING AGENCY PARTICIPATION	1
SUMMARY	3
PROBLEMS AND CONCERNS	7
SHEET AND RILL EROSION	9
CROPLAND	10
PASTURE	20
FOREST LAND	21
GROUNDWATER CONTAMINATION	22
LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT	31
LOSS OF FOREST LAND	33
LOSS OF AGRICULTURAL LAND	34
POLLUTION OF COLDWATER STREAMS	41
STREAMBANK EROSION	44
ALTERNATIVE PLANS	47
SHEET AND RILL EROSION	47
GROUNDWATER CONTAMINATION	56
LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT	59
LOSS OF FOREST LAND	64
LOSS OF AGRICULTURAL LAND	66
POLLUTION OF COLDWATER STREAMS	68
STREAMBANK EROSION	71
COMPARISON OF ALTERNATIVE PLANS	76

TABLE OF CONTENTS (Continued)

	Page	
IMPLEMENTATION	79	
EXISTING AGENCIES AND PROGRAMS	79	
SOIL CONSERVATION DISTRICTS	79	
NORTHEAST IOWA CONSERVANCY DISTRICT	79	
IOWA DEPARTMENT OF SOIL CONSERVATION	80	
IOWA DEPARTMENT OF WATER, AIR AND WASTE MANAGEMENT	80	
IOWA GEOLOGICAL SURVEY	81	
IOWA CONSERVATION COMMISSION	81	
COUNTY BOARDS OF SUPERVISORS	82	
IOWA CONSERVATION BOARDS	82	
USDA ASCS	82	
USDA SCS	82	
USDA FS	83	
USDA FmHA	83	
ISU COOPERATIVE EXTENSION SERVICE	83	
APPENDIXES	85	
APPENDIX A - RESOURCE BASE	A-1	
LOCATION	A-1	
GEOLOGY	A-1	
CLIMATE	A-4	
LAND RESOURCE AREAS	A-4	
SOILS	A-8	
LAND USE	A-11	
ECONOMIC RESOURCES	A-11	
FOREST RESOURCES	A-12	
WILDLIFE RESOURCES	A-14	
APPENDIX B - SOIL DEPLETION ON REPRESENTATIVE FARMS	B-1	
APPENDIX C - GROUNDWATER CONTAMINATION	C-1	
APPENDIX D - PUBLIC PARTICIPATION AND INFORMATION	D-1	
APPENDIX E - POLLUTION OF COLDWATER STREAMS	E-1	
APPENDIX F - STREAMBANK EROSION	F-1	
APPENDIX G - IOWA GOVERNMENT REORGANIZATION	G-1	
LIST OF TABLES		
<u>NO.</u>	<u>TITLE</u>	
1.	IDENTIFICATION OF PROBLEMS AND CONCERNS	8
2.	LAND USE	9
3.	EROSION OF DEEP CROPLAND SOILS - 2025	11
4.	IMPACT OF EROSION ON DEEP CROPLAND SOILS	12
5.	PROJECTED EROSION PHASE CHANGE OF DEEP CROPLAND SOILS	13
6.	DEPLETING DEEP CROPLAND SOILS - 2025	13

TABLE OF CONTENTS (Continued)

<u>No.</u>	<u>TITLE</u>	<u>Page</u>
7.	DEEP CROPLAND SOILS WITH CHANGING EROSION PHASE	14
8.	EROSION OF SHALLOW CROPLAND SOILS - 2025	15
9.	IMPACT OF EROSION ON SHALLOW CROPLAND SOILS	16
10.	PROJECTED EROSION PHASE CHANGE OF SHALLOW CROPLAND SOILS	16
11.	DEPLETING SHALLOW CROPLAND SOILS	17
12.	SHALLOW CROPLAND SOILS WITH CHANGING EROSION PHASE	18
13.	PASTURE EROSION BY SLOPE GROUP - 1985	20
14.	PASTURE EROSION BY SLOPE GROUP - 2025	21
15.	EROSION ON GRAZED FOREST LAND	22
16.	GROUNDWATER QUALITY HAZARD AREA	23
17.	WILDLIFE HABITAT SUITABILITY INDEXES	32
18.	EFFECT OF CONVERSION ON EROSION	33
19.	FOREST LAND AREA PROJECTIONS	34
20.	HISTORIC AREAL EXPANSION OF CITIES	35
21.	URBAN EXPANSION IN COUNTIES NOT ZONED	36
22.	HIGHEST PRIORITY COLDWATER STREAMS	43
23.	STREAMBANK EROSION DATA	44
24.	STREAMBANK EROSION DAMAGE	45
25.	AREA PROJECTED TO CHANGE EROSION PHASE	49
26.	CROPLAND EROSION SUMMARY AND COMPARISON	51
27.	PASTURE EROSION SUMMARY AND COMPARISON	53
28.	FOREST LAND EROSION SUMMARY AND COMPARISON	55
29.	GROUNDWATER CONTAMINATION SUMMARY AND COMPARISON	58
30.	WILDLIFE HABITAT SUITABILITY INDEXES, RPP	61
31.	WILDLIFE HABITAT SUITABILITY INDEXES, EAP	62
32.	INSTALLATION FUNDS WILDLIFE HABITAT, EAP	62
33.	WILDLIFE HABITAT SUMMARY AND COMPARISON	63
34.	LOSS OF FOREST LAND SUMMARY AND COMPARISON	66
35.	LOSS OF AGRICULTURAL LAND SUMMARY AND COMPARISON	67
36.	COLDWATER STREAM DATA	69
37.	POLLUTION OF COLDWATER STREAMS SUMMARY AND COMPARISON	70
38.	STREAMBANK EROSION CONTROL SUMMARY AND COMPARISON	75
39.	SUMMARY AND COMPARISON OF ALTERNATIVE PLANS	77
40.	COMPARISON OF IMPACTS OF ALTERNATIVE PLANS	78
41.	FINANCIAL AND TECHNICAL ASSISTANCE	79
A-1	1985 LAND USE	A-11
A-2	ANNUAL VALUE OF AGRICULTURAL PRODUCTS	A-12
A-3	CROP YIELD TRENDS	A-12
F-1	YELLOW RIVER STREAMBANK EROSION SITES	F-4
F-2	STREAMBANK EROSION SUMMARY DATA FROM 1977 NEI	F-6
F-3	CONSTRUCTION COST FOR STREAMBANK EROSION CONTROL	F-7

TABLE OF CONTENTS (Continued)

LIST OF FIGURES		Page
<u>NO.</u>	<u>TITLE</u>	
1.	GROUNDWATER QUALITY HAZARD AREAS	26
2.	BEDROCK GEOLOGY MAP BIG SPRING AREA	27
3.	BIG SPRING BASINS WHICH DRAIN TO SINKHOLES	28
4.	NITROGEN SOURCE	29
5.	NITRATE CONCENTRATION	30
6.	LOSS OF AGRICULTURAL LAND STUDY LOCATIONS	35
7.	CLINTON URBAN GROWTH	37
8.	DAVENPORT URBAN GROWTH	38
9.	DUBUQUE URBAN GROWTH	39
10.	OELWEIN URBAN GROWTH	40
A-1	LOCATION MAP	A-2
A-2	LANDFORM REGIONS	A-3
A-3	BEDROCK GEOLOGY MAP	A-5
A-4	LAND RESOURCE AREAS	A-7
A-5	GENERAL SOIL MAP	A-9
A-6	COMMERCIAL FOREST AREA - 1974	A-13
F-1	LOCATION OF BANK EROSION PROBLEMS	F-2
F-2	YELLOW RIVER STREAMBANK EROSION STUDY	F-3
F-3	STREAMBANK EROSION STUDY REACHES	F-5

PREFACE

NEED FOR STUDY

This study was requested by the Iowa Department of Soil Conservation, Iowa Department of Water, Air and Waste Management, Iowa Conservation Commission, Iowa Geological Survey, and the Northeast Iowa Conservancy District. The information developed from the study will be used by the sponsors and participating agencies to develop conservation programs. Many of the alternatives explored and the recommendations made as part of this cooperative study can be used directly in future planning processes.

AUTHORITY

The Northeast Iowa River Basin Study was conducted by authority of Section 6, Public Law 83-566, as amended. This authorizes the Secretary of the U.S. Department of Agriculture, in cooperation with other federal, state, and local agencies, to make investigations and surveys of the watersheds of rivers and other waterways. This is the basis for development of coordinated programs.

USDA RESPONSIBILITIES

Two agencies of the USDA (United States Department of Agriculture), the Soil Conservation Service and the Forest Service participated under the terms of the Memorandum of Understanding dated February 2, 1956 and revised April 15, 1968.

The Soil Conservation Service is responsible for making physical appraisals of water and related land resource problems and resource development needs, and for defining them in terms of meeting regional and economic needs for water-related goods and services; and the Forest Service is responsible for the aspects of planning related to woodlands and forested lands, both federal and non-federal.

The efforts of all study participants were coordinated and guided by the USDA Field Advisory Committee. The committee was composed of representatives from both of the participating USDA agencies. A Soil Conservation Service representative was chairperson.

SPONSORING AND COOPERATING AGENCY PARTICIPATION

The government of the State of Iowa was reorganized effective July 1, 1986. The names of cooperating state agencies have changed but their functions remain largely the same. A comparison of the "prior" and "after" names is shown in Appendix G. All references to state agencies in this report refer to the prior names.

The State of Iowa participated in this study through the sponsorship of the Iowa Department of Soil Conservation, the Iowa Department of Water, Air and Waste Management, Iowa Conservation Commission, Iowa Geological Survey, and the Northeast Iowa Conservancy District.

The Department of Soil Conservation is a state agency with responsibilities for the protection of soil and water resources. It cooperates with and provides assistance to federal, state, and local agencies for the purpose of achieving mutual objectives.

The Department of Water, Air and Waste Management provides assistance in flood plain management and coordinates the development of flood control projects. Certain construction activities in flood plain areas are subject to the regulatory permit authority of the Department. Responsibilities of the Department also include protecting the quality of the State's surface and groundwater resources.

The Northeast Iowa Conservancy District is responsible for developing and implementing a plan for the management of water resources within the Northeast Iowa Rivers Basin. The Conservancy District assists in the coordination of river basin and watershed management programs and activities among entities within the District.

The Iowa Conservation Commission has responsibility for providing outdoor recreational areas and facilities, fish and wildlife management, information and educational programs, technical assistance to forest land owners, and administering funding programs.

Cooperation, data, and assistance for this study and report were provided by the following:

- Northeast Iowa Conservancy District
- Soil Conservation Districts
- Iowa Department of Soil Conservation
- Iowa Department of Water, Air and Waste Management
- Iowa Geological Survey
- Iowa Conservation Commission
- Iowa Office for Planning and Programming
- Iowa State University
- Office of Historic Preservation
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Geological Survey

SUMMARY

The Northeast Iowa Rivers Basin Cooperative Study was requested by the Iowa Department of Soil Conservation with cooperation and sponsorship of the Northeast Iowa Conservancy District, Iowa Conservation Commission, Iowa Department of Water, Air and Waste Management, and Iowa Geological Survey.

The investigations and analyses, preparation of the main report, and five reference reports were completed by the Forest Service and Soil Conservation Service with assistance from other cooperating agencies. The five reference reports are: Soil Depletion on Representative Farms, Groundwater Contamination, Forest Resources, Pollution of Coldwater Streams, and Streambank Erosion. Detailed information can be obtained from these reports, which are available from the Soil Conservation Service, Des Moines, Iowa.

This main report contains a detailed description of the problems and concerns identified at public meetings and by the sponsoring agencies. It also contains two alternative levels of problem solution. Each alternative plan basically describes the probable impact on the resource base. In an effort to describe the emphasis of the different alternatives they were identified as follows: A Resource Protection plan and an Early Action plan. The Resource Protection plan presents actions to solve problems by 2025 without regard for cost or social acceptance. The Early Action plan is a description of the actions which could reasonably be accomplished by 2005 to reduce the problems.

The Early Action plan is designed to meet the most urgent needs first. It contains actions that can be implemented by the year 2005. Plan elements are shown in the plan element summary table. Existing federal, state, and local laws and programs are adequate to implement this plan with increased funding. The priorities and schedule for installation of various plan elements will depend upon willingness of local units of government and other local organizations to request assistance and assume leadership in carrying out financial and legal responsibilities. Some plan elements can only be accomplished with significant increases in levels of funding.

The projected problems and the impact of the Early Action plan elements on these problems are as follows:

SHEET AND RILL EROSION

CROPLAND - There are presently 2.1 million acres eroding above T (Tolerable) levels. This is projected to decrease to 1.4 million acres by year 2025 due to the ongoing conservation program. The Early Action plan will direct the erosion control efforts to those 800,000 acres that will be depleted by year 2025. The annual cost of this plan is a savings of \$5.5 million because of reduced production costs associated with conservation tillage.

PASTURE - Currently 57,600 acres of pasture are eroding excessively. The amount of pasture with excessive erosion is projected to decrease to 39,500 acres by the year 2025. The Early Action plan will treat 5,500 acres at an annual cost of \$320,000.

FOREST - Currently 114,000 acres of grazed forest land are eroding excessively. This is projected to decrease to 101,000 acres by the year 2025. The early actions will protect 36,000 acres of forest land from grazing and resulting erosion at an annual cost of \$324,000.

GROUNDWATER CONTAMINATION

Groundwater quality is a problem in northeast Iowa. High concentrations of nitrates have been found in wells throughout the basin and in Big Spring in Clayton County.

Nitrates and other contaminants enter groundwater by two processes. Most widespread is infiltration through shallow surface soils into bedrock aquifers. The other process is direct entry to sinkholes of surface water containing sediment with attached pollutants and soluble and insoluble contaminants. These pollutants may include nutrients, pesticides and bacteria.

Carbonate aquifers in some regions are protected by deep soils, some are covered with shallow soils and are relatively unprotected, and some are exposed to direct runoff into sinkholes.

The Early Action plan targets those areas that drain directly to sinkholes. Erosion control practices will be applied to 71,700 acres of cropland which are eroding at rates greater than tolerable. Most soil conservation practices result in improved groundwater quality. Fertilizer and pest management practices will be applied to 199,100 acres of cropland which drain to sinkholes.

The Early Action plan will cost about \$2.7 million per year and will require 8.5 additional staff-years of technical assistance annually.

LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT

Both upland and forest wildlife species and numbers have been decreasing and are expected to continue decreasing if no actions are taken. The upland habitat quality is 31 percent of its potential and forest habitat quality is 69 percent of its potential at the present time.

The Early Action plan will increase the habitat quality to 39 percent of its potential for upland habitat. The Early Action plan requires the addition of several practices to achieve these changes in habitat quality indexes at an annual cost of \$26.1 million. Major practices needed are as follows: 900 acres of windbreaks, 49,600 acres of reforestation, and 403,000 acres of new grasslands. Seven additional staff-years of technical assistance will be required.

LOSS OF FOREST LAND

Currently forest land acreage is being reduced 2,790 acres per year. This represents an annual loss of \$20,000 worth of primary forest products. The removal of forest land also reduces the diversity of the landscape and wildlife habitat. The Early Action plan will protect 800 acres per year at an annual cost of \$123,000.

LOSS OF AGRICULTURAL LAND

The agricultural land base is projected to decline 1,500 acres per year, an average annual production loss of \$405,000. These irreversible changes are from agriculture to cities, roads, and reservoirs. Implementation of the Early Action plan will reduce the loss to 1,060 acres per year and annual production loss to \$286,000 for an annual cost of \$50,000.

POLLUTION OF COLDWATER STREAMS

Livestock have access to 50 percent of the stream corridors of the 25 highest priority coldwater streams, a total length of 37 miles. Excessive sheet and rill erosion is a problem on 70,200 acres of cropland in the drainage areas of these 25 coldwater streams. High erosion rates result in sediment delivered to coldwater streams. Gully erosion is a problem at 585 locations causing sediment from gully erosion to reach the 25 streams. Streambank erosion is a problem on 15 miles of streambank. There are 180 farmsteads where livestock are kept that contribute animal waste runoff to coldwater streams.

The ICC has identified all of these factors as causes of the failure of trout to successfully reproduce at rates sufficient to maintain a population. These factors also reduce the trout carrying capacity of coldwater streams.

The Early Action plan will be effective in maintaining or improving water quality in six selected trout streams. It was formulated to reduce financial outlays and serve as both an implementation and demonstration project for all other coldwater streams.

The Early Action plan includes resource management systems for the 7,600 acres of cropland. Terraces are proposed on 3,800 acres and grade stabilization structures at 43 locations. Streambank protection measures for 3.8 bank miles are included in this plan. Livestock exclusion is needed to protect 3.3 miles of stream corridor from damage. Landrights would be required on at least 53 acres before fences could be installed. Animal waste management systems are proposed at 56 locations.

STREAMBANK EROSION

Local people, particularly in the northern part of this study area, are concerned with the annoying and damaging aspects of streambank erosion. At present nearly 8,000 bank miles are eroding with

approximately 340 bank miles classed as severely eroding. This amounts to a monetary loss of nearly \$800,000 per year. There will be a small increase in the streambank erosion rate in the future.

Recommended action includes non-structural and structural measures. First attention should be given problem areas where environmental values or man-made improvements are threatened. Economic returns to repairing and preventing streambank erosion are usually not sufficient to recover costs. Never-the-less, control may be very desirable from esthetic, convenience, or resource conservation viewpoints, and where particularly valuable improvements are threatened.

Total cost for an Early Action plan would be nearly \$22 million. Streambank erosion would be controlled on 70 bank miles.

PROBLEMS AND CONCERNS

Public meetings were held at two locations in the basin to explain broad resource studies and to gather public input (See Appendix D). This information, along with interviews and discussions held with citizens and technical field personnel, was particularly valuable in gaining insight into problems and needs as viewed by society.

The identified soil and water resource problems were grouped into major categories. Analysis of the identified problems led to the following study items:

1. Sheet and Rill Erosion
 - a. Cropland
 - b. Pasture
 - c. Forest Land
2. Groundwater Contamination
3. Loss, Deterioration, or Lack of Upland Forest and Wildlife Habitat
4. Loss of Forest Land
5. Loss of Agricultural Land
6. Pollution of Coldwater Streams
7. Streambank Erosion

These problems, which are quantified in Table 1, show present conditions and project future without project conditions for chosen target years. All references to the Northeast Iowa Rivers basin exclude the portion which lies in Minnesota.

TABLE 1
IDENTIFICATION OF PROBLEMS AND CONCERNS
Northeast Iowa Rivers Basin

Concern	Unit	1985	Future Without Project	
			2005	2025
Sheet and Rill Erosion <u>1/</u>				
Cropland	Acres	2,084,100	1,744,800	1,405,500
Pasture	Acres	57,600	48,600	39,500
Forest Land	Acres	114,200	107,000	101,000
Groundwater Contamination				
Shallow Bedrock, Cropland	Acres	2,348,000	2,402,000	2,454,100
Sinkhole Drainage Area, Cropland	Acres	178,600	188,900	199,100
Loss, Deterioration, or Lack of Upland and Forest Wildlife Habitat				
Upland Wildlife	Habitat Index	0.31	0.29	0.24
Forest Wildlife	Habitat Index	0.69	0.69	0.67
Loss of Forest Land				
Total Forest Land	Acres	426,500	361,700	314,900
Loss of Agricultural Land	Acres/Year	2,200	1,500	1,500
Pollution of Coldwater Streams				
Cropland >T in 25 Watersheds	Acres	80,200	75,000	70,200
Livestock access to streams	Miles	37	37	37
Confined Livestock Systems with Runoff Reaching Streams	Number	200	190	180
Streambank Erosion on Coldwater Streams	Miles of Stream		15	15
15 Gully Erosion	No. Locations	625	600	585
Streambank Erosion				
Voiding	Acres/Year	143	149	154
Depreciation	Acres/Year	36	38	39
Material Eroded	Tons/Year	1,040,000	1,081,000	1,122,000

1/ Erosion rates greater than T

Inventories prepared during the study include: use, productivity, and characteristics of the land; quality of wildlife habitat; groundwater quality at Big Spring Hatchery; water quality in Yellow River; land use study of 25 coldwater stream watersheds; agricultural land use changes including urban and built-up areas; and an analysis of the change in forest acreage. These inventories were used to explain problems in detail and quantify them for analysis.

The problems shown and explained in detail are those long range problems which are expected to remain at the end of a 40-year period. To insure enhancement and protection of the resource base, these problems should be identified and quantified and long range plans developed.

Table 2 is a listing of current land use and a projection of future land use. These data are used as a basis for identifying current and projected problems.

TABLE 2
LAND USE
Northeast Iowa Rivers Basin

Land Use	Year	
	1985 <u>1/</u>	2025 <u>2/</u>
	-----Acres-----	
Cropland	3,991,400	4,191,400
Pasture	478,600	327,700
Forest Land	426,500	314,900
Other	132,400	134,500
Federal	39,000	40,000
Urban Built-up	310,600	369,000
Water	57,500	58,500
TOTAL	5,436,000	5,436,000

1/ Data from 1982 National Resources Inventory.

2/ Without-project conditions.

SHEET AND RILL EROSION

Sheet and rill erosion by water is the most significant erosion problem. Sheet erosion is the removal of a relatively uniform layer of soil. Rill erosion is the formation of shallow, generally parallel channels that can be smoothed out by normal cultivation.

Sheet and rill erosion gradually removes productive topsoil and exposes the generally less productive subsoil. This reduction in productive potential of the resource base is defined as soil depletion.

Excessive sheet and rill erosion and resultant soil depletion is a potential problem on all sloping soils. The problem increases where the land use is continuous row crops with little or no residue left on the soil surface. Erosion can also cause off-site problems such as sedimentation and decreased water quality.

National Resources Inventory data were used for the analysis of cropland, pasture, and forest land erosion. These data are reliable for land resource areas but their use may cause some inconsistencies when projections are made for smaller areas. This may result in data for some soils, slope groups, or erosion phases to appear erratic. However, the overall analysis should be representative.

CROPLAND - Agricultural land use has trended toward more intensive farming. Rotations and soil-conserving crops are being replaced by continuous row crops. Row crop acreage increased nearly 34 percent from 1962 to 1972 and nearly 33 percent from 1972 to 1982. A result has been increased soil erosion. Soils with deeper topsoils or those with more fertile subsoils have been kept productive by substituting increased amounts of fertilizer as natural soil productivity decreases.

Projected conditions are based on long term trends and ignore short-term fluctuations. It is assumed that land treatment programs will remain at their present levels, and that increased technology will result in higher yields. It is also assumed that erosion rates and land adequately protected will remain relatively constant over the evaluation period.

Currently, there are about 2.1 million acres of excessively eroding cropland. Soil erosion from water on those acres averages about 17 tons per acre annually. This is 27 million tons of erosion in excess of the tolerable level, or 27 million tons of soil resource depletion.

An area of 1.9 million acres has water erosion rates less than the tolerable level. These acres have a weighted average soil loss of about 2.7 tons per acre per year.

An analysis of trends of applied land treatment indicates that cropland with an erosion problem will decrease from 2.1 million acres in 1985 to 1.4 million in 2025. During the 40-year period land treatment measures will be applied to adequately treat 700,000 acres of excessively eroding cropland. During that period cropland is expected to increase 200,000 acres from converted pasture and forest land.

For purposes of study and discussion, soils used in the analysis of erosion and depletion are divided into two groups. Deep soils are defined as soils that provide good rooting depths and are not underlain by limestone bedrock, sand and gravel, or dense glacial till within a depth of 40 inches. Shallow soils are defined as soils underlain by limestone bedrock, sand and gravel, or dense glacial till within depths of 40 inches which restricts plant root growth. Shallow soils are estimated to be six percent of the basin.

In 2025 it is estimated there will be 2.8 million acres of cropland with erosion rates below the tolerable level. These will have a weighted average soil movement of about 2.5 tons per acre per year.

Deep Soils: An analysis of future conditions shows that by 2025, 1.25 million acres of deep soils will be eroding at excessive rates. Table 3 shows a distribution of erosion problems by slope group and erosion phase. Slope groups are defined as follows:

<u>Slope Group</u>	<u>Percent Slope</u>
A	0 - 2
B	2 - 5
C	5 - 9
D	9 - 14
E	14 - 18
F	18 - 25
G	25 - 40

An estimated 53 percent of the deep soils which are eroding excessively have slopes from 5 to 14 percent.

TABLE 3
EROSION OF DEEP CROPLAND SOILS - 2025
Northeast Iowa Rivers Basin

Slope Group & Erosion Phase	Total Area	Erosion Rate				
		< T	T-2T	2T-3T	3T-4T	>4T
-----Acres-----						
A	915,500	879,600	28,400	3,000	3,000	1,500
B	1,426,600	1,126,900	251,500	42,400	4,400	1,400
C	299,900	172,700	75,700	26,800	10,400	13,300
C2	382,900	187,000	114,300	53,400	8,900	19,300
C3	5,900	1,500	4,400	0	0	0
D	78,500	29,800	28,200	6,300	7,900	6,300
D2	420,600	202,400	103,600	58,100	23,600	32,900
D3	75,300	9,400	11,000	12,500	9,400	33,000
E	24,400	4,600	7,600	0	3,100	9,100
E2	139,100	27,500	41,300	22,900	18,400	29,000
E3	48,900	4,600	7,600	4,600	9,200	22,900
F	15,400	4,600	6,100	3,100	1,600	0
F2	40,000	10,800	13,800	7,700	1,500	6,200
F3	32,300	1,500	3,100	4,600	1,500	21,600
G	11,400	2,800	1,500	2,900	1,400	2,800
TOTAL	3,916,700	2,665,700	698,100	248,300	104,300	199,300

Cropland soils that are currently being depleted are grouped into three erosion phases and shown in Table 4. Erosion Phase 1 is slightly eroded with no apparent erosion. Erosion Phase 2 is moderately eroded with usually 3 to 7 inches of topsoil, however, subsoil may be exposed when tilled. Erosion Phase 3 is severely eroded with 0 to 3 inches of topsoil, but the tillage layer is predominantly subsoil when plowed. The impact of projected excessive erosion on the acres in each erosion phase is projected to the year 2025. Slightly eroded soils are projected to decrease 371,100 acres. The area with moderately eroded soils is projected to decrease 370,700 acres by 2025 under present management systems. The area with severely eroded soils is projected to increase 741,800 acres by 2025. This 741,800-acre increase of severely eroded soils is the most urgent and important erosion problem.

TABLE 4
 IMPACT OF EROSION ON DEEP CROPLAND SOILS
 Northeast Iowa Rivers Basin

Erosion Phase	YEAR		
	1985	2005	2025
	-----Acres-----		
1	1,035,400	789,900	664,300
2	710,400	389,800	339,700
3	148,700	714,800	890,500
TOTAL	1,894,500	1,894,500	1,894,500

The projected changes by slope group and erosion phase are shown in Table 5. A summary of the deep soils which are expected to change erosion phase by slope group are shown in Table 6. Of those soils that are projected to deplete, 48 percent have 9 to 18 percent slopes.

TABLE 5

PROJECTED EROSION PHASE CHANGE OF DEEP CROPLAND SOILS

Northeast Iowa Rivers Basin

Slope Group & Erosion Phase	Year		
	1985	2005	2025
-----Acres-----			
A	143,400	128,200	120,000
A2	0	15,200	23,400
B	633,300	554,000	478,000
B2	0	79,300	155,300
C	165,400	91,800	56,800
C2	272,400	196,000	131,700
C3	5,700	155,700	255,000
D	51,300	15,900	9,500
D2	289,400	65,400	20,700
D3	69,400	328,800	379,900
E	20,600	0	0
E2	116,000	19,300	1,000
E3	44,000	161,300	179,600
F	11,800	0	0
F2	32,600	9,100	7,600
F3	29,600	64,900	66,400
G	9,600	0	0
G2	0	5,500	0
G3	0	4,100	9,600
TOTAL	1,894,500	1,894,500	1,894,500

TABLE 6

DEPLETING DEEP CROPLAND SOILS - 2025

Northeast Iowa Rivers Basin

Slope Group	Change in Erosion Phase
Acres	
A	23,400
B	155,300
C	249,300
D	310,500
E	135,600
F	36,800
G	9,600

An analysis to identify specific soils which can be expected to deplete by 2025 is shown in Table 7. This is a listing of soils with more than 10,000 cropland acres, some of which can be expected to change one or more erosion phases by 2025.

TABLE 7
DEEP CROPLAND SOILS WITH CHANGING EROSION PHASE 1/

Northeast Iowa Rivers Basin

Soil	Average	Cropland	Amount Depleted - 2025	
	Slope Percent		Acres	Acres
Sparta	7	10,000	1,000	10
Kenyon	3	156,000	34,000	22
Kenyon	7	22,000	4,000	18
Tama	3	38,000	14,000	37
Tama	7	46,000	34,000	74
Tama	11	11,000	1,000	9
Downs	3	39,000	13,000	33
Downs	7	128,000	79,000	62
Downs	11	100,000	90,000	90
Downs	16	14,000	14,000	100
Fayette	7	186,000	181,000	97
Fayette	11	270,000	218,000	81
Fayette	16	148,000	106,000	72
Fayette	20	62,000	32,000	52
Bassett	3	53,000	13,000	25
Bassett	7	16,000	7,000	44
Floyd	3	34,000	4,000	12
Waukegan	3	10,000	2,000	20
Dinsdale	3	47,000	12,000	26
Dinsdale	7	12,000	6,000	50
Clyde-Floyd Complex	3	44,000	10,000	23
Ostrander	3	25,000	6,000	24
Schley	3	18,000	2,000	11
Racine	3	12,000	2,000	17
Exette	16	15,000	12,000	80
Cresco	3	23,000	5,000	22
Protivin	3	12,000	2,000	17
TOTAL		1,551,000	904,000	

1/ Soils with more than 10,000 acres.

Shallow Soils: An analysis of the projected 1.4 million acres of excessively eroding cropland indicates that 155,500 acres of shallow soils will be depleting in 2025. Table 8 shows a distribution of erosion problems by slope group and erosion phase. An estimated 48 percent of the shallow soils which are eroding excessively have slopes from 5 to 14 percent.

TABLE 8
 EROSION OF SHALLOW CROPLAND SOILS - 2025
 Northeast Iowa Rivers Basin

Slope Group & Erosion Phase	Total Area	Erosion Rate				
		< T	T-2T	2T-3T	3T-4T	>4T
-----Acres-----						
A	17,900	17,900	0	0	0	0
B	84,800	57,000	19,000	2,900	4,400	1,500
C	28,200	14,800	3,000	7,400	0	3,000
C2	7,400	1,500	0	4,400	1,500	0
D	31,400	3,100	3,100	6,300	1,600	17,300
D2	37,700	11,000	12,600	4,700	4,700	4,700
E	13,700	3,100	3,000	1,500	0	6,100
E2	27,500	6,100	3,000	6,100	3,100	9,200
E3	7,600	0	3,100	0	1,500	3,000
F	6,200	0	3,100	0	1,600	1,500
F2	7,700	3,100	3,100	0	0	1,500
F3	4,600	1,600	0	0	1,500	1,500
TOTAL	274,700	119,200	53,000	33,300	19,900	49,300

Cropland on shallow soils that are currently being depleted is grouped into three erosion phases and shown in Table 9. The impact of projected excessive erosion on the acres in each erosion phase is projected to the year 2025. Slightly eroded soils are projected to decrease 73,000 acres. The area with moderately eroded soils is projected to increase 15,000 acres by 2025 under present management systems. The area with severely eroded soils is projected to increase 58,000 acres by 2025. This 58,000-acre increase of severely eroded soils is the most urgent and important erosion problem.

TABLE 9

IMPACT OF EROSION ON SHALLOW CROPLAND SOILS

Northeast Iowa Rivers Basin

Erosion Phase	Year		
	1985	2005	2025
-----Acres-----			
1	115,690	59,730	42,670
2	63,200	77,360	77,920
3	<u>10,700</u>	<u>52,500</u>	<u>69,000</u>
TOTAL	189,590	189,590	189,590

A further analysis of the projected changes by slope group and erosion phase is shown in Table 10.

TABLE 10

PROJECTED EROSION PHASE CHANGE OF SHALLOW CROPLAND SOILS

Northeast Iowa Rivers Basin

Slope Group & Erosion Phase	Year		
	1985	2005	2025
-----Acres-----			
A	1,490	1,430	1,370
A2	0	60	120
B	49,700	39,000	29,700
B2	0	10,700	20,000
C	16,300	10,400	6,300
C2	5,900	9,400	12,200
C3	0	2,400	3,700
D	29,800	8,000	5,000
D2	29,800	38,600	32,800
D3	0	13,000	21,800
E	12,200	900	300
E2	22,900	12,400	6,600
E3	7,600	29,400	35,800
F	6,200	0	0
F2	4,600	6,200	6,200
F3	<u>3,100</u>	<u>7,700</u>	<u>7,700</u>
TOTAL	189,590	189,590	189,590

A summary of the shallow soils which are expected to change erosion phase by slope group are shown in Table 11. Of those soils that are projected to deplete, 59 percent have 9 to 18 percent slopes.

TABLE 11
 DEPLETING SHALLOW CROPLAND SOILS
 Northeast Iowa Rivers Basin

Slope Group	Change in Erosion Phase Acres
A	120
B	20,000
C	10,000
D	24,800
E	28,200
F	6,200

An analysis to identify specific soils which can be expected to deplete by 2025 is shown in Table 12. This is a listing of soils with more than 4,000 cropland acres, some of which can be expected to change one or more erosion phase by 2025.

TABLE 12

SHALLOW CROPLAND SOILS WITH CHANGING EROSION PHASE 1/

Northeast Iowa Rivers Basin

Soil	Average	Cropland	Amount Depleted - 2025	
	Slope Percent		Acres	Acres
Lindley	20	5,000	5,000	100
Dubuque	11	15,000	14,000	93
Dubuque	16	26,000	24,000	92
Rockton	3	4,000	2,000	50
Rockton	3	9,000	1,000	11
Burkhardt	3	6,000	1,000	17
Sogn	11	10,000	3,000	30
Frankville	11	8,000	4,000	50
Nordness	11	14,000	14,000	100
Nordness	20	6,000	6,000	100
Marlean	11	5,000	5,000	100
Mottland	16	5,000	1,000	20
Winneshiek	3	6,000	2,000	33
Winneshiek	7	6,000	3,000	50
Wapsie	3	4,000	1,000	25
Lourdes	3	4,000	2,000	50
Donnan	3	<u>10,000</u>	<u>10,000</u>	100
TOTAL		143,000	98,000	

1/ Soils with more than 4,000 acres.

Depletion: A soil depletion model was used to estimate the impact of management decisions and erosion on the soil profile over time. The model was used to predict the effect that current levels of soil erosion, if continued, will have on individual soils.

A comparison of acreage changes for the time periods shows that the rate of change slows over time. Soils with high erosion rates or shallow topsoils deplete quickly. Those soils with low erosion rates or thicker topsoils remain in their respective erosion phases longer.

The first step in the model is to estimate soil erosion by the Universal Soil Loss Equation. Erosion occurring on each soil mapping unit is computed according to the combinations of tillage, rotation, and conservation practice being used. The tons of soil erosion by soil mapping unit is converted to inches of soil using the bulk density of the soil mapping unit.

Soil mapping units that are changing erosion phase are shown in Tables 7 and 12. Table 7 is a list of the major deep soils that are projected to change erosion phase. Table 12 is a list of major shallow soils that are projected to change erosion phase by 2025.

The soil resource depletion loss in 2025 on deep soils is estimated to be \$13.7 million in yield loss, \$4.1 million in increased fertilizer costs, and \$0.5 million in increased fuel costs. Present erosion rates continued to the year 2025 would mean a depletion cost of about \$9.60 per acre per year on the 1.9 million acres of cropland currently exceeding allowable erosion rates.

Soil resource depletion on shallow soils from 1985 to 2025 is estimated to be \$1.5 million in yield loss, \$0.5 million in increased fertilizer costs, and \$0.2 million in increased fuel costs. Present erosion rates continued to the year 2025 would amount to a depletion cost of about \$11.60 per acre per year on the 189,600 acres of cropland currently exceeding allowable erosion rates.

While the overall ability to produce crops continues to increase because of increasing technology, the potential to produce has been decreased significantly by soil resource depletion.

Excessive erosion from past uses and management has caused some soil mapping units to change from slightly eroded to moderately eroded or to severely eroded. This depletion by past erosion is referred to as historic depletion. The income reduction resulting from past excessive erosion is \$19.3 million annually. Once depletion has occurred adverse effects remain. Present erosion control programs have no impact on historic depletion.

PASTURE - Pasture in the Northeast Iowa Rivers basin is distributed over all slope groups (Table 13). Currently, erosion rates are not a problem on 421,000 acres of pasture. The remaining 12 percent or 57,600 acres are eroding at rates exceeding tolerable levels.

TABLE 13
PASTURE EROSION BY SLOPE GROUP - 1985
Northeast Iowa Rivers Basin

Slope Group	Total Area Acres	Erosion Rate					
		< T Acres	Percent	T-2T	2T-3T	3T-4T Acres	> T
A	96,800	96,100	99	700			
B	68,400	68,400	100				
C	42,700	41,900	98	800			
D	93,000	84,800	91	7,200	1,000		
E	57,000	52,400	92	3,600	1,000		
F	73,200	55,500	75	7,400	4,800	1,900	3,600
G	47,500	21,900	46	9,300	4,700	1,000	10,600
TOTAL	478,600	421,000		29,000	11,500	2,900	14,200
PERCENT		88		6	2	1	3

Erosion rates on pasture vary depending on cover, soil type, slope, and slope length. Under good cover conditions, pasture soils can be expected to have very small amounts of erosion. When pastures are misused or overgrazed, the soil erosion rate can be very high, sometimes exceeding 10 to 15 tons per acre per year. About 90 percent of excessive pasture erosion occurs on soils with slopes greater than 18 percent.

Overgrazed pastures and lack of care and maintenance makes these areas vulnerable to excessive erosion. Overgrazing causes suppression of growth and elimination of the taller and more desirable grasses, permitting the increase of weeds, brush, and less desirable species of grasses. When stands deteriorate, pastures decrease in productive capacity and are subject to increased erosion. The average rate for pasture exceeding tolerable levels is 14 tons per acre per year. This amounts to 806,000 tons of erosion on the problem acres.

Pasture acreage is projected to decline about 32 percent by 2025 (Table 2). In the future, 151,000 acres of pasture will be converted to other uses. With this decline in pasture acreage, the number of acres with an excessive erosion problem can also be expected to decrease.

TABLE 16
GROUNDWATER QUALITY HAZARD AREA
Northeast Iowa Rivers Basin

Land Use	1985	2025
	-----Acres-----	
Shallow and Unprotected Bedrock Areas		
Cropland	2,348,000	2,454,100
Pasture	237,500	180,000
Forest Land	246,400	159,900
Other	299,800	338,000
Water	29,100	28,900
TOTAL	3,161,000	3,161,000
Karst Areas and Sinkhole Drainage Areas		
Cropland	178,600	199,100
Pasture	42,000	27,500
Forest Land	46,800	39,400
Other	5,300	5,900
Water	7,300	8,100
TOTAL	280,000	280,000

SHALLOW OR UNPROTECTED BEDROCK - Areas where the thickness of soil materials overlying carbonate aquifers are less than 50 feet thick are relatively unprotected. Water and dissolved contaminants easily percolate into the shallow bedrock aquifers. The shallower the soil, the greater the rate at which water reaches the aquifer. In this high infiltration region, nitrates have become a significant problem. Most wells have nitrate concentrations within acceptable limits, however, the median is 19 milligrams per liter, over three times the concentration in the protected area. Nineteen percent of the wells have nitrate levels exceeding the drinking water standard of 45 milligrams per liter. Atrazine and several other herbicides were detected during intensive groundwater monitoring in the Big Spring basin of Clayton County, however, the concentrations were generally less than one microgram per liter (one part per billion) and well below toxic levels. However, the long term effects of humans ingesting these levels of herbicides is unknown. An estimated 3,161,000 acres or 58 percent of the Northeast Iowa Rivers basin are within this shallow or unprotected bedrock hazard area (Table 16).

KARST AREAS AND SINKHOLE DRAINAGE AREAS - The sinkhole region of the basin is probably the best known and most dramatic of the areas subject to groundwater contamination. More than 12,700 sinkholes have been mapped in the basin. Sinkholes occur where the soil materials covering carbonate rocks are thin enough that the collapse of a solution cavern or conduit and the overlying material extends to the land surface. The sinkhole areas exhibit the poorest water quality of the three regions. Runoff water carrying sediment, nutrients, herbicides, insecticides, and other pollutants not only enter the aquifer directly through sinkholes, but the overlying soil materials are very thin allowing rapid infiltration of water and dissolved pollutants. High nitrate levels are commonly found in wells, with a median value of 34 milligrams per liter, over five times those in protected areas. Twenty-five percent of the wells sampled have nitrate levels exceeding the drinking water standard of 45 milligrams per liter. Herbicides are also found in low concentrations, but the levels are higher and more persistent than in the shallow or unprotected area. Atrazine concentrations in groundwater were found as high as 15 micrograms per liter. Groundwater quantity and quality can fluctuate widely in this region. During runoff events, water from wells in major conduits will likely turn cloudy and contain bacteria and peak levels of herbicides and possibly insecticides, as well as other contaminants. The average annual sediment yield to sinkholes is estimated to be 1,101,000 tons. The area draining to individual sinkholes may be very small or as large as several square miles. The total area draining to sinkholes in the Northeast Iowa Rivers basin is estimated to be 280,000 acres (Table 16).

A detailed assessment of land management and water quality has been made in the groundwater basin draining to the Big Spring fish hatchery in Clayton County. Numerous samples were taken from wells, tile lines, streams, and springs to get a better understanding of the processes resulting in groundwater degradation and evaluate possible control measures or management practices. The 103-square mile area was chosen because of specific concerns of the Iowa Conservation Commission and other sponsors of the Northeast Iowa Rivers Basin Study. The spring allows the direct measurement of the quality and quantity of discharge from the basin which is generally not possible in other areas.

The basin provides a good representation of the three groundwater contamination hazard regions. About a third is deep aquifers or are protected by the Brainard Shale Member of the Maquoketa Formation (Figure 2). Of the remaining area, sinkholes drain 11.5 square miles (Figure 3).

Nitrate concentrations ranged from less than detectable to 280 milligrams per liter with an average of 40 milligrams per liter in 1982 and 45 milligrams per liter in 1983. The total discharge of nitrate-N in the groundwater amounted to 33 to 55 percent of the fertilizer-N applied during the preceeding years. Not all of the nitrate lost is applied as fertilizer, however. Nitrate comes from a mix of all available sources. The high nitrate levels are, however, related to fertilizer application practices. High applications of fertilizer-N, along with other sources of N, put more N on the land than plants can use.

Atrazine and several other herbicides were also found in groundwater while studying the Big Spring basin. The levels are very low, generally less than one microgram per liter, and far below toxic levels. The only source of these herbicides is agriculture. About 0.04 percent of the atrazine applied is leached to the groundwater below.

Water-quality data from Big Spring indicate that nitrate concentrations remained relatively constant through the 1950's and 1960's. Recent testing in 1982 and 1983, however, indicates that nitrate levels in the Big Spring basin groundwater have increased about 230 percent since the late 1960's (Figure 4). During this same period of time, livestock and resulting manure increased some, however, the total fertilizer-N applied increased about 250 percent (Figure 4). Water-quality analyses made in 1975 and 1983 from wells in similar geological settings to those found in the Big Spring basin, display the same magnitude of change in nitrate levels (Figure 5).

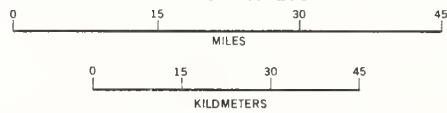
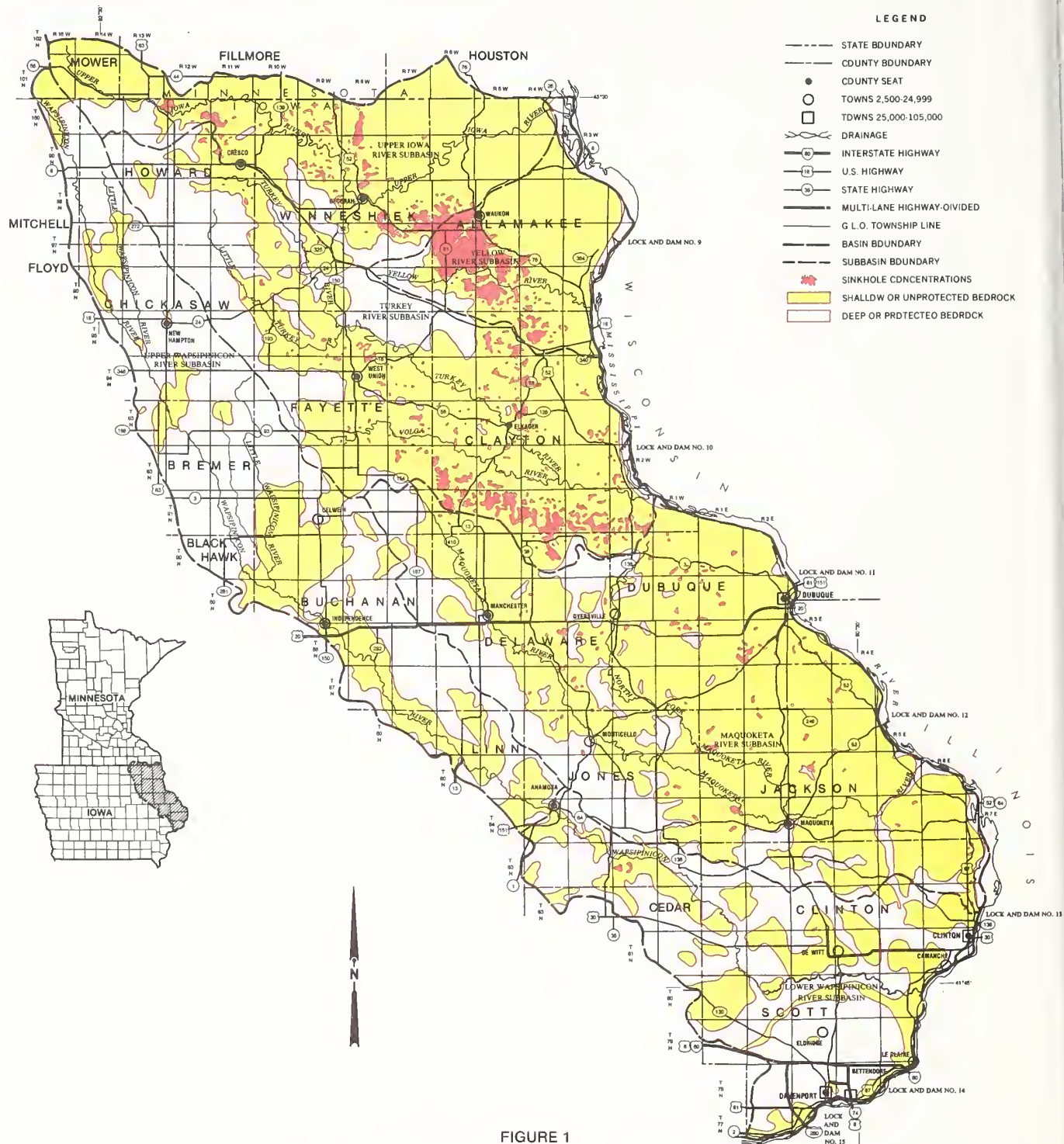
As soils erode, increased amounts of fertilizer are substituted for the depleting natural soil productivity. The additional fertilizer-N inputs needed just to keep management at recommended levels are as follows:

	Erosion Phase Change	
	<u>Slight to Moderate</u>	<u>Moderate to Severe</u>
	(pounds)	
Nitrogen, N	10	30

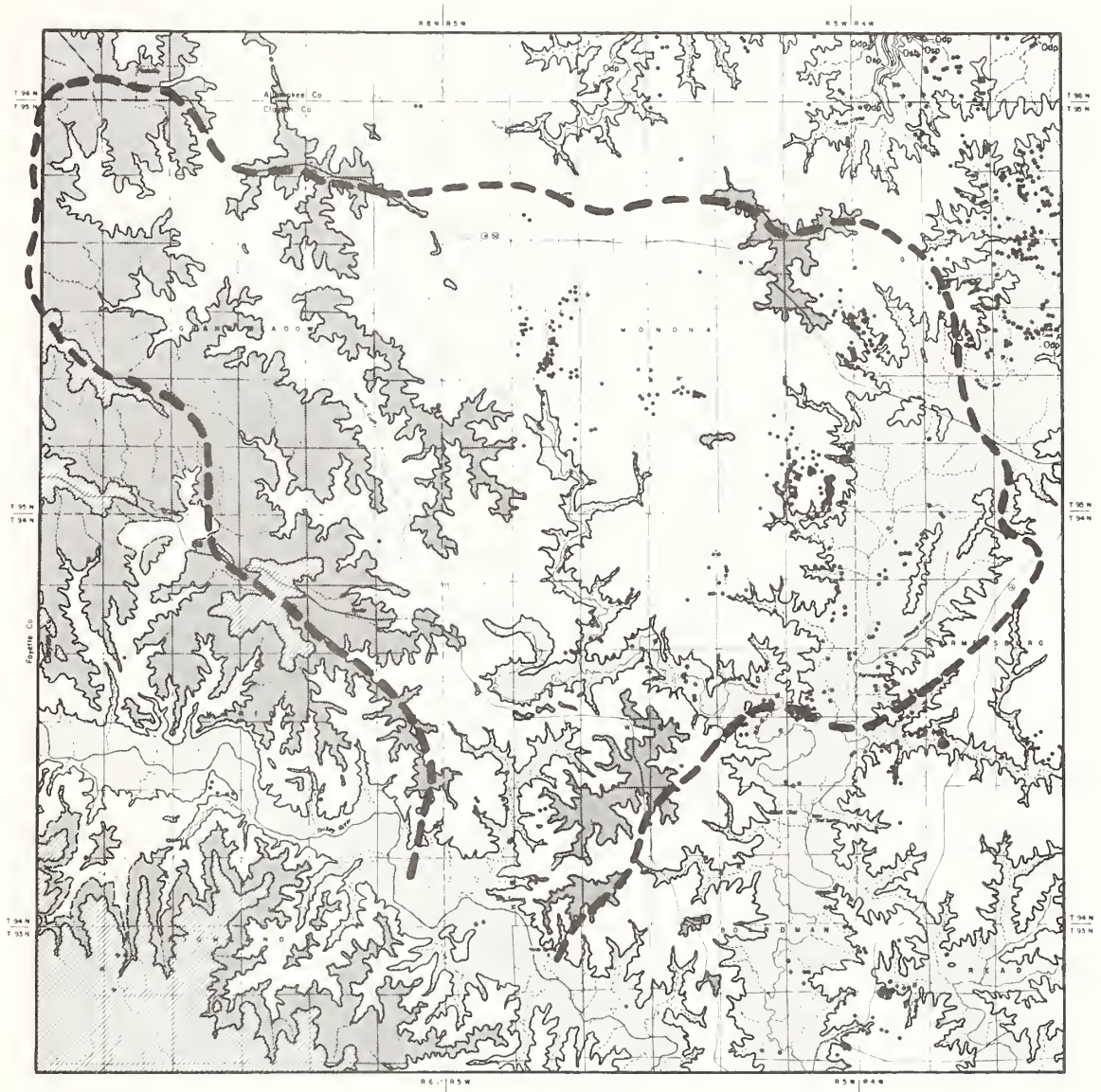
Currently (1985), only about three percent of the Northeast Iowa Rivers basin is in erosion Phase 3. If present erosion rates continue, almost 38 percent, an additional 800,100 acres of cropland will be in erosion Phase 3 by 2025. An additional 30-40 pounds of fertilizer-N will be required on these acres to maintain the current recommended level of management.

Cropland is expected to increase almost 5 percent in the shallow or unprotected areas and over 11 percent in the areas draining to sinkholes during the next 40 years. The expected increase in area, coupled with the continued increase in management level and soil depletion, will increase the application of fertilizer-N in 2025 by 92 percent in the shallow or unprotected areas and 104 percent in the areas draining to sinkholes. This is projected to cause a corresponding increase in nitrate levels in groundwater.

During the early stages of the Northeast Iowa Rivers Basin Study the sponsors rated groundwater contamination as their number one concern. An ad hoc committee was formed in 1983 after findings led researchers to conclude that groundwater contamination is primarily the result of modern agricultural operations in conjunction with the natural processes of recharging carbonate aquifers. The Ad Hoc Karst Committee (later called Iowa Consortium on Agriculture and Groundwater Quality) was formed to organize, develop, and coordinate activities of the many groups concerned with groundwater quality. The agencies, organizations, and political subdivisions represented on the committee include: Iowa State University, Agricultural Experiment Station and Cooperative Extension Service; Northeast Iowa Conservancy District; Iowa Department of Soil Conservation; Iowa Department of Agriculture; Iowa Geological Survey; Iowa Department of Water, Air and Waste Management;



SOURCE:
 1:000,000 GEOLOGICAL SURVEY BASE MAPS,
 1:800 IOWA AND 1:625 MINNESOTA, OFFICIAL IOWA
 TRANSPORTATION MAP AND INFORMATION FROM
 USGS FIELD PERSONNEL,
 LAMBERT CONFORMAL CONIC PROJECTION



BEDROCK GEOLOGY

Compiled by G.A. Ludvigson
 (field mapping by G.A. Ludvigson, R.M. McKay,
 M.J. Bounk, S.J. Lenker)
 1982

SILURIAN

Su-Silurian dolomites
 (Blanding, Tete des Marts, Mosalem Frms)

● Approximate location of sinkholes

ORDOVICIAN

Omb-Maquoeta Fm
 Brainard Shale Member

Og-Galena carbonates
 Dubuque, Wise Lake, and Dunleith Frms

Osp Osp-St Peter Sandstone

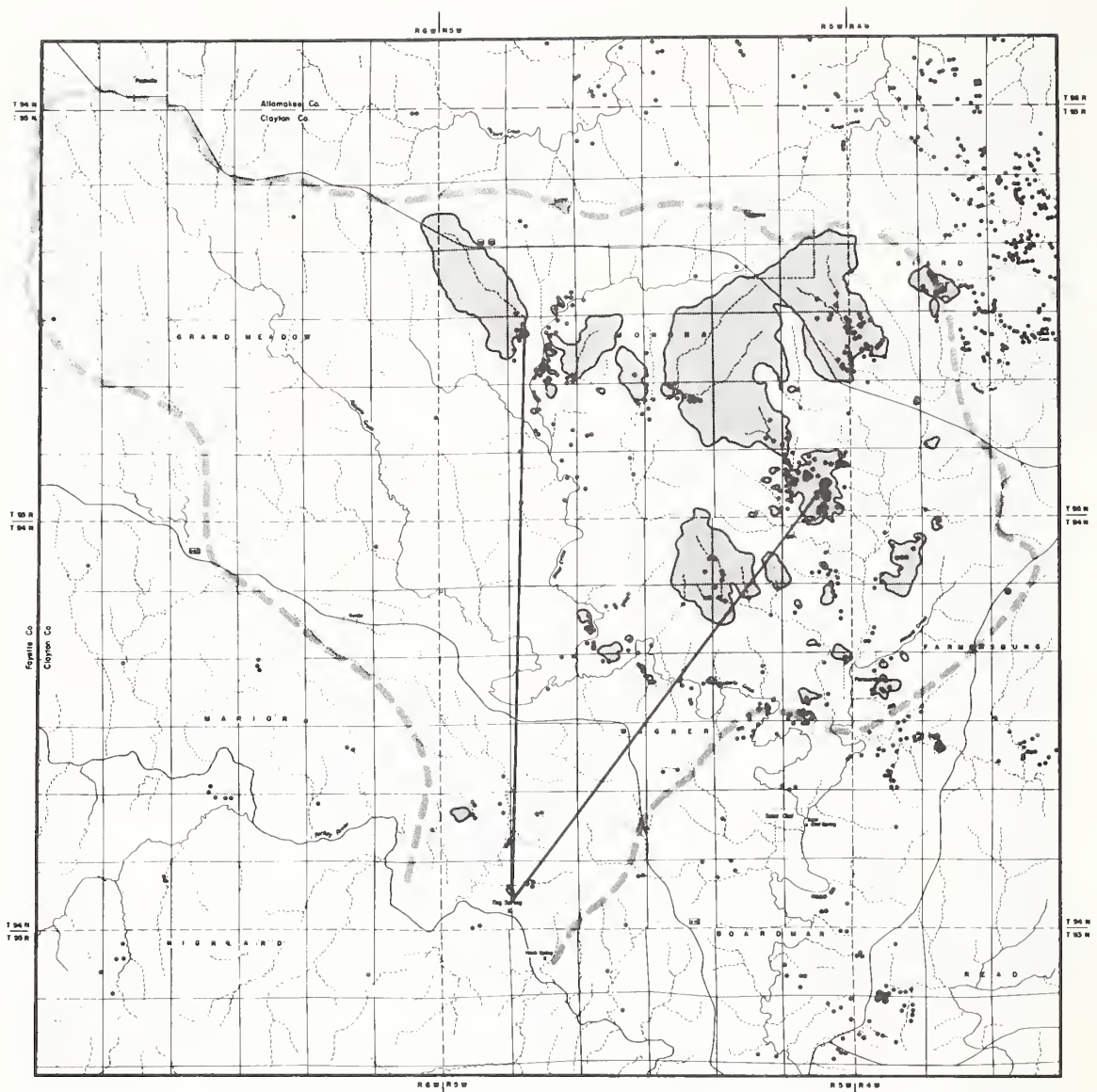
Omf-Maquoeta Fm
 Ft Atkinson, Clermont, and Elgin Members

Odp Odp-Decarah, Plattville, and Glenwood Frms.

Osh Osh-Shokapee Fm

Bedrock geology map of Big Spring study area.

FIGURE 2

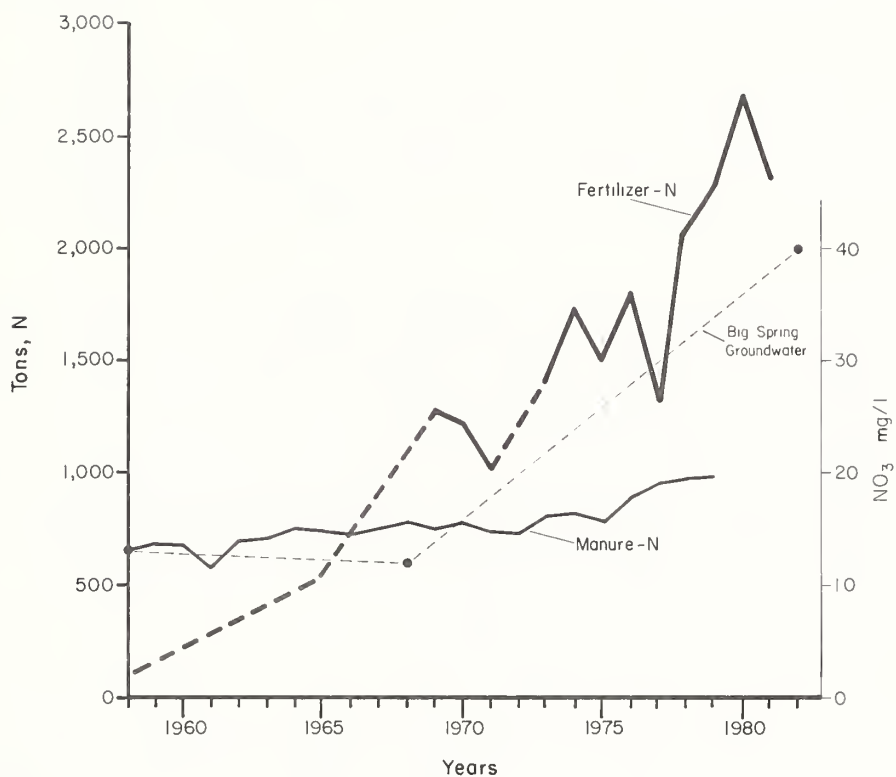


 Major surface basins draining to sinkholes
 in the Big Spring Groundwater Basin

Big Spring basin showing major surface water basins which drain to sinkholes.

FIGURE 3

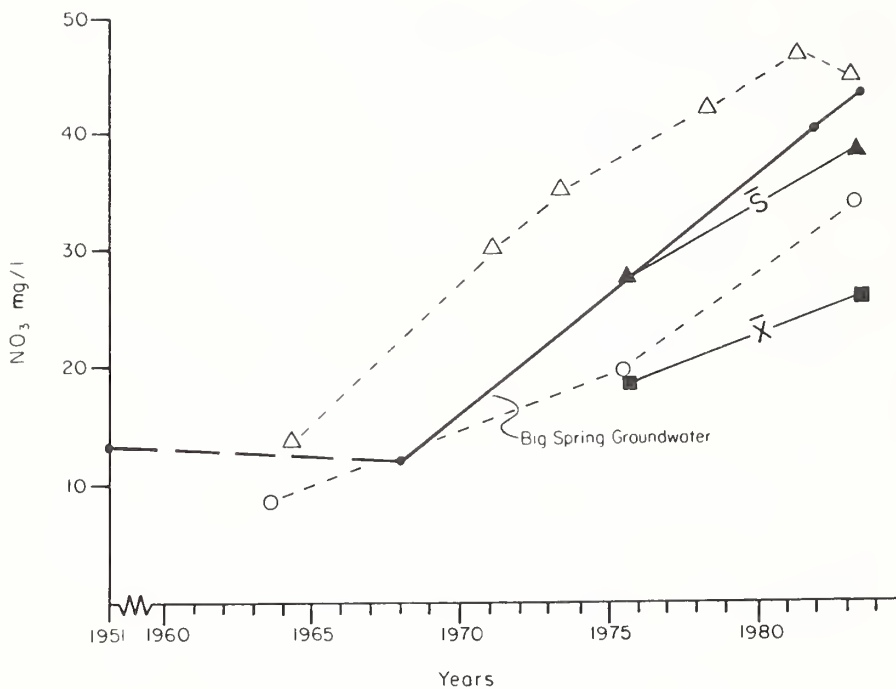
NITROGEN SOURCE



Estimated tons of fertilizer and manure nitrogen applied in the Big Spring Basin and mean nitrogen concentration (right axis) in groundwater from Big Spring (from Hallberg et al., 1983b).

FIGURE 4

NITRATE CONCENTRATION



Change in mean nitrate concentration in groundwater from Big Spring, the total well network (\bar{x} , solid squares), the surficial-aquifer wells (\bar{y} , solid triangles), and two individual wells (open circles and triangles). Open-triangle data are from Hallberg and others (1983b, p. 159).

FIGURE 5

U.S. Environmental Protection Agency; University of Iowa Hygienic Laboratory; University of Iowa Institute of Agricultural Medicine; Soil Conservation Society of America; Iowa Fertilizer and Chemical Association; and the Soil Conservation Service.

Among the needs recognized by the committee were two that have general application for the entire groundwater quality hazard area: 1) the need to develop a groundwater data base, and 2) the need for systems to evaluate the effectiveness of crop production recommendations that are implemented within the hazard area.

The levels of contaminants in groundwater and the practices needed to reduce them are generally well known. A need exists, however, to quantitatively determine the effects of land treatment and management practices on groundwater quality and to determine the health effects of relatively low and persistent levels of nitrates and pesticides in drinking water.

LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT

Wildlife species which are year-round residents of the basin generally fall into two categories -- upland wildlife and forest wildlife. Upland wildlife are those species which live on land primarily managed for agriculture. Cropland, grassland, small woodlots, and the borders or 'edges' between those major land uses are the principal cover types used by upland species. Pheasant, cotton-tailed rabbit, and bobwhite quail are upland wildlife. Forest wildlife includes those species which are dependent on forest land for all or a major portion of their habitat requirements. White-tailed deer, ruffed grouse, and wild turkey are examples.

Most forest wildlife species also utilize cover types other than forest. Grassland and cropland are used for feeding, loafing, and other activities. Some minimum amount of forest must remain within the home range of the species, but above that minimum, addition of cropland and/or grassland within the home range will usually enhance the area's habitat value.

Upland species are even more dependent on a mixture of cover types being available within their home range. Generally, the more cropland, pastureland, and forest land are intermixed, the better the area is for upland wildlife. Most of the basin land is managed such that further increases in row crop acreage will cause a decline in types and interspersions of upland cover.

Wildlife habitat quality was evaluated using modifications of the 1980 Habitat Evaluation Procedure (HEP). The HEP evaluates how factors such as land use, interspersions of land uses, and management of land affect selected wildlife species. The HEP quantifies habitat quality using a Habitat Suitability Index (HSI) of 0.0 to 1.0, with 1.0 being optimal habitat for the evaluation species. Separate indexes were developed for forest and upland wildlife. Basin conditions were evaluated, and HSI's developed for 1950, 1985, and projections were made for 2005 and 2025 (Table 17). Current basin

HSI's of 0.69 for forest and 0.31 for upland wildlife mean the basin's land provides about 69 percent of its potential forest wildlife habitat value and 31 percent of its potential upland wildlife habitat value.

TABLE 17

WILDLIFE HABITAT SUITABILITY INDEXES

Northeast Iowa Rivers Basin

Habitat Type	1950	1985	2005	2025
Upland	0.33	0.31	0.27	0.24
Forest	0.60	0.69	0.68	0.67

Since 1950, cropland acreage has increased from 54 percent to 73 percent of the basin, pasture has decreased from 29 percent to 9 percent, and forest land declined from 12 percent to 8 percent. At the same time, cropping intensity has increased. In 1950, about 55 percent of the cropland was used for small grains and hay production. Presently, about 30 percent of the cropland is used for these close grown crops.

These changes in land use have contributed to a slight decline in upland habitat values. At the same time, forest habitat values increased as small fields of row crops and hay replaced small portions of forest. This increased diversity of the area for most forest wildlife species without reducing forest area below minimum requirements for the species.

Management of the various land uses as well as the interspersions of land uses affects wildlife. Much of the grassy cover is grazed heavily or mowed early in the summer. This reduces its value to wildlife. At least 60 percent of the forest land is grazed, reducing its value. Much cropland is fall plowed, burying an important winter food source, as well as allowing blowing snow to reduce the value of winter cover areas.

Habitat quality is projected to decline. Forest habitat quality will decline slightly as many small tracts of forest land are converted to other uses. Upland habitat quality will decline more severely. Grassland will be converted to cropland. Fields will be made larger, eliminating fence rows and odd areas. This all decreases the diversity of cover types.

Partially offsetting these losses are increases in land treatment practices that benefit wildlife. Conservation tillage has shown dramatic increases recently and is expected to continue. Grassed backslope and narrow base terraces with grassed slopes add grassy areas to crop fields, thus increasing diversity. These practices, and others, benefit many wildlife species. However, with projected rates of application favorable effects on wildlife will not compensate for the reduction caused by reduced land use diversity.

LOSS OF FOREST LAND

Forest land in Iowa decreased from 2.3 million acres in 1954 to 1.5 million acres in 1974—a rate of decline of 1.8 percent per year. Between 1972 and 1982 approximately one percent of the forested acres was converted each year. In the mid-1800's, forest cover for the Iowa portion of the basin was 2,141,000 acres or 40 percent of the land area. The decline to 426,500 forested acres in 1985 has been steady with the majority of converted forest land changed either to cropland or pasture. During the period from 1972 to 1982 which was studied for this report, 55 percent of the conversion was to cropland and 40 percent to pasture, with the remainder going to minor residential clearing. The size of the clearings ranged from 0.6 acres to 44 acres with an average size of 15 acres.

The main objective of forest conversion has been to use the rich fertile soils of northeast Iowa to grow more immediate and profitable agricultural crops. Much converted acreage was well suited for agricultural crops, particularly those sites on A and B slopes. However, because of the high returns agricultural crops bring, land which is better suited for permanent cover crops or forest land is also being converted to row crops. The majority (79 percent) of the forest land converted between 1972 and 1982 was on D slopes (9 to 14 percent) and steeper. A total of 291,000 acres of forest land in the Iowa portion of the basin now occupies these slopes. An expected 1,330 acres of forest land on slopes over 9 percent is projected to be converted to cropland each year until 2025. The annual total erosion on these acres is project to increase four fold from 424,000 tons to 1,692,000 tons per year. On the flatter slopes, 352 acres per year will be converted with an expected change in annual total erosion from 4,000 tons to 85,000 tons (Table 18).

TABLE 18
EFFECT OF CONVERSION ON EROSION
Northeast Iowa Rivers Basin

Slope Group	Area Converted		Average Annual Erosion	
	by 2025		1985 (Forest Land)	2025 (Cropland)
	Acres	Tons		
A-C (0-9%)	14,000	4,000	85,000	
D-G (9-25%)	<u>53,000</u>		<u>424,000</u>	<u>1,692,000</u>
TOTAL	67,000		428,000	1,777,000

Woodlot conversion to pasture (whether planned or unplanned) is often the long range effect of continued forest grazing. However, "conversion by grazing" is not recommended for cattle or forest management. Because

pastures have productivity twenty times greater than grazed woodlots, it would be beneficial to clear and maintain a small pasture than to let livestock gradually clear the entire woodlot.

The conversion of forest land affects more than timber resources and soil erosion. Some related losses include outdoor recreation opportunities and wildlife habitat.

The rate of forest conversion has shown little sign of decreasing over the last 30 years. The projection for the next 40 years is also for little change in the rate of conversion, staying at approximately one percent per year. Using this depletion rate along with an average tree planting rate of 800 acres per year, the forested acres in Table 19 are projected.

TABLE 19
FOREST LAND AREA PROJECTIONS
Northeast Iowa Rivers Basin

Year	Forested Acres
1974	473,800
1985	426,500
1990	409,800
1995	393,700
2000	375,400
2005	361,700
2010	348,800
2015	336,700
2020	325,400
2025	314,900

If no changes in the current trend occur, over 111,000 acres of forest land will have been converted to other uses, primarily cropland or pasture, by the year 2025. Some forested slopes and soils are suitable for cropland, but much of the conversion will occur on areas with high erosion hazard.

LOSS OF AGRICULTURAL LAND

Land use information developed by the USDA in 1958, 1967, 1977, and 1982 shows that the basin's farmland base has decreased one percent during the 24-year period. This is due to an average annual land use conversion of about 2,200 acres of cropland, pasture, forest land, and other farm uses to urban built-up areas. If this rate continues to year 2025 a total of over 88,000 acres will be converted to non-farmland uses, an annual loss equivalent in 2025 to eight million bushels of corn.

The historic expansion of Davenport, Dubuque, Clinton, and Oelwein was studied in detail (See Figure 6). Aerial photographs from different time periods were used to determine the area of expansion. Specific soils involved were identified from soils maps.

The four cities data were used to estimate the changes of prime farmland for the entire basin. Built-up areas of these cities and suburbs were measured from historic photographs and maps and compared with recent photographs. The time base was not equal for all. Data are summarized in Table 20.

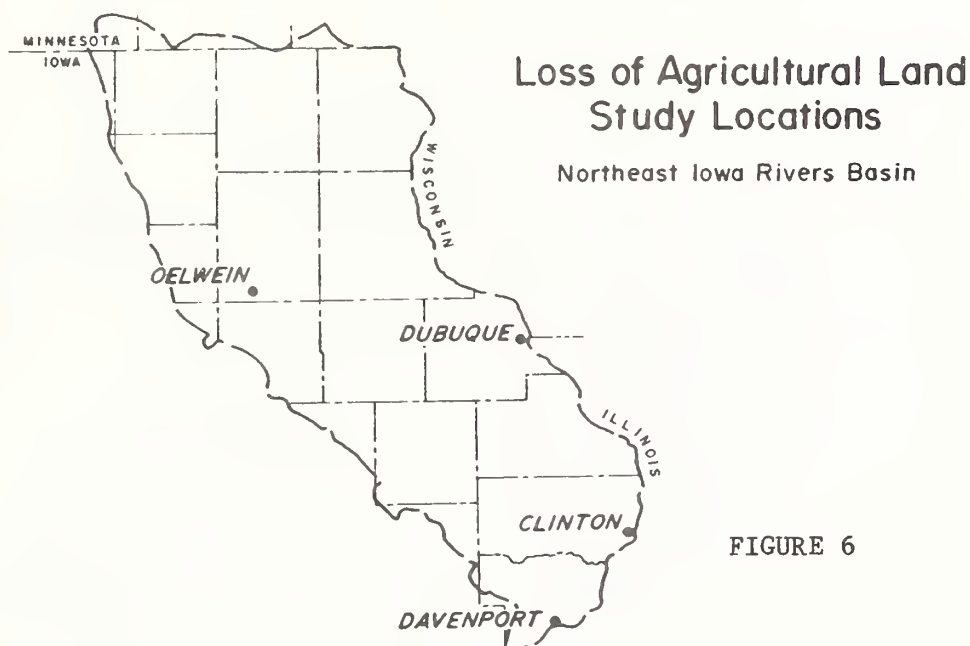


FIGURE 6

TABLE 20

HISTORIC AREAL EXPANSION OF CITIES

Northeast Iowa Rivers Basin

City	Total Growth Acres	Period Years	Average Annual Growth Ac/Yr	Loss of Prime Farmland		
				Acres	Percent	Ac/Yr
Davenport	16,430	45	365	6,570	40	146
Dubuque	9,140	40	230	320	3	8
Clinton	3,910	30	130	1,000	26	33
Oelwein	<u>1,240</u>	42	<u>30</u>	<u>1,080</u>	87	<u>26</u>
TOTAL	30,720		755	8,970	29	213

The historic growth rate for the four cities has been 754 acres per year of which 29 percent is prime farmland (Table 20). The percentage of prime farmland varies from a high of 87 percent around Oelwein to a low of 3 percent around Dubuque. The county base data for the entire basin show a decline in farmland of 2,200 acres per year. If the studied cities are typical, then 640 acres of prime farmland are being irreversibly changed to urban uses annually.

A more general study of the five unzoned counties in the basin was made to see if urban expansion in those counties was decreasing the farmland base. These data were taken from the 1982 National Resources Inventory, county base data, and previous Conservation Needs Inventories. Four of the five showed either slight or no urban expansion (Table 21).

TABLE 21

URBAN EXPANSION IN COUNTIES NOT ZONED

Northeast Iowa Rivers Basin

County	Urban Area		Urban Expansion	
	1977	1982	1977	1982
	-----Acres-----			Percent
Chickasaw	2,600	3,230	630	24
Delaware	3,520	3,660	140	4
Howard	2,530	2,570	40	2
Jones	5,170	5,170	0	0
Winneshiek	<u>3,950</u>	<u>3,950</u>	<u>0</u>	<u>0</u>
TOTAL	17,770	18,580	810	5

The accumulated land use conversion in the five unzoned counties is 810 acres in five years, an average of 162 acres per year.

The historic rate of 2,200 acres per year loss of agricultural land was considered higher than a realistic future long-term average. Therefore, future rate of loss to agriculture, based upon the 1982 National Resources Inventory, was assumed to be 1,500 acres per year of which 29 percent is prime farmland. The estimated rate allows for new water and recreation areas, 1,000 acres per year growth in urban and built-up areas, and a modest increase for highways.

CLINTON

URBAN GROWTH



FIGURE 7

DAVENPORT

URBAN GROWTH

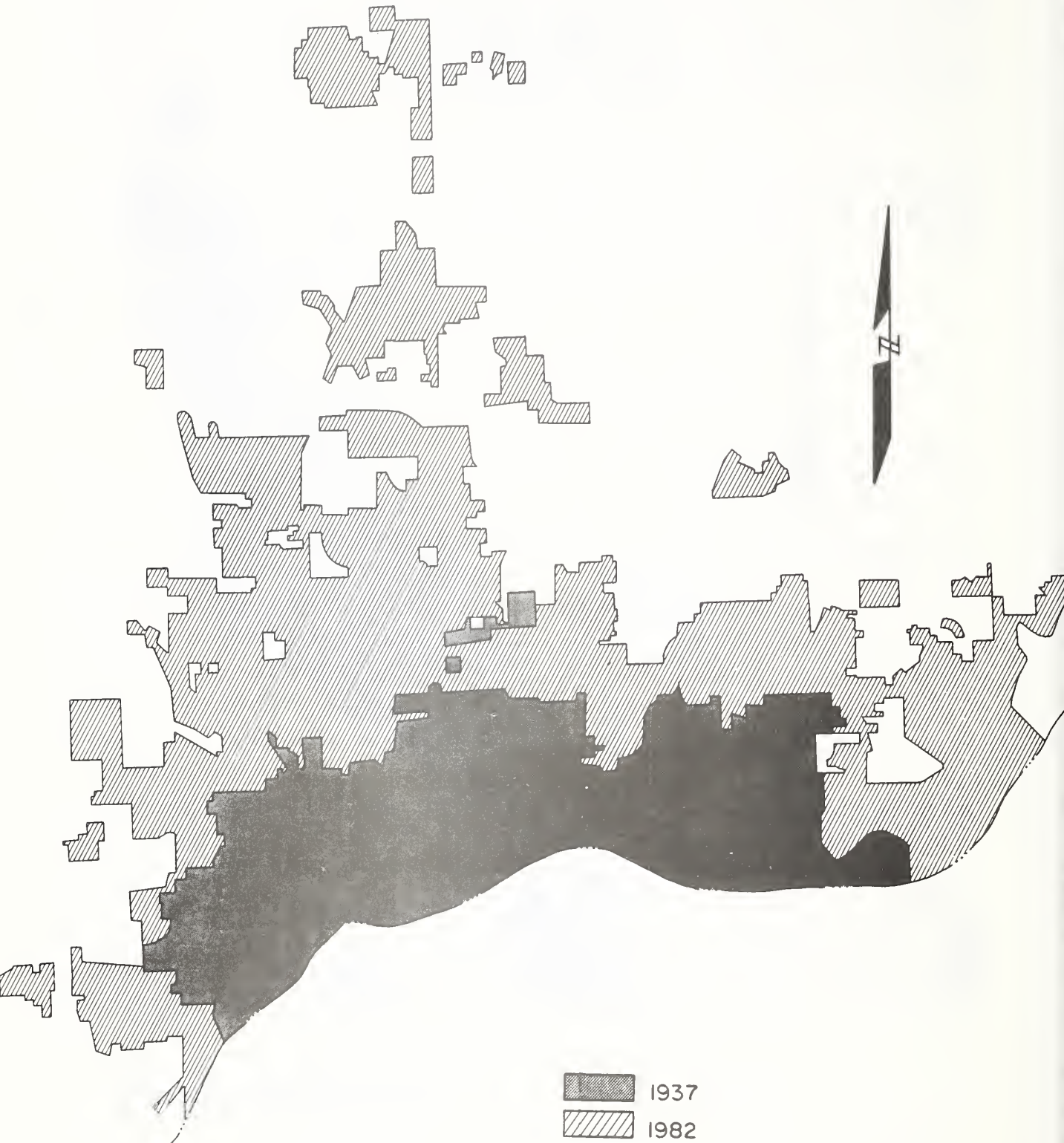


FIGURE 8



DUBUQUE

URBAN GROWTH



FIGURE 9

OELWEIN

URBAN GROWTH

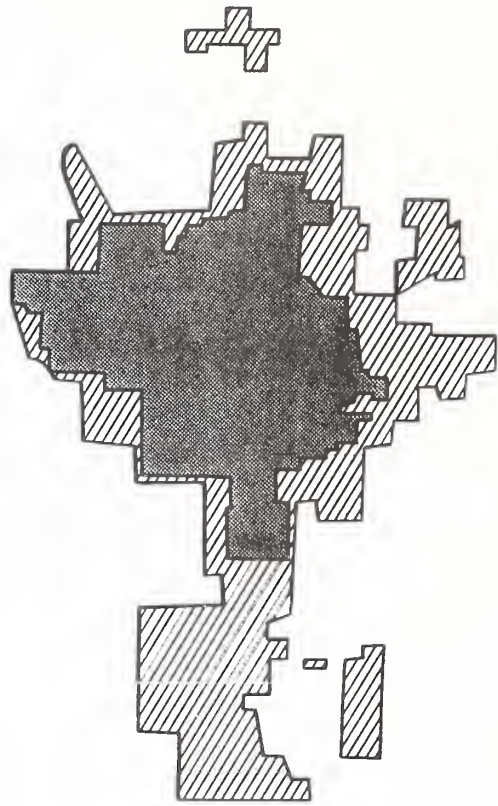


FIGURE 10

POLLUTION OF COLDWATER STREAMS

Pollution of streams was identified as a problem by the public and Sponsors. Agricultural activities were thought to impair aquatic habitat, recreation, and esthetics.

In an effort to define problems a cooperative study of the Yellow River was conducted by the University of Iowa Hygienic Laboratory, Iowa Department of Water, Air and Waste Management, and the Soil Conservation Service.

The Yellow River is classified as a warm water stream and is used for fishing and canoeing. Laboratory analyses were conducted on samples taken during two runoff events and one low-flow period in 1982. The most notable effects of the runoff on water quality were increases in total solids and associated parameters. A study of benthic organisms indicated that the water quality was good. An abstract of the Yellow River water quality report is found in Appendix E.

A conclusion based upon the Yellow River study and other data was that water quality in warm water streams in Northeast Iowa is not generally impaired for the uses designated by the State of Iowa. However, some agricultural non-point source of pollution does occur. The impact is minor and of short duration. As a result, the Sponsors agreed to limit further studies to coldwater streams.

Most of the coldwater streams in Iowa are in the basin. Of the 48 coldwater streams ^{1/} stocked with catchable-size trout by the Iowa Conservation Commission (ICC), 46 are in the basin. The base flow of these streams is from springs. Measurements at Big Spring trout hatchery show decreasing groundwater quality during the last 30 years with other springs in the area experiencing similar declines. This trend is expected to continue.

The lands of the basin are being used much more intensively now than they were in the recent past. Between 1962 and 1982 the land planted to row crops increased 78 percent while oats and hay acreage decreased 26 percent. This has caused an increase in land subject to sheet and rill erosion.

Sediment from sheet and rill, gully erosion, and streambank erosion results in a major water quality problem. Excessive sediment in runoff water adversely affects the quality of water for fish in several ways. Sediment in water has an abrasive action which physically harms the gills of fish and other aquatic life. Sediment deposited in the stream covers gravel and rubble used by spawning fish and aquatic invertebrates that serve as important fish foods. Sediment accumulations also fill the deep holes in streams used by fish as escape and resting areas. Associated increases in turbidity interferes with the efficiency of the sight-feeding trout, lowering growth rates and survival. Turbid water also tends to raise water temperatures which stress trout, lowering growth rates and survival.

1/ Iowa Trout Fishing Guide, Iowa Conservation Commission.

Livestock with access to streams and waste from confined livestock systems degrade water quality. In addition to causing problems similar to those caused by sediment, livestock wastes exert an excessive biochemical oxygen demand on the stream. In the event of large runoff, or unusually hot summers, dissolved oxygen levels can be lowered enough to stress trout, even causing downstream migration to areas where water quality is better. Ammonia levels may also become toxic, especially when combined with high temperatures and high pH.

The ICC recently quit stocking and managing a trout stream because a large cattle feeding operation was established near the headwaters of that stream. With this and more intensive land use in the watershed, water quality deteriorated enough to make the stream unsuitable for trout. The ICC believes that livestock access to streams and livestock waste runoff have the highest negative water quality impact on coldwater trout streams.

The 25 highest priority "Put and Take" streams were identified to study water quality problems. Criteria for this selection included all-season fishing and direct public access. Table 22 lists ownership data for the 25 stocked stream corridors. Data from ICC indicate about 80 percent of the stocked stream corridors in all "Put and Take" streams are privately owned.

On the 25 highest priority trout streams livestock will have access to 50 percent of the stream corridors, a total length of 37 miles. There will be 180 farmsteads where livestock are kept that contribute animal waste runoff to coldwater streams.

Excessive sheet and rill erosion will be a problem on 70,200 acres of cropland in the drainage areas of 25 trout streams. High erosion rates result in sediment delivered to coldwater streams.

Gully erosion will be a problem at 585 locations causing sediment from gully erosion to reach the 25 streams. Streambank erosion will be a problem on 15 miles of streambank.

The ICC has identified all of these factors as causes of the failure of trout to successfully reproduce at rates sufficient to maintain a population. These factors also reduce the trout carrying capacity of coldwater streams.

There are an estimated 500,000 fishing activity days per year expended for trout fishing in the Northeast Iowa Rivers Basin. Nearly 99 percent of this activity is on the 46 "Put and Take" streams. The annual economic impact of this activity is about \$10 million. Demand for trout fishing is increasing by 6 percent annually.

TABLE 22

HIGHEST PRIORITY COLDWATER STREAMS

Northeast Iowa Rivers Basin

Stream Name	County	STOCKED STREAM CORRIDORS 1/										WATERSHED	
		Private		Ownership		Total		Grazed		Tilled 4/		Area Square Miles	
		Number	Private	Percent of Length	Public	Length Miles	Length Miles	Length Miles	Length Percent	Percent	Percent		
Bigalks Creek	Howard	3	100	0	0	1.2	1.2	100	65	17.5			
Bloody Run	Clayton	15	64	36	0	11.9	5.0	42	36	20.4			
Clear Creek	Allamakee	5	100	0	0	6.6	2.6	40	22	16.2			
Coldwater Creek	Winneshiek	1	16	84	0	1.9	0	0	57	18.7			
Ensign Hollow	Clayton	2	100	0	0	0.9	0.7	83	41	1.1			
Fountain Springs	Delaware	4	46	54	0	2.4	1.7	71	52	3.8			
French Creek	Allamakee	4	62	38	0	5.0	3.5	69	12	11.2			
Glover Creek	Fayette	2	79	21	0	2.0	0.7	33	76	6.9			
Grannis Creek	Fayette	4	78	22	0	1.5	0.4	25	70	5.9			
Hickory Creek	Allamakee	4	100	0	0	3.3	2.5	74	52	23.3			
Joy Springs	Clayton	2	83	17	0	1.4	0.7	50	79	19.0			
Little Paint	Allamakee	0	0	100	0	1.9	0	0	35	13.7			
Little Turkey	Delaware	5	100	0	0	3.0	2.7	89	44	8.0			
North Bear 2/	Winneshiek	7	60	40	0	4.2	3.8	91	57	33.7			
North Cedar	Clayton	0	0	100	0	3.2	0	18	29	5.5			
Richmond Spring	Delaware	0	0	100	0	1.0	0	0	64	12.8			
Sny Magill	Clayton	2	16	84	0	6.3	0	0	38	9.7			
South Bear	Winneshiek	5	48	52	0	4.4	2.0	46	42	19.7			
S. Fork Big Mill	Jackson	0	0	100	0	0.8	0	0	32	2.2			
Spring Branch	Delaware	6	73	27	0	2.9	2.1	74	74	18.8			
Trout River	Winneshiek	7	75	25	0	2.6	1.8	72	22	20.2			
Trout Run	Winneshiek	3	62	38	0	1.2	1.2	100	57	36.5			
Twin Springs	Winneshiek	0	0	100	0	1.0	0	0	38	1.1			
Waterloo Creek 3/	Allamakee	9	100	0	0	6.2	3.9	63	59	47.7			
Wexford Creek	Allamakee	2	100	0	0	1.9	1.0	52	30	15.6			
TOTAL						78.7	37.5			389.2			

1/ Physical Inventory of Trout Streams and Survey of Trout Angler Attitudes Study 604.1 (1981) and Study 604.2 (1982), Iowa Conservation Commission.

2/ North Bear Creek drainage area is 34 percent in Minnesota.

3/ Waterloo Creek drainage area is 58 percent in Minnesota

4/ SCS Land Use Study - 1983.

STREAMBANK EROSION

Public concern for streambank erosion, expressed at DeWitt and Fayette public meetings September 1981, placed this problem third priority based upon response sheet data compilation. Local people in the northern part of the basin are particularly concerned with the annoying, damaging aspects of streambank erosion. Forty-one percent of respondents at Fayette and 36 percent at DeWitt chose this problem as one of the four most important.

The 1977 NEI (National Erosion Inventory) was the principal source for quantifying the streambank erosion problem. County data were tabulated for total length of streams, eroding length, rate of land voiding, and weight of eroded material. County summaries were factored by the percent of the county area in the Northeast Basin. See numerical data below for quantification of this problem (Table 23). Length of streams is the summation of measurements along the thread of all intermittent streams. Streambank erosion distances have been analyzed in units of bank miles. One stream mile equals two bank miles. Area voided is the land surface formerly above the streambank but later eroded away. Area depreciated is land area not eroded away but isolated or otherwise caused to lose economic value by irregular patterns of streambank erosion. Economic damage results from inability to farm the land or from less efficient farming due to additional or more crooked end rows. Depreciated land may revert to less intense land uses as pasture or forest land.

More intense land use is the principal cause for a 1985-2025 projected 0.2 percent average annual increase in streambank erosion.

TABLE 23

STREAMBANK EROSION DATA

Northeast Iowa Rivers Basin

Item	Unit	1985	2025
Length of Streams	stream miles	11,080	11,080
Length of Erosion	bank miles	7,860	8,480
Severely Eroding	bank miles	337	364
Material Eroded	tons/year	1,040,000	1,122,000
Area Voided	acres/year	143	154
Area Depreciated	acres/year	36	39

Damages were classified as loss of land, sedimentation damage, and other damage. Land loss includes the actual voiding of land, and depreciation of adjacent areas. Sedimentation damage is composed of: depletion of reservoir storage, loss of channel capacity, infertile deposition on productive land, and loss of depth in navigation channels. Sediment material from streambank erosion is low in magnitude when compared with the great amounts attributed

to other sources. The sediment damage value herein reflects only that attributed to streambank erosion. Other damages includes damage to public and private facilities, and reduction in environmental quality. Included with facilities are buildings, bridges, fences, roads, and utilities. Environmental aspects include safety, inconvenience, water quality, fisheries, and esthetics.

Monetary loss to streambank erosion totals \$790,000 annually. This amount is projected to increase to \$854,000 by 2025. Monetary amounts for three categories of damage are displayed below (Table 24).

TABLE 24
STREAMBANK EROSION DAMAGE
Northeast Iowa Rivers Basin

Damage	Average Annual Loss	
	1985	2025
	-----Dollars-----	
Land <u>1/</u>	317,000 (179 ac/yr)	343,000 (193 ac/yr)
Sediment <u>2/</u>	70,000	75,000
Other <u>2/</u>	<u>403,000</u>	<u>436,000</u>
TOTAL	790,000	854,000

1/ Land acreage is 80 percent voiding and 20 percent depreciation. Valued at \$1,776 per acre, the November 1, 1983, weighted average land price for NEIRB. Source: "USDA Census of Agriculture", and "Survey of Real Estate Brokers County Data", Iowa State University.

2/ Sediment damage estimated at 22 percent of Land Damage. Other damage estimated at 127 percent of Land Damage. Source: U.S. Army, Corps of Engineers, North Central Division, "Report on Streambank Erosion Study of the Upper Mississippi Region", Chicago, May 1969.

ALTERNATIVE PLANS

Two alternative plans, a RPP (Resource Protection plan) and a EAP (Early Action plan), were developed for the protection or enhancement of natural resources. These two alternatives were developed to quantify the range of plan elements needed for problem reduction, costs, and impacts associated with each plan. The needed plan elements are in addition to the on-going programs. These alternatives present a range which can be used to compare a moderate amount of activity and a maximum amount of activity. It is expected that somewhere within this range an acceleration of technical assistance and installation will occur.

The elements included in the Early Action plan can be installed or implemented in a 20-year period while the Resource Protection plan is projected to take 40 years.

Both alternatives consider current and projected technical assistance, cost-sharing levels, and acceptance by the public. The Resource Protection plan was developed to minimize the problems. This plan would enhance or preserve the natural resources and minimize irreversible or irretrievable commitments of resources.

Neither alternative completely solves all identified problems. A plan to treat all problems would be both unrealistic and uneconomical. Each alternative simply represents a combination of plan elements with high priority and expressed local interest to solve identified problems.

SHEET AND RILL EROSION

CROPLAND - The Resource Protection plan was based on needs shown in 1982 National Resources Inventory data. Inventory data were used to identify existing conservation practices by slope group. These basic data were used to project amounts of accelerated soil conservation practices for the basin. The plan elements recommended are based on current conditions for cost sharing, technical assistance, and acceptance by local landowners. The conservation treatments in the Resource Protection plan are based on reducing erosion to tolerable levels on each acre of cropland. Although this plan was constrained to allowable soil loss levels, it was developed using commonly acceptable practices and combinations of practices.

Average installation costs were developed for each treatment measure. Total installation costs, \$345 million, were converted to annual costs including operation and maintenance costs. An 8-5/8 percent interest rate was used to amortize installation costs.

The annual cost of the Resource Protection plan to treat cropland is \$28.4 million annually. If this cost were spread over the problem acres treated, it would be \$20 per acre per year. If this plan were installed evenly over a 40-year period, it would require a capital investment of \$8.6 million per year. Additional costs beyond installation costs will be 2,800 staff-years of technical assistance or 70 staff-years per year.

The costs shown in Table 26 are estimated 1985 values. Estimated total cost does not reflect cost sharing or potential benefits. The negative numbers for reduced tillage reflect the reduced cost of operation to the farmer for adopting these practices.

The plan element acreages listed in Table 26 total more than those identified as problems (Table 1) because more than one treatment is needed on some acres. For example, reduced tillage and terraces may be applied on the same area. Also, the erosion control alternatives were based on treating problems in a field and not merely the soil mapping units with a problem. Therefore, many acres of nonproblem areas are included.

The RPP would provide a significant impact on cropland in the Northeast Iowa Rivers Basin. This plan would reduce the erosion rate on excessively eroding cropland from 13.3 tons per acre per year to 4.5 tons per acre per year. Depletion costs of \$20.5 million in 2025 would be eliminated. For every acre of soil mapping unit that is identified as depleting, a total of 1.6 acres will be treated. This is because of multiple treatments on some acres and treatment of associated acres within fields.

Consequently in order to treat the 1.4 million acres with excess erosion, 2.3 million acres would be treated at an annual cost of \$28.4 million. This would reduce annual depletion costs by \$20.5 million. The direct cost to the farmer is \$345 million. The cost of \$345 million does not take into account cost sharing of any kind.

The Early Action plan will treat those soils that generally have shallow topsoils, high erosion rates, and are cropped intensively. The selected soils included in the Early Action plan are projected to change to the next erosion phase by 2025.

The specific soils selected for early action are shown in Table 25. Highest priority is given to the Downs-Fayette soils associations in all slope groups and all shallow soils with more than 4,000 cropland acres. This high priority area includes an estimated 1.1 million cropland acres of which 831,000 acres are expected to change erosion phase by 2025.

TABLE 25

AREA PROJECTED TO CHANGE EROSION PHASE

EARLY ACTION PLAN

Northeast Iowa Rivers Basin

Soil	Average	Cropland	Amount Depleted - 2025	
	Slope		Acres	Acres
	Percent			
Lindley	20	5,000	5,000	100
Dubuque	11	16,000	14,000	88
Dubuque	16	26,000	24,000	92
Rockton	3	4,000	2,000	50
Rockton	3	9,000	1,000	11
Burkhardt	3	6,000	2,000	33
Sogn	11	9,000	3,000	33
Frankville	11	8,000	4,000	50
Nordness	11	14,000	14,000	100
Nordness	20	6,000	6,000	100
Marlean	11	5,000	5,000	100
Mattland	16	5,000	1,000	20
Winneshiek	3	6,000	2,000	33
Winneshiek	7	6,000	3,000	50
Wapsie	3	4,000	1,000	25
Lourdes	3	4,000	2,000	50
Donnan	3	10,000	10,000	100
Downs	3	39,000	13,000	33
Downs	7	128,000	79,000	62
Downs	11	100,000	90,000	90
Downs	16	14,000	14,000	100
Fayette	7	186,000	181,000	97
Fayette	11	270,000	218,000	81
Fayette	16	148,000	105,000	71
Fayette	20	62,000	32,000	52
TOTAL		1,090,000	831,000	

Approximately 42 percent of the depleting soils are located on 9 to 14 percent slopes. Another 32 percent are on 5 to 9 percent slopes. These areas may require more than one type of practice on each acre. Some practices will be applied to field-size areas and therefore will be applied to acres which do not have an erosion problem.

The cropland erosion reduction measures in the Early Action plan are shown in Table 26. These measures will be installed in areas where they are best adapted to solving the specific types of erosion problems.

Elements of the Early Action plan are based on systems to reduce sheet and rill erosion. Grassed waterways or grade stabilization structures may have a minimal impact on sheet and rill erosion. If they are installed in conjunction with contouring or contour stripcropping for example, they are considered necessary parts of an erosion control system.

With reduced costs of conservation tillage annual installation costs for protecting 830,600 problem acres will be reduced an estimated \$5.5 million or \$2.70 per excessively eroding acre. Table 26 compares the Early Action plan with Future Without Conditions and with the Resource Protection plan. Installation of these land treatment measures will preserve the resource base and enhance the landscape appearance.

Implementation of the EAP elements to achieve soil conservation will not shift production within the basin. The area with highly erodible soils or serious depletion can be expected to receive high priority for land treatment and technical assistance.

Implementation of this plan will have a capital cost of nearly \$71 million for the installation of erosion control measures. This cost is in addition to the current on-going program. Other land treatments will result in additional costs due to reduced income or in some cases improved income due to reduced production costs.

The \$71 million capital costs expended equally over a 10-year period will require an annual capital outlay of \$7.1 million. This could be a combined input from landowners and federal, state, and local cost sharing.

In addition it will require 710 staff years of technical assistance, an additional 71 people per year. This plan does not solve all problems within the basin. The long-range critical need is for treatment of the 0.6 million acres of eroding cropland not included in the Early Action plan.

The Early Action plan will have a significant impact on maintaining the quality of the land resource base in the Iowa portion of this basin. This plan will reduce the erosion rate on cropland exceeding tolerable levels from an average of 13.3 tons per acre per year to less than tolerable levels. Total tons of erosion on excessively eroded cropland will be reduced from 18.6 million tons per year to 7.6 million tons per year.

Annual depletion costs will be reduced from \$20.5 million to \$8.4 million. This EAP will treat those soils with the highest erosion rates and most serious depletion, therefore, by implementing this plan a large proportion of depletion would be reduced.

Those soils listed in Table 25 are presently utilized intensively for row crop production and are degrading. The Early Action plan will sustain productivity without a significant change in row crop intensity. Some soils will need several conservation practices combined with some management practices, when used for row crop production, to eliminate excessive erosion.

TABLE 26

SHEET AND RILL EROSION - CROPLAND

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Elements & Impacts	Units	Future Without Project Conditions	Resource Protection Plan	Early Action Plan
Change in Rotations	Acres	--	130,000	--
	Ann Cost (\$)	--	3,250,000	--
Conservation Tillage	Acres	--	2,271,000	1,300,000
	Ann Cost (\$) <u>1/</u>	--	-28,388,000	-16,250,000
Contour Farming	Acres	--	1,501,000	500,000
Grade Stabilization Structure	Number	--	6,000	3,000
	Ann Cost (\$)	--	5,790,000	2,895,000
Grassed Waterway	Acres	--	18,000	8,400
	Ann Cost (\$)	--	3,294,000	1,537,000
Stripcropping, Contour	Acres	--	655,000	130,000
Terrace	Acres	--	706,000	100,000
	Ann Cost (\$)	--	44,478,000	6,300,000
Land With Erosion Exceeding Tolerable Levels	Acres	1,400,000	--	600,000
Erosion Rate	T/Ac/Yr	13.3	4.5	8.1
Total Erosion on Cropland	1,000 Tons	18,600	6,300	7,600
Annual Depletion Cost	Million (\$)	20.5	--	8.4
Annual Cost of Treatment	Million (\$)	--	28.4	-5.5
Additional Technical Assistance	Staff Years/Yr	--	70	35
	Ann Cost (\$)	--	2,450,000	1,225,000

1/ Negative costs reflect reduced production expenses associated with this practice or plan.

Within the list of soils changing erosion phases, there are a number of ways that they can be prioritized for early action. Local leaders may want to consider one or more of the following alternatives for setting priorities by soil mapping unit. Priority may be based on depletion costs per acre as they change from one erosion phase to another. It could also be based on total depletion cost. This value is the area of a soil mapping unit in acres times the depletion costs per acre of changing erosion phases. Priority may be based on those soils that have an unfavorable subsoil or a combination of depletion costs and subsoil characteristics.

PASTURE - The objective of the Resource Protection plan is to control excessive erosion on all pasture and enhance environmental quality. This alternative consists of utilizing warm season grasses, cool season grasses, and grass-legume mixtures in pasture programs. The steeper slopes would be planted with trees and livestock grazing would be eliminated.

Pasture planting and management practices would be used on approximately 12,800 acres. Approximately 26,700 acres of tree planting is needed on those acres with greater than 18 percent slopes. This plan would treat the entire problem area of 39,500 acres.

The total cost of the RPP is \$1,025,500 annually or \$26 per problem acre treated. Installation of these measures would have a capital cost to landowners of \$5,157,000; \$1,152,000 for pasture planting and \$4,005,000 for tree planting.

Installation of erosion control measures would reduce erosion to tolerable levels on each treated acre. Excessive erosion would be reduced by 376,000 tons with these measures.

Diversity of pasture plantings and tree planting would enhance the quality of the environment. These measures would eliminate overgrazing and provide sufficient vegetative cover to adequately protect the soil. In addition to controlling erosion, this plan will provide an additional 38,400 AUM (animal-unit-months) of grazing with an estimated annual value of \$768,000. It will also provide an additional \$60,000 annual value of forest products.

The Early Action plan consists of treating 5,500 problem acres with slopes of 5 through 18 percent. These acres are the easiest to work without special machinery. This includes 5,000 acres of pasture planting and pasture management and 500 acres of brush management. An additional 4,000 acres of tree planting on slopes over 18 percent should be emphasized immediately. Slopes over 18 percent are too steep for mechanical operations, therefore, large amounts of hand labor will be required to plant trees.

The annual cost of brush management and pasture planting and management is \$268,000 or \$49 per acre. The annual cost of tree planting for this alternative is \$52,000.

The implementation of the Early Action plan will reduce erosion to tolerable levels on all treated acres. In addition, it will provide 15,000 animal-unit-months of grazing with an estimated annual value of \$300,000.^{1/}

TABLE 27
SHEET AND RILL EROSION - PASTURE
SUMMARY AND COMPARISON OF ALTERNATIVE PLANS
Northeast Iowa Rivers Basin

Elements & Impacts	Units	Future Without Project Conditions	Resource Protection Plan	Early Action Plan
Brush Management	Acres	--	--	500
	Ann Cost (\$)	--	--	3,000
Pasture Planting	Acres	--	12,800	5,000
	Ann Cost (\$)	--	230,000	90,000
Pasture Management	Acres	--	12,800	5,000
	Ann Cost (\$)	--	448,000	175,000
Tree Planting	Acres	--	26,700	4,000
	Ann Cost (\$)	--	347,000	52,000
Land With Erosion Exceeding Tolerable Levels	Acres	39,500	0	30,000
Additional Forage Production	AUM Ann Value (\$)	-- --	38,400 768,000	15,000 300,000
Forest Production	Ann Value (\$)	--	60,000	--
Annual Cost of Treatment	Million (\$)		1.0	0.6
Additional Technical Assistance	Staff Years/Yr Ann Cost (\$)	-- --	0.7 24,500	0.3 10,500

^{1/} Value of \$20 per animal-unit-month based on value of production when marketed through a cow-calf operation.

FOREST LAND - Although some erosion may result from normal forestry activities such as harvesting and site improvement, the principal cause of forest land erosion is livestock grazing. Extensive and continuous grazing of forest lands results in serious erosion problems, especially on the steeper slopes. Livestock exclusion, timber stand improvement, and reforestation are three measures that can be undertaken to reduce future erosion.

Under the Resource Protection plan livestock exclusion measures (fencing) would be established on all grazed forest land eroding over T (Table 28). In addition, about 76,000 acres of forest land would receive timber stand improvement measures to develop a healthy productive stand of desirable forest species. Practices such as chemical control and non-commercial thinning would be applied to some of the previously grazed forest land to control species mix and quality. Supplemental tree planting is planned for 44,000 acres of previously grazed forest lands to ensure adequate quality and quantity of desirable species.

Currently there are about 114,000 acres of forest land eroding above T due to excessive livestock grazing. The average erosion rate for these acres is 14 tons per year for a total annual erosion of 1,593,000 tons. These severely eroding acres account for only 24 percent of all forest land in the Iowa portion but contribute 75 percent of the total annual erosion from forested lands.

With implementation of the Resource Protection plan, all soil erosion in excess of T that is occurring on forest land would be eliminated (Table 28). This would reduce the annual erosion rate for grazed forest land from 9.6 tons per acre to 1.4 tons per acre. Total erosion from forest land would be reduced to 86,000 tons per year, a reduction of 1,598,000 tons. With the additional conversion of 140,000 acres of marginal cropland, soil erosion within the basin would be reduced an additional 2,380,000 tons per year.

In addition, many acres currently cropped are marginally productive and have exceptionally high erosion rates. These marginal croplands are usually on the steeper slopes and, in most cases, are in erosion phase 2 or 3. In most cases these acres should be converted to permanent vegetation, either grass or trees. The Resource Protection plan calls for 140,000 acres of marginal cropland to be planted to trees. These acres include those croplands on E slopes and in erosion phase 3 and those on F and G slopes in erosion phases 2 or 3.

The total annual cost for these measures is \$4,850,000. In addition, it is estimated that two additional staff years of technical assistance will be needed annually for the duration of the implementation period.

Under the Early Action plan, forest land erosion control would be targeted towards the more severely eroding sites. These would be those grazed forest lands on slopes greater than 17 percent. It is anticipated

TABLE 28

SHEET AND RILL EROSION - FOREST LAND
SUMMARY AND COMPARISON OF ALTERNATIVE PLANS
Northeast Iowa Rivers Basin

Elements & Impacts	Units	Future Without Project Conditions	Resource Protection Plan	Early Action Plan
Cropland Conversion	Acres	--	140,000	46,000
	Ann Costs (\$)	--	2,588,000	1,185,000
Livestock Exclusion	Acres	--	114,000	36,000
	Ann Costs (\$)	--	1,026,000	324,000
Timber Stand Improvement	Acres	--	76,000	22,000
	Ann Costs (\$)	--	392,000	160,000
Tree Planting	Acres	--	44,000	14,000
	Ann Costs (\$)	--	844,000	364,000
Land with Erosion Exceeding Tolerable Levels	Acres	114,000	0	78,000
Erosion Rate <u>1/</u>	T/Ac/Yr	9.6	1.4	8.4
Forest Land Erosion	Tons/Year	1,684,000	86,000	1,166,000
Grazed Forest Land	Acres	175,000	61,000	139,000
Reduction in Cropland Erosion	Tons/Year	--	2,380,000	782,000
Annual Cost of Treatment	Million (\$)		4.8	2.0
Additional Technical Assistance	Staff Years/Yr	--	2	1
	Annual Cost (\$)	--	100,000	50,000

1/ For grazed forest land only. Undisturbed forest land estimated to have a negligible erosion rate.

that livestock could readily be excluded from 36,000 such acres with a modest amount of activity (Table 28). Associated with this level of activity it is expected that 22,000 acres would receive some form of timber stand improvement. This may be non-commercial thinning or weed-brush control. In addition 14,000 acres would be reforested.

It is anticipated that with a modest amount of activity 46,000 acres of marginal cropland would be converted to trees. Efforts would be concentrated on those cropland acres on 18 to 30 percent slopes and in erosion phase 2 or 3.

Under the Early Action plan, only 32 percent of those forested acres with soil erosion in excess of T would be treated. Still, this would reduce total erosion from grazed forest land by over 250,000 tons per year (Table 28). By converting 46,000 acres of marginal cropland, total annual erosion in the basin would be reduced 782,000 tons.

Annual costs for this alternative would total \$2,033,000. An additional staff year of technical assistance would be necessary annually to implement the plan.

GROUNDWATER CONTAMINATION

The Ad Hoc Karst Committee, as part of their work, defined specific problems and identified potential solutions. The committee recommended that agencies should include the concerns of groundwater protection within the scope of their programs. They also recommended prioritizing programs to sinkhole basins with emphasis on crop rotations, stripcropping, conservation tillage, permanent vegetation, and total nitrogen management.

The Resource Protection plan was developed to minimize the contamination of groundwater due to agricultural practices.

Sediment and attached and dissolved pollutants reaching groundwater through sinkholes will be reduced. Commonly acceptable soil and water conservation practices and combinations of practices will be used on cropland within sinkhole drainage areas that are eroding at rates above the tolerable level.

Conservation practices will also be used on cropland within sinkhole basins and overlying shallow bedrock that would be depleting by 2025, and thereby require additional fertilizer-N and pesticide inputs to maintain the recommended level of management.

Fertilizer and pest management are also needed on all 2,653,000 acres of cropland within sinkhole basins and overlying shallow bedrock. Fertilizers and pesticides could be used more efficiently. With higher efficiency, total applications could be reduced with a corresponding decrease in nitrate and pesticides reaching the groundwater.

A demonstration project is included as part of the Resource Protection plan that would address the health effects as well as concerns about the effectiveness and practicality of certain practices. This demonstration project would also provide a basis for an educational program aimed at residents of the entire 3.4 million acre high-hazard area.

A seven-year cooperative project will be conducted within a 103-square mile groundwater basin which discharges at Big Spring in Clayton County. It consists of various components aimed at the whole area and parts of the area. Educational efforts will be directed at the basin area to gain cooperation in managing fertilizer, pesticides, and animal wastes. The Cooperative Extension Service has already started a newsletter for residents of the Big Spring basin.

Soil conservation practices and fertilizer, pest, and animal waste management practices will be implemented in a single subbasin draining to a sinkhole. Surface and tile drainage waters will be monitored. The data that are collected will allow the evaluation of the economics of the fertilizer and pest management practices. Researchers will also demonstrate and evaluate the effects of selected practices such as nitrogen shielding, multiple or split applications of nitrogen, different nitrogen rates, and crop rotation effects on crop yields and nitrogen losses.

The ultimate proof of effectiveness of the practices installed in the demonstration project is improvement in groundwater quality. Discharge and quality of both surface water and groundwater will be monitored so that the volume of water, nitrogen, and pesticides lost from the basin can be quantitatively evaluated in relation to management changes.

The annual cost of each of the recommended plan elements in the Resource Protection plan is shown in Table 29. It will require an additional 1,670 staff years of technical assistance or 42 staff years per year.

The Early Action plan targets those acres that drain directly to sinkholes. Soil conservation practices will be applied to 71,700 acres of cropland that would be eroding at rates greater than tolerable. Without soil conservation measures, 40,500 of these acres will be depleted by 2025. As soils deplete additional inputs of fertilizer are necessary to maintain the recommended level of management. An additional 18.9 million pounds of nitrogen fertilizer are estimated to be needed during the next 40 years if these soils are not protected.

Fertilizer and pest management are also needed on 199,100 acres of cropland draining to sinkholes. Nitrate and pesticides in groundwater can be reduced about 30 percent by applying fertilizer and pesticides more efficiently.

An implementation project is also proposed to demonstrate best management practices in the field, evaluate their effects both on groundwater quality and on crop production, and provide a foundation for a research data base for the educational programs, and the institutional and policy issues which agriculture must address to solve these problems.

The total cost of the Early Action plan and the plan elements are shown in Table 29. It will require an additional 170 staff years of technical assistance or 8.5 staff years per year.

TABLE 29
GROUNDWATER CONTAMINATION
SUMMARY AND COMPARISON OF ALTERNATIVE PLANS
Northeast Iowa Rivers Basin

Elements	Units	Resource Protection Plan	Early Action Plan
Conservation Tillage	Acres	864,000	116,000
	Ann Cost (\$)	- 10,806,000 <u>1/</u>	- 1,449,000
Contour Farming	Acres	571,000	76,600
Demonstration Project	Number	1	1
	Ann Cost (\$)	2,769,000 <u>2/</u>	2,769,000
Fertilizer Management	Acres	3,476,000	260,800
Filter Strip	Acres	3,300	3,300
	Ann Cost (\$)	148,000	148,000
Grade Stabilization Structure	Number	2,600	600
	Ann Cost (\$)	2,509,000	579,000
Grassed Waterway	Acres	7,200	1,300
	Ann Cost (\$)	1,318,000	238,000
Pest Management	Acres	3,476,000	261,000
Stripcropping, Contour	Acres	249,000	33,400
Terrace	Acres	49,500	6,600
	Ann Cost (\$)	3,118,000	416,000
Annual Cost of Treatment	Million (\$)	- 0.9	2.7
Additional Technical Assistance	Staff Years/Yr	42	8.5
	Ann Cost (\$)	1,470,000	298,000

1/ Negative costs reflect reduced production expenses associated with this practice or plan.

2/ Demonstration project is amortized for a seven-year period.

LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT

Habitat evaluation indicated four primary factors limiting upland habitat quality and two primary factors limiting forest habitat quality. Upland habitat limiting factors are lack and poor distribution of grasslands, improper management of existing grassland, poor distribution of forest land and other woody cover, and improper cropland management. Factors reducing forest habitat quality are loss of forest cover and uncontrolled grazing of forest land.

Two alternative plans were developed to improve habitat quality by treating those limiting factors which were identified. These plans are based on elements from plans developed primarily to address other problems as well as elements developed specifically to offset wildlife habitat losses. Alternatives, discussed below, were developed based on information supplied by Soil Conservation Districts and Iowa Conservation Commission.

The objective of the Resource Protection plan alternative is to maintain and wherever possible to improve habitat values. Some plan elements may be implemented by redirecting existing programs and funding. Other elements would require special legislation on the state or national level or additional funding levels of existing programs.

Plan elements are listed in Table 33. Total annual cost of the RPP is \$53,067,000. It would require an additional 16 staff years of technical assistance per year costing \$560,000. These costs are in addition to those included in other alternatives. Elements which are specifically included for wildlife are discussed below.

Wildlife upland habitat management involves the creation, retention, or management of areas, other than wetlands, specifically to provide food, shelter and other life requirements for desired wildlife species. A special cost sharing program to establish wildlife upland habitat is proposed. The program is designed to increase the amount and distribution of grassland to provide nesting and escape cover for upland wildlife.

The program would involve taking 20 percent of the basin's present cropland out of row crop production. Landowners would be paid rent for the land removed from production for each year they participate in the program, with a multi-year agreement required. The rental amount would be adequate to compensate the landowner for loss of income, seeding, control of weeds, and other needed management practices. Participation would be required to be eligible for existing government price support programs. The acres in the program would be required to be seeded with perennial grass or a grass and legume mixture. Hay harvest or clipping for weed control would be allowed between July 15 and August 15 only, and no grazing would be allowed. Cropland on 9 to 25 percent slopes would be targeted for inclusion in the program. Benefits include providing areas managed for upland wildlife nesting, reduced soil loss and decreased feed grain production.

Farmstead and feedlot windbreaks are included to improve the distribution of woody cover for upland wildlife. The approximately 1,200 windbreaks included in this program would be larger than the minimum required for the normal purposes of energy conservation, controlling snow blowing, and livestock shelter. They would be designed specifically to provide adequate winter cover for pheasants and other non-migrating upland wildlife. Benefits would include all those listed as normal purposes, plus secure winter cover, beautification, and some reduced soil loss.

Protected Water Areas is an ICC program for development of management plans for the best remaining natural areas along lakes, rivers, and marshes. Management of the resources will be established through the joint efforts of the Iowa Conservation Commission and cooperating landowners. Uses such as livestock grazing, timber management and harvesting, crop production, and recreation activities will occur within protected water areas. These land uses will be located and managed so that each has minimal adverse impacts on other uses, and such that the natural and scenic character of the area will be protected. The program will benefit both forest and upland wildlife by insuring a well managed, diverse land use within 23 stream corridors. All or parts of the rivers and streams to be included in the program are listed below.

Coldwater Streams

Bear Creek	Ensign Hollow	Pine Creek
Calhoon Creek	Grimes Hollow	Richmond Springs
Coldwater Creek	Little Turkey	Spring Branch
Dousman Creek	Mossy Glen	Steele's Branch
English Creek	North Cedar Creek	Unnamed Creek

Warmwater Streams

Little Turkey River	Upper Iowa River
Maquoketa River	Volga River
North Fork Maquoketa River	Wapsipinicon River
Turkey River	Yellow River

Filter strips are vegetative buffers which will be established around sinkholes as a part of the groundwater contamination alternative. They will usually be established as a mixture of cool season grasses and legumes. For the Resource Protection plan, they will be managed as described for the wildlife upland habitat program. This will make them more valuable for upland wildlife use.

Implementation of this RPP would provide HSI values of 0.55 for upland and 0.76 for forest wildlife. Table 30 compares HSI values with and without project conditions.

TABLE 30

WILDLIFE HABITAT SUITABILITY INDEXES

RESOURCE PROTECTION PLAN

Northeast Iowa Rivers Basin

	1985 Current	2025 Without Project	2025 With Project
Upland	0.31	0.24	0.55
Forest	0.69	0.67	0.76

The RPP would also reduce soil loss an estimated 6.8 million tons annually and decrease feed grain production by 96 million bushels yearly.

This alternative meets the objectives of improving existing habitat wherever possible. It can be expected that populations of both forest and upland wildlife species would increase from current levels. Associated human activities such as hunting, birdwatching, and nature study could be expected to increase.

The objective of the Early Action plan is to maintain existing habitat values for the basin as a whole, and to improve them in areas of greatest need. The EAP includes some or all of the elements of the Resource Protection plan. The wildlife upland habitat and farmstead and feedlot windbreak programs have the most potential for improving upland habitat in a relatively short time period. These two practices will be emphasized most in Howard and Bremer Counties since they have the greatest need for upland habitat improvement.

Plan elements are also listed in Table 33. Total annual cost of the EAP is \$26,143,000. It would require an additional seven staff-years of technical assistance per year, costing \$245,000. All costs are in addition to those included for other problem alternatives.

Implementation of this alternative would provide HSI values of 0.39 for upland 0.70 for forest wildlife. Table 31 compares HSI values with and without project conditions.

TABLE 31
 WILDLIFE HABITAT SUITABILITY INDEXES
 EARLY ACTION PLAN
 Northeast Iowa Rivers Basin

	1985 Current	2005 Without Project	2005 With Project
Upland	0.31	0.27	0.39
Forest	0.69	0.68	0.70

The EAP would also include 550 windbreak locations, reduce soil loss an estimated 3.4 million tons annually, and decrease grain production by an estimated 48 million bushels yearly.

This alternative exceeds the objective of maintaining existing habitat. Upland habitat improves primarily due to the dramatic increase in grassland caused by the wildlife upland habitat program. Forest habitat improves slightly, primarily due to livestock exclusion on forest land. Populations of most upland wildlife species will increase. Forest wildlife populations will remain about the same. Associated human activities, such as upland bird hunting and nature study, could be expected to increase slightly.

Implementation of the Early Action plan will require significant amounts of capital from all sources. Sources include county, state, and federal cost-sharing and grant programs, as well as individuals' personal capital. Table 32 shows a suggested division of costs among these sources of funds.

TABLE 32
 INSTALLATION FUNDS NEEDED - LOSS OF WILDLIFE HABITAT
 EARLY ACTION PLAN
 Northeast Iowa Rivers Basin

Source	Amount, Dollars
Individuals	214,300
Counties	200,000
State	1,621,450
Federal	24,107,250

TABLE 33

LOSS, DETERIORATION, OR LACK OF UPLAND AND FOREST WILDLIFE HABITAT

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Elements	Unit	Resource Protection Plan	Early Action Plan
Conservation Tillage <u>1/</u>	Acres	2,271,000	1,300,000
Contour Stripcropping <u>1/</u>	Acres	655,000	130,000
Convert Cropland to Filter Strips <u>3/</u>	Acres	3,300	3,300
Convert Cropland to Forest <u>2/</u>	Acres	140,000	46,000
Convert Cropland to Wildlife Upland Habitat	Acres Ann Cost (\$)	800,000 48,000,000	400,000 24,000,000
Convert Pastureland to Forest <u>1/</u>	Acres	26,700	4,000
Farmstead & Feedlot Windbreaks	Acres Ann Cost (\$)	1,950 310,000	900 143,000
Livestock Exclusion Forest Land <u>6/</u>	Acres	114,100	36,000
Livestock Exclusion <u>5/</u> Trout Streams	Stream Miles Acres	37 600	3.3 53
Pasture Planting & Management <u>1/</u>	Acres	15,000	5,000
Protected Water Areas	Stream Miles Acres Ann Cost (\$)	476 150,000 4,757,000	200 65,000 2,000,000
Streambank Protection <u>4/</u>	Acres	4,500	850
Terrace <u>1/</u>	Acres	706,000	100,000
Additional Technical Assistance	Staff Years/Yr Ann Cost (\$)	16 560,000	7 245,000

1/ Cost included in erosion control alternative.

2/ Costs included in forest conversion alternative.

3/ Costs included in groundwater contamination alternative.

4/ Costs included in streambank protection alternative.

5/ Costs included in protection of coldwater streams alternative.

6/ Costs included in forest land erosion alternative.

LOSS OF FOREST LAND

Conversion of forest land to cropland or pasture is a common occurrence in the Northeast Iowa Rivers basin. Woodlots which have had livestock grazing for a long period of time eventually have so few trees left that clearing the trees seems to be the most logical step to the landowner. If the current trend continues, about 112,000 acres of forest land will have been converted by the year 2025. Some slopes and soils now in forest are suitable for cropland, but much of the conversion will occur on high erosion hazard areas.

Educating landowners as to the benefits of proper forest management is the principal means of reducing forest land conversion. If the landowners realize that properly managed forest lands will provide financial returns, as well as benefits such as improved wildlife habitat and reduced soil erosion, they will be less likely to convert those lands. Implementation of this I&E (Information and Education) effort will require additional technical specialists and detailed economic data evaluating the financial returns from managed forest land.

The major thrust of education and assistance, both technical and (when possible) financial, needed for this group of landowners include the following:

1. Fencing woodlots to keep livestock out.

Getting the livestock out of the woods and into improved pastures results in better timber growth, regeneration, and erosion control as well as better grazing for the livestock. With the continuing decline of forest land, maintaining adequate stocking levels and managing existing stands becomes even more important.

2. Harvesting practices.

Harvesting assistance includes showing the landowner when to cut and which management systems to use. It is important to design and use harvesting practices that ensure regeneration. In stands which have been high-graded, post harvest timber stand improvement practices are needed to remove the poor quality trees which are left and are suppressing desired regeneration. Other effects of harvesting, such as those which influence wildlife habitat, should also be discussed.

3. Regeneration methods.

Regeneration will follow harvesting but, if the regeneration is allowed to happen naturally, the desirable stand may not always occur (unless maple-basswood-ash is the desired stand). Site preparation may be needed to control brush and undersirable species and to prepare the seedbed. Sites which have been grazed in the past are often overtaken with multiflora rose, prickly ash, or other persistent species and intensive site preparation is needed before any trees will grow. Some grazed sites with dense overhead shade often do not have brush and are relatively easy to regenerate with

protection and natural regeneration and/or tree planting. If oak and walnut are the desired species, planting either before or after the harvest is necessary. For these and other regeneration practices to be implemented, on-the-ground technical assistance from a professional forester is needed.

Under the Resource Protection plan, this I&E initiative would be handled by a full-time forester or information specialist. This individual would be active in the basin through the year 2025. Salary, clerical support, and operating funds would total a current annual cost of \$55,000 (Table 34). It is expected that as the I&E efforts reduce the forest land clearing, additional forestry technical assistance will be needed. Annually this need was estimated to be 0.25 person year at a cost of \$13,000 including clerical support and operating costs. The current annual cost for the I&E initiative under the Resource Protection plan would be \$68,000 per year with a total cost of \$2,330,000 (Table 34).

The Early Action plan would be a more intense alternative. As a result, the current annual costs would be higher than for the other two alternatives (Table 34). The higher costs would be a result of a greater use of the various media and information dissemination systems. As with the other alternatives, additional technical assistance would be required to manage those forest lands that would otherwise have been converted. Annually the current cost for the I&E effort and supplemental technical assistance would be \$73,000. Because of the short installation time (5-10 years) and the anticipated lag in response from landowners, it is expected that less technical assistance will be needed during the early phases of the installation period.

Sound economic data are necessary to "sell" forest management. The landowners need to know what the prospective financial returns are from properly managing their forest resource. To be fully useful, this information should be as site specific as possible. Therefore it will be necessary to develop data on the economics of forest management for the soils, stand conditions, and timber types of the basin. It is anticipated that this effort will take 3 years and cost a total of \$150,000 (Table 34).

As previously stated, it is anticipated that with current program levels forest land will decline to about 315,000 acres by the year 2025. Under the proposed plans, the decline will be slowed. It is estimated that implementation of the Resource Protection plan elements for the reduction of forest land conversion would reduce the conversion of forest land by more than half. As a result, it is estimated that almost 382,000 acres of forest land will exist in the year 2025 (Table 34).

Under the Early Action plan, loss of forest land would be reduced by over 800 acres per year, resulting in almost 347,000 acres of forest land in the year 2025. This is an increase of 10 percent in total forest land when compared with future without project conditions (Table 34).

TABLE 34

LOSS OF FOREST LAND

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Elements & Impacts	Units	Future Without Project Conditions	Resource Protection Plan	Early Action Plan
Annual Loss of Forest Land	Acres	2,790	1,120	1,990
Total Forest Land Converted to Other Uses	Acres	112,000	45,000	80,000
Total Forest Land By Year 2025	Acres	315,000	382,000	347,000
Technical Assistance (Information Specialist)	Staff Yrs Ann Cost (\$)	-- --	40 55,000	20 60,000
Technical Assistance (Forest Management)	Staff Yrs Ann Cost (\$)	-- --	10 13,000	5 13,000
Technical Assistance (Economics Information)	Staff Yrs Ann Cost (\$)	-- --	3 50,000	3 50,000

LOSS OF AGRICULTURAL LAND

Each county should have methods to protect farmland from conversion to other uses. Several methods are available to local government for land use control. All alternative plans should include education of community leaders and officials regarding trends in the loss of agricultural land and the tools available for reducing the loss. Two levels of activity are presented in Table 35, the Resource Protection plan and Early Action plan.

Each of the Iowa counties has established a County Commission for Land Preservation and Use as provided by Iowa law. Fourteen of the nineteen counties in the basin are zoned. Early action should include zoning in Chickasaw County with the other unzoned counties following. Cost is estimated to be \$20,000 per county to establish zoning and \$10,000 per year for administration.

An excellent method to aid administration of zoning ordinances is the LESA (Land Evaluation and Site Assessment) system. This program was developed by SCS and is applicable to any county in the nation with agricultural land. It is a systematic method of comparing tracts of land for various purposes to assist officials and others with land use decisions. LESA shows which lands should remain in farms. Local input is required to adapt the system to a county and local officials use the system to evaluate various land uses. The estimated cost of establishing a LESA system is \$5,000 per county and \$5,000 per year thereafter to administer it.

Table 35 shows the projected annual loss of agricultural land for the two levels of activity and the accumulative effect on crop production. Moderate success in keeping good farmland in agricultural use can have rather dramatic effects over a long term. No comparisons have been made with alternative uses of agricultural land which may have greater economic benefits.

TABLE 35
LOSS OF AGRICULTURAL LAND
SUMMARY AND COMPARISON OF ALTERNATIVE PLANS
Northeast Iowa Rivers Basin

Elements & Impacts	Unit	Future Without Project Conditions	Resource Protection Plan	Early Action Plan
Zoning				
Counties	No	14	19	15
Establishment Cost	\$	--	100,000	20,000
Annual Cost	\$	140,000	190,000	150,000
LESA				
Counties	No	2	19	10
Establishment Cost	\$	--	95,000	50,000
Annual Cost	\$	10,000	95,000	50,000
Agricultural Land Lost	Ac/Yr	1,500	800	1,060
Prime Farmland Lost	Ac/Yr	430	230	310
Production Lost	\$1,000/Yr	405	216	286
Accumulated Land Lost by 2025	Acres	60,000	32,000	42,400
Production Lost by 2025	\$Mil/Yr	15.8	8.7	11.5
Additional Technical Assistance	Staff Years/Yr Ann Cost (\$)	-- --	3.9 135,000	1.4 50,000

POLLUTION OF COLDWATER STREAMS

The coldwater streams of Northeast Iowa are a limited and valuable resource but actions are needed to prevent water quality degradation and improve the water quality. Major water quality problems are caused by animal waste and sediment in coldwater streams. Livestock access to streams and runoff from confined livestock result in animal waste delivered to coldwater streams. Excessive sheet and rill erosion yields sediment that is delivered to coldwater streams.

Alternative solutions to those problems were based on information developed by the SCS and the Iowa Conservation Commission. The 25 highest priority coldwater streams are identified in Table 24. These streams are stocked with trout by the ICC for "Put and Take" fishing and all have direct public access.

The Resource Protection plan includes soil conservation practices including terraces on 35,000 acres and 585 grade stabilization structures (Table 37). Other soil conservation practices including conservation tillage, contour stripcropping, conservation cropping sequence, and contour farming will be installed in conjunction with terraces and grade stabilization structures as resource management systems to control excessive sheet and rill erosion on cropland. These other practices are assumed to have no installation cost.

The grade stabilization structures will control gully erosion and serve as sediment traps upstream from coldwater streams.

Streambank protection including riprap and other practices are proposed on 15 bank miles of stream to control streambank erosion.

Livestock exclusion is proposed to eliminate livestock access to 37 miles of coldwater streams. This would require 74 miles of fencing and landrights (fee title or 50-year easement) on 600 acres.

Agricultural waste management systems will be planned to control animal waste runoff at 180 locations.

The Early Action plan will be effective in maintaining or improving water quality in six selected trout streams. It was formulated to reduce financial outlays and serve as both an implementation and demonstration project for all other coldwater streams.

Six streams were selected for inclusion in the Early Action plan. Table 36 details information on these streams. The following criteria were concurred in by the ICC and were used for stream selection. First of all, small watershed areas were selected to minimize implementation costs and the time required to install practices. The six coldwater streams range in drainage area from two to twenty square miles and average ten square miles.

TABLE 36
COLDWATER STREAM DATA
EARLY ACTION PLAN
Northeast Iowa Rivers Basin

Stream	County	Drainage		Stream Corridor		
		Area Sq. Mi.	Cropland Sq. Mi.	Length Mi.	Public %	Grazed Mi.
North Cedar	Clayton	5.5	2.3	3.2	100	0
Sny Magill	Clayton	17.2	6.5	6.3	84	0
South Fork Big Mill	Jackson	2.2	0.7	0.8	100	0
Fountain Springs	Delaware	4.3	2.2	2.4	54	1.7
Little Paint	Allamakee	13.7	4.8	1.9	100	0
South Bear	Winneshiek	<u>19.7</u>	<u>10.2</u>	<u>4.4</u>	52	<u>2.0</u>
TOTAL		62.6	26.7	19.0	78	3.7

Secondly, a high percentage of public ownership of the stream corridor was a criterion. Three of the stream corridors are 100 percent publicly owned. The other three range from 52 percent to 84 percent public ownership. The six streams are distributed among five counties to maximize publicity for the demonstration aspect of the Early Action plan. All but three of the 25 highest priority coldwater streams listed in Table 22 are in these five counties.

Thirdly, landowners above two of the selected streams, North Cedar and Sny Magill, have shown interest in installing conservation practices to improve the quality of runoff that reaches those trout streams.

The Early Action plan includes conservation practices in the drainage areas of these six streams which includes 10,200 acres of excessively eroding cropland. Resource management systems should be installed on 7,600 acres of cropland. Terraces are proposed on 3,800 acres and grade stabilization structures at 43 locations.

Other problems in the drainage areas of the six selected streams are addressed in the following manner. Streambank protection measures for 3.8 bank miles are included in this plan. Livestock exclusion is needed to protect 3.3 miles of stream corridor from damage. Landrights would be required on at least 53 acres before fences could be installed. Animal waste management systems are proposed at 56 locations.

A lower level of cooperator participation is assumed for the EAP. This lower participation rate would result in 75 percent of the needed terraces and 50 percent of the grade stabilization structures being installed. Animal waste management systems and livestock exclusion would be installed at 90 percent of total needs because of the high negative impact of animal waste on water quality. Ninety percent of the streambank erosion control measures could be installed because of the high percentage of public ownership of the stream corridors.

TABLE 37

POLLUTION OF COLDWATER STREAMS

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Elements & Impacts	Unit	Resource Protection Plan	Early Action Plan
Grade Stabilization			
Structure	No.	585	43
Capital Cost	\$	4,388,000	322,000
Annual Cost	\$	564,000	41,500
Livestock Exclusion			
	Stream Mi.	37	3.7
	Ac.	600	63
Capital Cost	\$	1,200,000	106,000
Annual Cost	\$	188,000	16,500
Streambank Protection			
	Bank Mi.	15	3.8
Capital Cost	\$	2,835,000	630,000
Annual Cost	\$	365,000	81,000
Terrace			
	Ac.	35,000	3,800
Capital Cost	\$	14,000,000	1,530,000
Annual Cost	\$	2,205,000	241,000
Waste			
Management Systems	No.	180	56
Capital Cost	\$	1,350,000	420,000
Annual Cost	\$	174,000	54,000
Streams Benefited	No.	25	6
TOTAL CAPITAL COST	\$	23,773,000	3,008,000
TOTAL ANNUAL COST	\$	3,496,000	434,000
Additional Technical Assistance	Staff Years/Yr Ann Cost (\$)	4.7 164,500	1.5 52,500

STREAMBANK EROSION

A suggested structural program for reducing damages stemming from streambank erosion is outlined below. Two alternative plans have been prepared which differ in degree of magnitude and time frame. Damage would be virtually eliminated (about 95 percent) at locations where work was done. This program was planned for remedying streambank erosion problems at only the places being severely damaged. Non-structural measures are also recognized and discussed.

The Resource Protection and Early Action plans are structural programs quantitatively presented in Table 38. Installation time frames are 1985 - 2025 for the first plan while the Early Action plan would be installed by 2005. Early Action plan elements comprise the first increment of the Resource Protection plan. These plans were devised to remedy streambank erosion problems particularly where environmental values or man-made constructed improvements are currently threatened.

NON-STRUCTURAL MEASURES - In addition to the construction alternatives presented here non-structural measures may be used to reduce damage from streambank erosion and should be considered. Some of these possibilities could be achieved through the Protected Water Areas Program, an Iowa Conservation Commission effort for protecting some of Iowa's most scenic and natural lakeshores, stream corridors, and marshes. Protection methods include: fee title land acquisition, leasing agreements, conservation easements, tax credits, state preserves, and zoning.

Fee Title Land Acquisition: The purchase of land and all its associated ownership rights. Fee title ownership provides the proprietor with the most control over land use and management. Land can be acquired in fee title by purchase from willing sellers, eminent domain, and donation. Fee title land acquisition is generally the most costly protection method available.

Leasing Agreements: Obtainment of all rights to property as by fee title except a time duration is established for termination of the lease.

Conservation Easements: The acquisition of rights on a parcel of land that would otherwise allow the landowner to develop the area so as to destroy the scenic and natural character of the land. A typical conservation easement may: 1) Protect the land from heavy industrial development and large subdivisions, 2) Specify that certain parts of the property will remain "forever wild," 3) Specify the purposes for which the land may be used in future years, and 4) Prohibit the clear cutting of trees.

Tax Credits: Tax credits can provide incentives for landowners to maintain their lands in a native state. They also can encourage landowners to seriously consider donating their property or an easement by providing reduced income taxes. Landowners who participate in the forest reserve program agree to manage their forest lands according to specifications established by law in return for a zero property tax assessment.

State Preserves: Any area of land or water dedicated under the State Preserves Act, Chapter 111B, Code of Iowa. To qualify as a preserve, an area must have the potential to be maintained in its primeval character or have unusual flora, fauna, geological, archeological, scenic, or historic features of scientific or educational value.

Zoning: Zoning is a land-use control that partitions a governmental unit or area by ordinance into sections reserved for specific purposes. With respect to the Protected Water Areas Program this could be a means for establishing and maintaining greenbelts adjacent to streams.

STRUCTURAL MEASURES - Engineering practice techniques by which streambank erosion may be reduced or stopped were evaluated for cost and effectiveness. Controlling streambank erosion usually involves one or more of these practices: reshaping bank slopes, establishing vegetation, protecting vulnerable areas by overlaying of durable material, or by reducing flow impact by deflection devices. Environmental corridors have been considered and are also recommended for installation as a structural increment in these plans.

Several streambank erosion control engineering practices were studied. Practices chosen for these plans and the proportion deemed appropriate for each within the total program are tabulated below:

<u>Practice</u>	<u>Percent</u>
Reshape and Vegetate	25
Reshape and Riprap	40
Rock Jetty	5
Fence Retard	10
Kellner Jacks	5
Anchor Trees	5
Permeable Jetty	5
Tire Mattress	5

Locations of works of improvement depend upon further investigations of eroding sites. Streambank erosion work should be targeted on streams used extensively for recreation, near roads, bridges, and building areas. Engineering studies and designs will be needed for each problem area.

Computation of construction costs estimates required consideration of streambank height. Estimated distribution of work by height is tabulated here.

<u>Bank Height (ft)</u>	<u>Percent</u>
4 - 6	27
6 - 9	27
9 - 13	24
13 - 18	22

The above assumed mix of practices and bank heights resulted in an estimated weighted average construction cost per linear foot of \$56, about \$296,000 per bank mile.

Environmental corridors of trees, periodically interspersed with one-third of the length being grass segments, are recommended to be established in conjunction with the engineering practices. In addition to values in lessening or preventing streambank erosion, additional benefits to landowners and the public would accrue. These linear, water-oriented parcels of land can enhance man's environment in realms of scenic beauty, wildlife habitat, natural areas, open space, recreational opportunities, flood damage reduction, water quality improvement, and other desirable aspects.

Corridor establishment may occur on one side of a stream or both sides. Other considerations being equal the location of corridors on the south and west streambanks would benefit in-stream habitat most by reducing water temperature. Primary consideration in location should be to maximize reduction of streambank erosion. Corridor location may be coincident with construction practices, or, corridors alone may adequately defend against damage by streambank erosion.

Proper management of the corridor system is an important task. The resource base of each corridor segment is intimately related to that of the surrounding areas so use of the basin's land and water resources affects the quality of the corridors to some degree. Each segment is also unique from each other segment, thus precluding generalized management of the system as a whole. Increasing competition for use of the corridors themselves by a variety of interests will further compound management problems in the future.

A management alternative to minimize adverse impacts on streams from poor land use is to maintain strips of land adjacent to the stream in permanent vegetation. It would be most desirable to maintain native cover as much as possible. These strips tend to filter out sediment and other pollutants before they reach the stream. A system of environmental corridors would serve this function.

By regulating land use adjacent to the streams valuable development can be kept out of zones of high flood hazard thereby reducing need for structural flood control measures. A more natural environment prevails when floodways are not encroached upon. Flood stages remain essentially constant for given discharges. An environmental corridor system could provide these benefits by regulating development in portions of the flood plain.

Recreation opportunities could be supplied by utilizing environmental corridors. Future recreation development in the corridors requires careful planning. Flooding in some areas can cause severe damage to facilities. Standing water can kill grass and other vegetation over a period of time. Bank sloughing and debris pile-up can become an eyesore. Sediment deposits on playfields, parking lots, and picnic grounds are unpleasant. Comprehensive site planning can avoid these problems.

Installation of environmental corridors were estimated to cost \$12,100 per mile. This amount is based upon a 100-foot average width on one side of the stream. Land area for that width is 12.1 acres per mile. Fee title purchases or long term, 50-year easements for securing landrights would incur approximately the same cost of \$888 per acre. Landrights are the principal cost for corridors as this comprises 89 percent of total costs.

SUMMARY - Implementation of an accelerated streambank erosion control program will be the responsibility of landowners and operators, county supervisors, and soil conservation district commissioners. Selective locations for treatment need to be made so that the most beneficial returns-cost relation may be achieved.

Farmlands are damaged principally by increasing nuisance losses rather than by the actual magnitude of land lost. Infrequently, streams threaten roads, or other improvements. The economic return to repairing and preventing streambank erosion is usually not sufficient to recover costs. Intrinsic value of land protected does not approach even minimal costs for streambank work. The factor of inconvenience due to bank erosion is much greater than the economic loss of agricultural land. Where buildings, roads, bridges, utilities, or other improvements are threatened by bank erosion, the economic recovery of costs for a remedy to the problems is much more likely.

It must be acknowledged that the prevention of streambank erosion may be very desirable from esthetic, convenience, or resource conservation viewpoints. Where landowners and operators desire to protect specific locations, professional assistance may be requested from consulting engineering firms, the Iowa Department of Water, Air and Waste Management, or the local Soil Conservation District. The Department and the Soil Conservation Service have cooperatively prepared a streambank protection manual, "How to Control Streambank Erosion," to guide in the planning and installation of such measures. This manual is available at local soil conservation district offices.

TABLE 38

STREAMBANK EROSION CONTROL

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Elements & Impacts	Unit	Resource Protection Plan	Early Action Plan
Engineering Practices	Bank Miles	364	70
Construction Cost	\$1,000	107,700	20,700
Environmental Corridors	Bank Miles	364	70
Construction Cost	\$1,000	4,300	830
Total Cost of Elements	\$1,000	112,000	21,530
Average Annual Cost	\$1,000	9,820	1,890
Annual Maintenance	\$1,000	1,120	220
Annual Investment Cost plus Maintenance	\$1,000	10,940	2,110
Channel Banks Stabilized	Bank Miles	364	70
Area Voided Reduction	Acres/Year	139	26
Area Depreciated Reduction	Acres/Year	35	7
Channel Erosion Reduction	1,000 Tons/Year	1,013	192
Value of Land Saved	\$/Year	309,000	58,600
Sediment Reduction	\$/Year	68,000	12,900
Other Damage Reduction	\$/Year	392,000	74,400
Annual Value of Treatment	\$/Year	769,000	145,900
Additional Technical Assistance	Staff Years/Yr Ann Cost (\$)	13 455,000	5.2 182,000

COMPARISON OF ALTERNATIVE PLANS

Throughout the preceding sections of this report the seven concerns have been discussed and a Resource Protection plan and an Early Action plan proposed for each concern. Table 39 is a summary of elements of the two plans for all seven concerns. It includes estimates of the annual costs for each of the elements. Table 40 is a comparison of the impacts of the two alternative plans for all seven concerns.

The Resource Protection plan addresses all resource needs and would reduce soil erosion to tolerable levels. It is evaluated over a 40-year period ending in 2025. The Early Action plan addresses only the more urgent needs and should be completed in the 20-year period ending in 2005.

TABLE 39

SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Element	Units	Annual			Resource Protection Plan			Early Action Plan		
		Unit Cost \$	No. of Units	Annual Cost, \$	No. of Units	Annual Cost, \$	No. of Units	Annual Cost, \$		
Brush Management	Ac	6	0	0	500	3,000				
Conservation Tillage	Ac	(-)12.5	2,271,000	-28,388,000	1,349,600	-16,870,000	1/			
Contour Farming	Ac	0	1,501,000	0	551,100	0				
Cropland Conversion	Ac	-	140,000	2,588,000	46,000	1,185,000				
Farmstead & Feedlot Windbreak	Ac	159	1,950	310,000	900	143,000				
Fertilizer Management	Ac	-	3,475,600	-	260,800	-				
Filter Strip	Ac	45	3,300	148,000	3,300	148,000				
Grade Stabilization Structure	No	965	6,885	6,644,000	3,493	3,370,000				
Grassed Waterway	Ac	183	18,300	3,349,000	9,300	1,702,000				
Land Eval. & Site Asses. (LESA)	County	5,000	19	95,000	10	50,000				
Livestock Exclusion	Ac	9	114,700	1,032,000	36,053	325,000				
Pasture Conversion to Forest	Ac	-	26,700	-	4,000	-				
Pasture Management	Ac	35	15,000	525,000	5,000	175,000				
Pasture Planting	Ac	18	15,000	270,000	5,000	90,000				
Pest Management	Ac	-	3,475,600	-	260,800	-				
Protected Water Areas	Ac	31	150,000	4,757,000	65,000	2,000,000				
Streambank Protection	Ft	-	2,000,000	11,305,000	390,000	2,191,000				
Stripcropping, Contour	Ac	0	655,000	0	156,800	0				
Terrace	Ac	63	706,000	44,478,000	106,600	6,300,000				
Timber Stand Improvement	Ac	-	76,000	392,000	22,000	160,000				
Tree Planting	Ac	-	70,700	1,191,000	18,000	416,000				
Waste Management System	No	965	180	174,000	56	54,000				
Wildlife Upland Habitat	Ac	60	800,000	48,000,000	400,000	24,000,000				
Zoning	County	10,000	19	190,000	15	150,000				
TOTAL				97,060,000		25,592,000				

1/ Negative costs reflect reduced production expenses associated with this practice.

COMPARISON OF IMPACTS OF ALTERNATIVE PLANS

Northeast Iowa Rivers Basin

Impact	Units	Future Without Plan	Resource Protection Plan	Early Action Plan
Sheet and Rill Erosion				
Cropland Erosion >T	Ac	1,400,000	0	600,000
Cropland Erosion Rate	Tons/Ac/Yr	13.3	4.5	8.1
Cropland Erosion	1,000 Tons/Yr	18,600	6,300	7,600
Annual Depletion Cost	\$ Mil	20.5	0	8.4
Annual Cost of Treatment	\$ Mil	0	28.4	- 5.5
Annual Capital Outlay	\$ Mil	0	8.6	7.1
Pasture Erosion >T	Ac	39,500	0	0
Forest Land Erosion >T	Ac	114,200	0	0
Forest Land Erosion Rate	Tons/Ac/Yr	9.6	1.4	8.4
Forest Land Erosion	1,000 Tons/Yr	1,684	86	1,166
Grazed Forest Land	Ac	175,000	61,000	139,000
Technical Assistance	Staff Yr/Yr	0	74	36
Groundwater Contamination				
Sediment Yield to Sinkholes	Tons/Yr	1,393,100	666,400	666,400
Cropland Protected from Depletion Preventing Increased Fertilizer Rates	Ac	0	503,800	40,500
Cropland Protected from Excessive Fertilizer and Pesticides by Better Mgmt.	Ac	0	3,475,600	260,800
Technical Assistance	Staff Yr/Yr	0	42	8.5
Loss Upland Wildlife Habitat				
Upland HSI	Index Number	0.24	0.55	0.39
Forest HSI	Index Number	0.67	0.76	0.70
New Windbreaks	Number	0	1,200	550
Reduce Feed Grain Production	Mil Bu/Yr	0	96	48
Technical Assistance	Staff Yr/Yr	0	16	7.0
Loss of Forest Land				
Annual Loss	Ac	2,790	1,120	1,990
Forest Land Converted by 2025	Ac	112,000	45,000	80,000
Forest Land in 2025	Ac	315,000	382,000	347,000
Technical Assistance	Staff Yr/Yr	0	2.3	2.3
Loss of Agricultural Land				
Annual Loss	Ac	1,500	800	1,060
Prime Farmland Lost	Ac/Yr	420	230	310
Land Lost by 2025	Ac	60,000	60,000	42,000
Value of Production Lost by 2025	\$ Mil	15.8	8.7	11.5
Technical Assistance	Staff Yr/Yr	0	3.9	1.4
Pollution of Coldwater Streams				
Streams Benefited	Number	0	25	6
Gully Erosion	% Controlled	0	100	7
Livestock Access to Stream Corridors	% Eliminated	0	100	9
Streambank Erosion	% Controlled	0	100	25
Excessive Sheet and Rill Erosion	% Controlled	0	100	11
Waste Management Systems	% Installed	0	100	20
Technical Assistance	Staff Yr/Yr	0	4.7	1.5
Streambank Erosion				
Channel Banks Stabilized	Bank Ml	0	364	70
Area Voided Reduction	Ac/Yr	0	139	26
Area Depreciated Reduction	Ac/Yr	0	35	7
Channel Erosion Reduction	1,000 Tons/Yr	0	1,013	192
Value of Land Saved	\$/Yr	0	309,000	58,600
Sediment Reduction	\$/Yr	0	68,000	12,900
Other Damage Reduction	\$/Yr	0	392,000	74,400
Annual Value of Treatment	\$/Yr	0	769,000	145,900
Technical Assistance	Staff Yr/Yr	0	13	5.2

IMPLEMENTATION

Individual plan elements can be installed through a variety of existing federal, state, and local programs. Priorities for installing the various elements will depend upon the willingness of local people to undertake the responsibility. Installation of both the Resource Protection plan and the Early Action plan require acceleration of existing programs in the form of additional financial and technical assistance as shown in Table 41.

TABLE 41
FINANCIAL AND TECHNICAL ASSISTANCE

Northeast Iowa Rivers Basin

Item	Units	Resource Protection Plan	Early Action Plan
Financial	Dollars/year	97,060,000	25,592,000
Technical	Staff-years/year	155.6	62.2

EXISTING AGENCIES AND PROGRAMS

The following federal, state, and local agencies and groups have administrative responsibility for resource programs. Most of these agencies have participated in the development of this report. All of them can influence the conservation, development, and management of water and related land resources in the basin. Refer to Appendix G for changes in agency names as a result of Iowa state government reorganization July 1, 1986.

SOIL CONSERVATION DISTRICTS - Soil Conservation Districts are legally constituted units of state government created to administer soil and water conservation activities within their boundaries. They sponsor or co-sponsor most watershed protection and flood prevention projects and resource conservation and development projects. Because of their broad activities, districts have an important role in the development of rural areas.

These districts focus attention on land and water problems, develop annual and long-range programs designed to solve problems, and enlist all the appropriate and available help from public and private sources that will contribute to the accomplishment of the district's goals.

NORTHEAST IOWA CONSERVANCY DISTRICT - The Northeast Iowa Conservancy District was established by the Iowa Legislature to preserve and protect the public interest in the quantity and quality of the water resources of the District for future generations. The Conservancy District was established in 1971 as a governmental subdivision of the state through the enactment of Chapter 467D, Code of Iowa.

The Conservancy District is charged by Iowa law to develop and implement a plan for the management of the water resources of the District. The District is also charged to coordinate river basin and watershed management programs through cooperation with other entities.

IOWA DEPARTMENT OF SOIL CONSERVATION - The DSC is a state agency with responsibilities for the protection of the State's soil and water resources. The Department accomplishes these objectives by providing administrative and financial assistance to soil conservation districts and conservancy districts and by cooperating with agencies at all levels to achieve mutual goals.

Statutory Duties of the DSC, as authorized under 467A.4 Iowa Code, are:

- (1) To encourage and promote soil and water conservation programs.
- (2) Offer assistance to soil conservation districts and to conservancy districts.
- (3) Provide financial and staff assistance to soil conservation districts and conservancy districts.
- (4) Disseminate information to soil conservation districts and conservancy districts.
- (5) Secure cooperation and assistance among federal, state, and local agencies.
- (6) Allocate and administer appropriated funds to soil conservation districts and conservancy districts.

Delegated duties from the Governor are:

- (1) Approve or disapprove applications for assistance under the P.L. 566 Watershed program.
- (2) Review and make recommendations for action on Resource Conservation and Development Projects.

The DSC provides cost-share money to soil conservation districts. Allocations to districts are made on the basis of estimated needs and are subject to approval of the State Soil Conservation Committee. Portions of the appropriation are held in reserve for priority work or for cost-sharing mandated soil conservation measures required by the Iowa erosion control law. Districts are allowed to use state cost-share funds on eligible practices approved by the State Committee. The Iowa Cost Share Program allocation for the basin in fiscal year 1985 was \$915,000.

IOWA DEPARTMENT OF WATER, AIR AND WASTE MANAGEMENT - Major departmental activities include:

- (1) Prevention, abatement, and control of air pollution.
- (2) Public water supply program.
- (3) Flood plain management.
- (4) Solid and hazardous waste management.
- (5) Prevention, abatement, and control of water pollution.
- (6) Ensuring the orderly development, wise use, protection and conservation of the surface and groundwater resources.

DWAWM activities that relate to this plan are item (3), (5) and (6). A brief description of these three activities follows:

- (3) The DWAWM promotes the protection of life and property from flooding and ensures the orderly development, wise use, protection and conservation of the water resources of the state by establishing administrative thresholds for the types of flood plain development which require a permit from the department; issuing appropriate permits; and by enforcing the statutes, rules and permits relating to flood plain development.
- (5) DWAWM prevents, abates and controls water pollution by developing comprehensive plans and programs, establishing standards for water quality and treatment of wastewater, issuing permits for the construction and operation of waste disposal systems, certifying public wastewater operators, administering certain grants for construction of municipal wastewater disposal systems, and enforcing the statutes, rules and permits relating to water pollution control. The DWAWM also establishes minimum standards for private sewage disposal systems, which are regulated by local boards of health.
- (6) DWAWM ensures the orderly development, wise use, protection and conservation of the surface and groundwater resources of the state by issuing appropriate permits relating to the use of water, and by preparing a plan of water allocation priorities for submission to the General Assembly.

IOWA GEOLOGICAL SURVEY - The fundamental function of the Iowa Geological Survey is to collect, interpret and report information on geologic features and resources of the state, including surface and groundwater. As the repository for basic geologic and hydrologic data, the IGS makes every effort to secure all such data, and to make the data meaningful and available to individual citizens, industry and governmental agencies that need the information. This agency will utilize the increased knowledge of soil and water resources, problems, and needs resulting from this study.

IOWA CONSERVATION COMMISSION - The ICC manages fish and wildlife, forest land, and recreation areas within the basin. Technical assistance is provided for fish, wildlife, and forest management on private lands through soil conservation districts.

The ICC acquires unique land resource areas, such as prairie remnants and wetlands, in order to insure preservation of these areas. Other areas are acquired to provide public recreation such as hunting, fishing, bird watching, picnicking, hiking, and camping. The ICC may provide cost-sharing assistance to county conservation boards for recreation and fish and wildlife area acquisition and development.

COUNTY BOARDS OF SUPERVISORS - Each county government is directed by a Board of Supervisors. Responsibilities relating to plan implementation include maintenance of county roads and bridges. Right of way erosion control and sediment removal are common activities. County Boards are often sponsors in project activities.

COUNTY CONSERVATION BOARDS - Each county in the basin except Allamakee has an active conservation board. County conservation boards develop and manage parks, recreation areas, historic sites, and wildlife areas. Many also participate in activities such as conservation education, windbreak planting, roadside ditch seeding, and farm wildlife area establishment.

USDA AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE - The ASCS administers several agricultural programs. One of these, the Agricultural Conservation Program (ACP), provides cost-sharing assistance to land users who undertake soil, water, forestry, and wildlife conservation practices on farmlands currently in agricultural production. Fiscal year 1985 ACP allocation for the basin was \$1,270,000.

The Forestry Incentives Program (FIP) provides technical assistance and cost-sharing for forestry practices to accelerate timber production. It is limited to designated counties. The eleven FIP counties in the basin are Allamakee, Cedar, Chickasaw, Clayton, Clinton, Dubuque, Floyd, Jackson, Jones, Linn, and Winneshiek. The cost of such practices is shared between the federal government and the land user.

The SCS and the Forest Service are responsible for the technical assistance for ACP practices. The Forestry Section of the ICC provides the technical assistance for forestry practices.

USDA SOIL CONSERVATION SERVICE - Under authority of Public Law 46 of the 74th Congress as amended, the SCS provides assistance to owners, operators and other land users in planning, applying, and maintaining water and land resource conservation program measures. Assistance provided by the SCS to cooperating landowners or operators is through local conservation district programs. Most of the on-the-land SCS assistance to landowners is channeled through local soil conservation districts.

The SCS administers the Cooperative Soil Survey Program, which surveys the soil resources of the nation. When available, this information can be utilized in the selection of building sites, production of crops, location of recreation development, and many other undertakings where the soil will have a major effect.

The SCS under authority of Public Law 83-566 as amended provides technical and financial assistance to state and local organizations for planning, designing, and installing watershed works of improvement. The Forest Service and the Forestry Section of the ICC are responsible for the forestry phase of P.L. 566 watershed projects and for soil and water conservation applicable to land used for forestry purposes. Cost-sharing is provided for watershed protection (land treatment); flood prevention; and water management, including irrigation, drainage, rural water supply, public

recreation, fish and wildlife, municipal and industrial water supply, and water quality management.

Long term credit can be obtained by sponsoring local organizations for their share of the cost. This program provides a means of reducing watershed protection and flood prevention problems which cannot be adequately met by other programs. Currently, there are three P.L. 566 projects at various stages of development in the basin.

Section 102 of the Food and Agriculture Act of 1962, Public Law 87-703, as amended provides the SCS with authority to assist local people in planning and carrying out Resource Conservation and Development (RC&D) Projects. To carry out the program, financial and technical assistance may be provided to sponsors in carrying out eligible measures having community benefits. Five counties in the basin are in Upper Explorerland RC&D Area.

USDA FOREST SERVICE - Under authority of P.L. 95-313 (RFA), forestry assistance is provided by the ICC in cooperation with the Forest Service. This assistance includes the production and distribution of tree seedlings, technical assistance for forest management, technical assistance to improve production and utilization (to local forest product industries), insect and disease management, and fire control.

USDA FARMERS HOME ADMINISTRATION - The Farmers Home Administration provides credit for specific types of farmers who cannot get the financing they need at reasonable rates and terms elsewhere. FmHA authority provides for several types of loans including soil and water conservation loans to eligible farmers and to nonprofit associations.

The basic objective of soil and water conservation loans is to encourage and facilitate the improvement, protection, and proper use of farmland by giving adequate financing for erosion control, shifts in land use, water development, water conservation and use, forestation, drainage of farmland, the establishment and improvement of permanent pasture, and other related measures. Similar opportunities to adopt soil and water conservation practices are offered to farmers who obtain farm ownership loans under FmHA authority.

ISU COOPERATIVE EXTENSION SERVICE - The Iowa Cooperative Extension Service (CES) is part of a nationwide system funded and guided by a unique partnership of federal, state, and local governments that delivers information to help people help themselves through the land grant university system. In Iowa, CES, administered by Iowa State University, carries out programs in the broad categories of agriculture and natural resources; community resource development; home economics; and 4-H and youth. CES provides practical, problem-oriented education for people of all ages. It is designed to take the knowledge of the University to those persons who do not or cannot participate in the formal classroom instruction of the University. Furthermore, it utilizes research from university, government, and other sources to help people make their own decisions.

Under Iowa statute, a cooperative relationship exists between CES and the county agricultural extension districts which cooperate with Iowa State University and the USDA in educational activities. CES has similar working arrangements with appropriate federal, state and local agencies and groups to provide resources needed by its clientele.

APPENDIXES

- A - RESOURCE BASE
- B - SOIL DEPLETION ON REPRESENTATIVE FARMS
- C - GROUNDWATER CONTAMINATION
- D - PUBLIC PARTICIPATION AND INFORMATION
- E - POLLUTION OF COLDWATER STREAMS
- F - STREAMBANK EROSION
- G - IOWA GOVERNMENT REORGANIZATION

APPENDIX A - RESOURCE BASE

LOCATION

The Northeast Iowa Rivers Basin Study area includes 8,724 square miles. Of this total, 8,493 square miles are in Iowa and 231 square miles are in Minnesota (Figure A-1). Principal subbasin areas are listed below.

	<u>Square Miles</u>
Upper Iowa River	1,005
Yellow River	241
Turkey River	1,684
Maquoketa River	1,879
Wapsipinicon River	2,540
Direct to Mississippi River	1,375

All or part of 19 counties in northeastern Iowa and three counties in southeastern Minnesota lie within this basin. Nine entire counties in Iowa are included.

GEOLOGY

The topography of the Northeast Iowa Rivers Basin varies considerably from west to east and the basin lies within three landform regions (Figure A-2).

Unique erosional landscapes exist in the eastern part known as the Paleozoic Plateau. Scenic landscapes exist here with deep valleys, abundant rock outcrops, high bluffs, caves, springs, and sinkholes characteristic of the terrain.

In the west, the land is a broad, flat to gently rolling till plain, moderately well drained, and dotted with boulders. This area, known as the Iowan Surface, is a combination of landforms.

Prominent elongated ridges and isolated elliptical hills, called paha, are characteristic of the region, particularly near the southern boundary of the basin. Sinkholes occur in the northern part of the region where the drift cover is thin. This complex landform region developed from normal processes of erosion, acting on a paleosol-covered landscape of Pre-Illinoian till, similar to that in Southern Iowa, during the period of Wisconsinan loess deposition.

The Southern Iowa Drift Plain borders the Iowan Surface and the Paleozoic Plateau to the south. Topography here is one of steeply rolling hills interspersed with areas of uniformly level upland divides and level alluvial lowlands. The border with the Iowan Surface is not well defined, but they are clearly separate topographic units.

The bedrock in the basin is relatively shallow, with over 63 percent of the basin having bedrock within 50 feet of the surface. The bedrock ranges in age from Cambrian to Cretaceous and consists of limestone, dolomite, shale, and sandstone (Figure A-3).

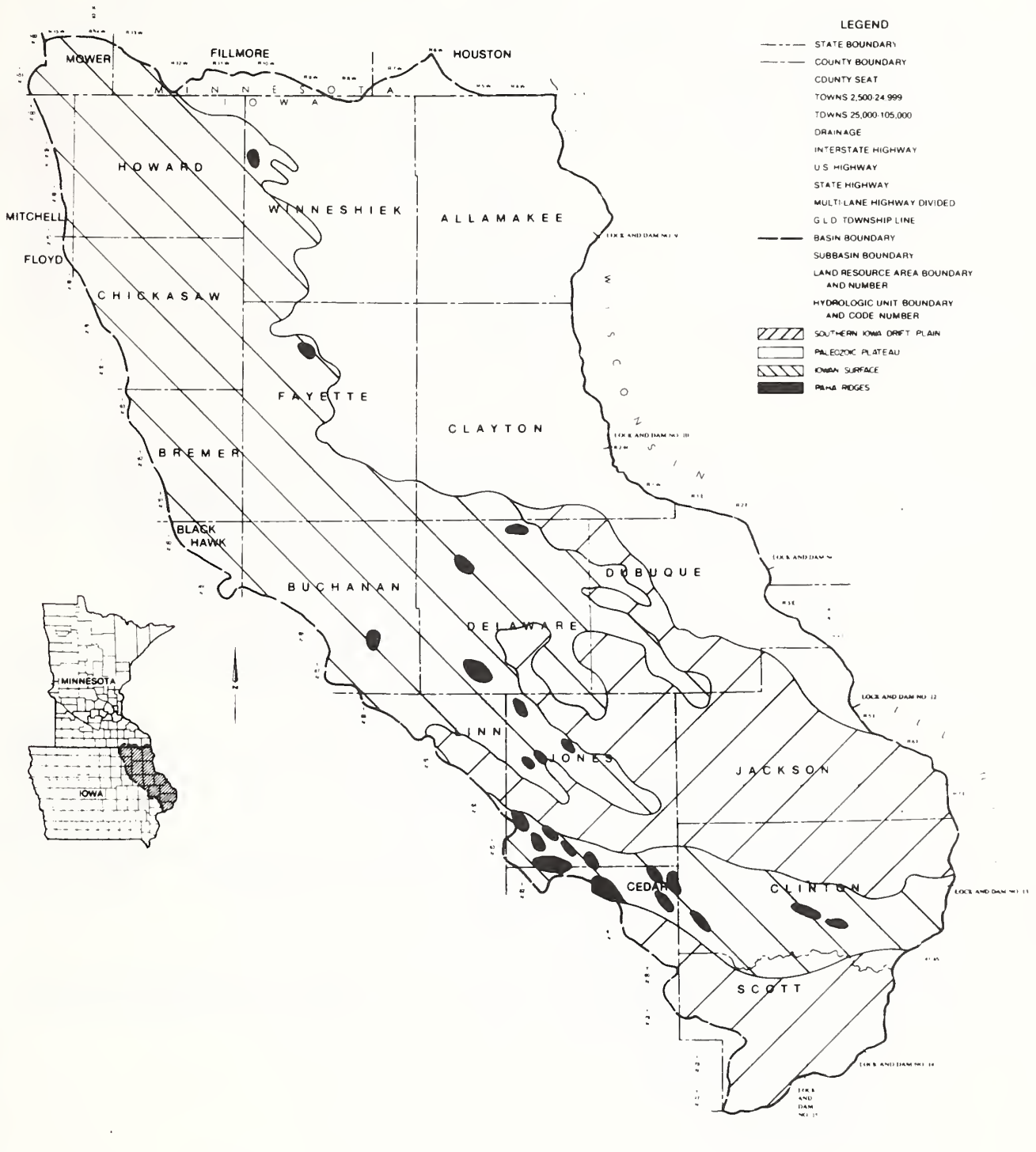


- LEGEND**
- STATE BOUNDARY
 - - - COUNTY BOUNDARY
 - TOWNSHIP SEAT
 - TOWNS 2,500-24,999
 - TOWNS 25,000-105,000
 - DRAINAGE
 - INTERSTATE HIGHWAY
 - U.S. HIGHWAY
 - STATE HIGHWAY
 - MULTI-LANE HIGHWAY-DIVIDED
 - G.L.O. TOWNSHIP LINE
 - BASIN BOUNDARY
 - SUBBASIN BOUNDARY
 - LAND RESOURCE AREA BOUNDARY AND NUMBER
 - HYDROLOGIC UNIT BOUNDARY AND CODE NUMBER

LOCATION MAP
NORTHEAST IOWA RIVERS BASIN
 IOWA and MINNESOTA



SOURCE:
 1958 SOIL CONSERVATION SERVICE BASE MAPS
 1958 SOIL AND WATER CONSERVATION SERVICE
 TRANSPORTATION MAP AND INFORMATION FROM
 SOIL FIELD RESEARCH,
 LANDSAT CORPORAION, CONIC PROJECTION
 1968 800-20000-1000-100



LANDFORM REGIONS
NORTHEAST IOWA RIVERS BASIN
 IOWA and MINNESOTA

SOURCE:
 1982-83 HYDROLOGICAL SURVEY DATA
 1982 IOWA AND MINNESOTA OFFICIAL CORNER
 TRANSPORTATION DATA AND INFORMATION CENTER
 U.S. FLD. (1982) (1982)
 IOWA COUNTY DATA - LAND RESOURCE AREA
 AND NUMBER



FIGURE A-2

The limestone and dolomite (carbonate rocks) and the relatively thin covering allow the development of a topography known as karst. Carbonate rocks transmit water through fractures, joints, and other secondary openings that have been enlarged by chemical solution. Locally, large caves may develop. Where soils are thin, sinkholes form as a consequence of rock solution and collapse. Over 11,000 sinkholes have been mapped in the basin, with over 1,800 in one township alone in Allamakee County.

CLIMATE

The climate is continental type. Average annual precipitation is about 33 inches. The snowfall range is from 28 to 45 inches. The mean annual temperature is 48° F. July is the warmest month with an average of 73° F while January is coldest with an average of 16° F. The average frost-free growing season varies from 140 to 160 days across the basin.

LAND RESOURCE AREAS

The basin is in the Central Feed Grains and Livestock Region 1/ where fertile soils and favorable climate contribute to a strong cereal grain, dairy and red meat industry. It contains three IRA (Land Resource Areas) (Figure A-4). Approximately one-half of this area is located within IRA 105, 40 percent within LRA 104, and the remainder is in LRA 108.

104 - Eastern Iowa and Minnesota Till Prairies

This is a nearly level to gently sloping till plain with a local relief of only a few feet. The streams have narrow, shallow valleys in their upper reaches with some dissection at the lower ends.

Nearly all the area is in farms and about 80 percent is cropland. Less than 10 percent is pasture. A small portion is wooded, mainly on wet bottomland and steep slopes bordering stream valleys.

Soils are deep and medium textured and moderately fine textured prairie soils and have a mesic temperature regime and mixed mineralogy.

105 - Northern Mississippi Valley Loess Hills

Elevations range from 600 feet on the valley floors to 1,300 feet on the highest ridges. The sloping to hilly uplands are dissected by both large and small tributaries of the Mississippi River.

1/ Agriculture Handbook 296, Land Resource Regions and Major Land Resource Areas of the United States, SCS, USDA, Revised 1981.

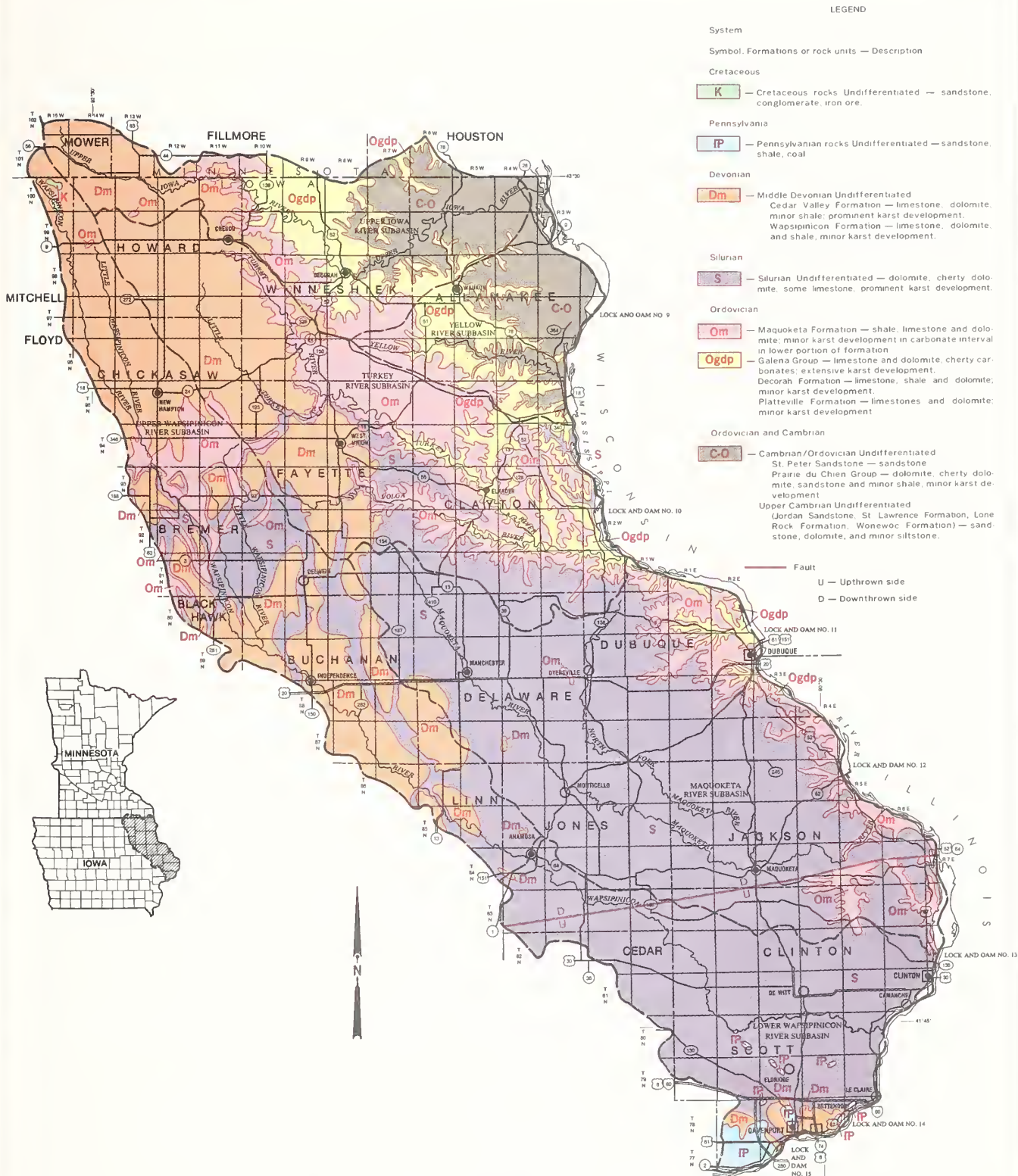
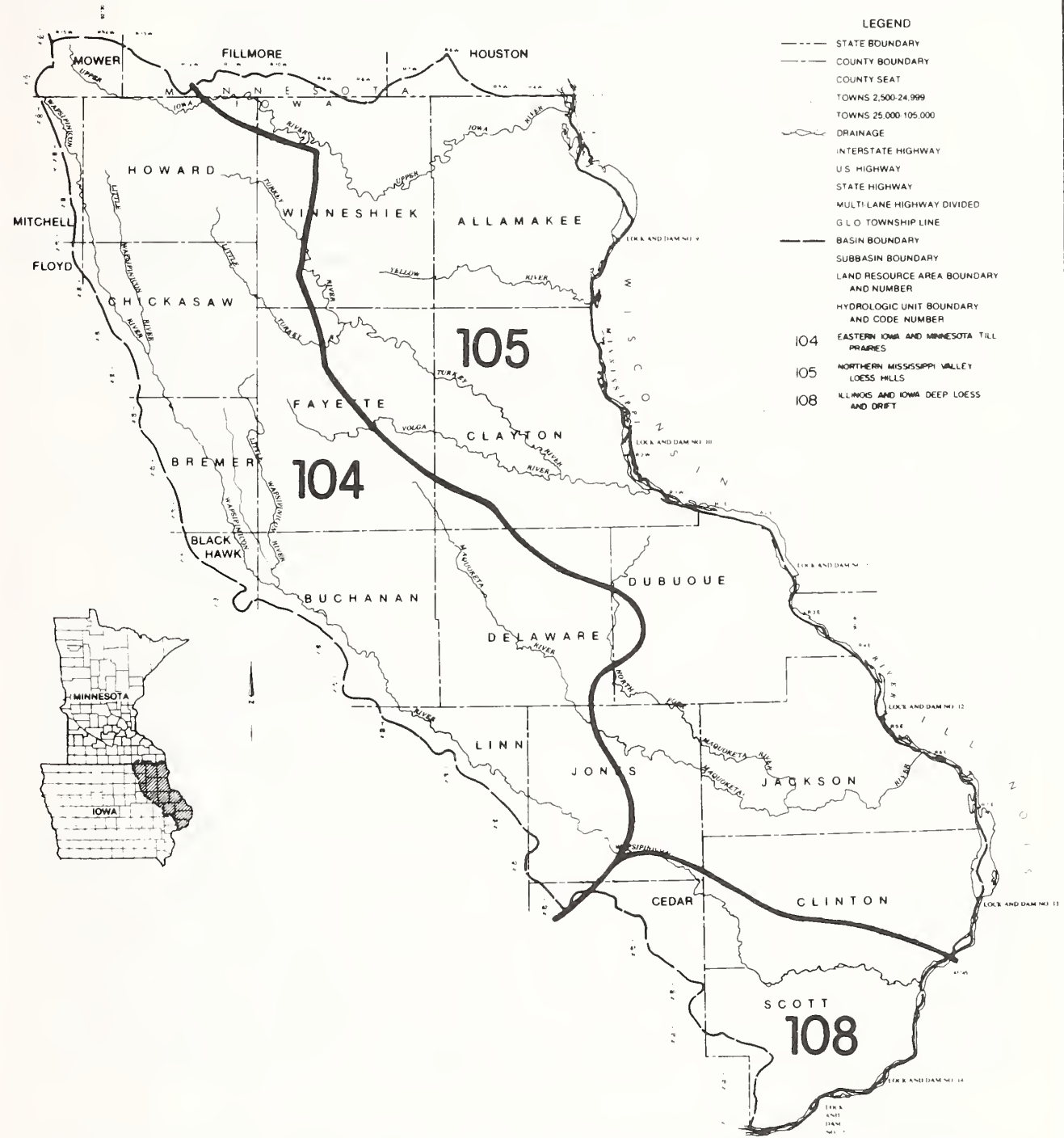


FIGURE A-3

BEDROCK GEOLOGY MAP NORTHEAST IOWA RIVERS BASIN IOWA AND MINNESOTA



SOURCE:
1960-62 GEOLOGICAL SURVEY BASE MAPS,
1960 IOWA AND 1975 MINNESOTA, OFFICIAL IOWA
TRANSPORTATION MAP AND INFORMATION FROM
SOIL FIELD PERSONNEL,
LAMBERT CONFORMAL OGDIC PROJECTION



- LEGEND**
- STATE BOUNDARY
 - - - COUNTY BOUNDARY
 - COUNTY SEAT
 - TOWNS 2,500-24,999
 - TOWNS 25,000-105,000
 - ~ DRAINAGE
 - == INTERSTATE HIGHWAY
 - U.S. HIGHWAY
 - STATE HIGHWAY
 - MULTI-LANE HIGHWAY DIVIDED
 - G.L.O. TOWNSHIP LINE
 - BASIN BOUNDARY
 - SUBBASIN BOUNDARY
 - LAND RESOURCE AREA BOUNDARY AND NUMBER
 - HYDROLOGIC UNIT BOUNDARY AND CODE NUMBER
 - 104 EASTERN IOWA AND MINNESOTA TILL PRAIRIES
 - 105 NORTHERN MISSISSIPPI VALLEY LOESS HILLS
 - 108 ILLINOIS AND IOWA DEEP LOESS AND DRIFT

LAND RESOURCE AREAS
NORTHEAST IOWA RIVERS BASIN
 IOWA and MINNESOTA

SOURCE:
 1980-88 SOCIOLOGICAL SURVEY BASE MAPS
 1989 IOWA AND MINNESOTA OFFICIAL CORA
 TRANSPORTATION MAP AND INFORMATION FROM
 IOWA FIELD PERSONNEL
 LANDSAT CORRELATION, CORA PRODUCTION
 1988-89, 1989-90



FIGURE A-4

The area is nearly all in farms but only about 40 percent is cropland. Feed grains and forage for dairy cattle and other livestock are the principal crops. About 20 percent is pasture and 30 percent is woodland.

Well drained soils that formed in a loess mantle over bedrock or in glacial till are dominant.

108 - Illinois and Iowa Deep Loess and Drift

This is a dissected loess--mantled glacial plain with much of the area rolling to hilly, but some of the broad uplands far from the large streams are level to undulating. Local relief is mainly ten feet to more than 150 feet, but the upland flats have relief of only a few feet.

Cropland makes up about 80 percent of the area. About 10 percent of the area is in permanent pasture. Narrow bands of forest land are found on steep valley sides and wet bottomland comprising about five percent.

Soils on steeper sideslopes are developed in loess and outcrops of till and are subject to severe erosion. Soils on the flats or in depressions have clayey subsoils that are often wet in the winter and spring. Soils on the flood plains range from poorly drained soils in clayey sediments to moderately well drained soils in loamy or silty sediments.

SOILS

The Northeast Iowa Rivers basin covers an area that extends from the southeast corner of Minnesota down the east side of Iowa to include most of Scott County. It includes all or parts of 22 counties. There are many types of soil. The dendritic drainage pattern is controlled in many places by thin glacial till, and in many places limestone bedrock and shale outcrop in the stream valleys.

The soils of the basin can be broadly grouped on the basis of parent materials and native vegetation. The western third is nearly level to gently sloping till plain with a thin mantle of loess. Prairie grasses were the native vegetation over most of that area which often requires drainage improvement before common field crops can be grown successfully. Sloping to hilly land occupies the eastern half where bottom lands are narrow. A loess mantle over bedrock or glacial till ranges from several feet thick to virtually nothing on steep slopes or elsewhere following extensive erosion. Much of this area was forested originally. Less than ten percent of the basin near the south end is nearly level with large streams exhibiting broad flood plains. Loess-derived soils several feet thick are common.

Detailed information about the individual soils is available in published soil survey reports or in SCS files. The accompanying map (Figure A-5) is not intended for intensive planning and management of a farm or individual fields, or for selecting exact locations for roads, buildings, or structures. Soils in any one association ordinarily differ in one or more of the following characteristics: slope, depth, drainage, and/or characteristics that affect management. The seven soil association areas and the major soils in each are briefly discussed on the General Soil Map, Figure A-5.

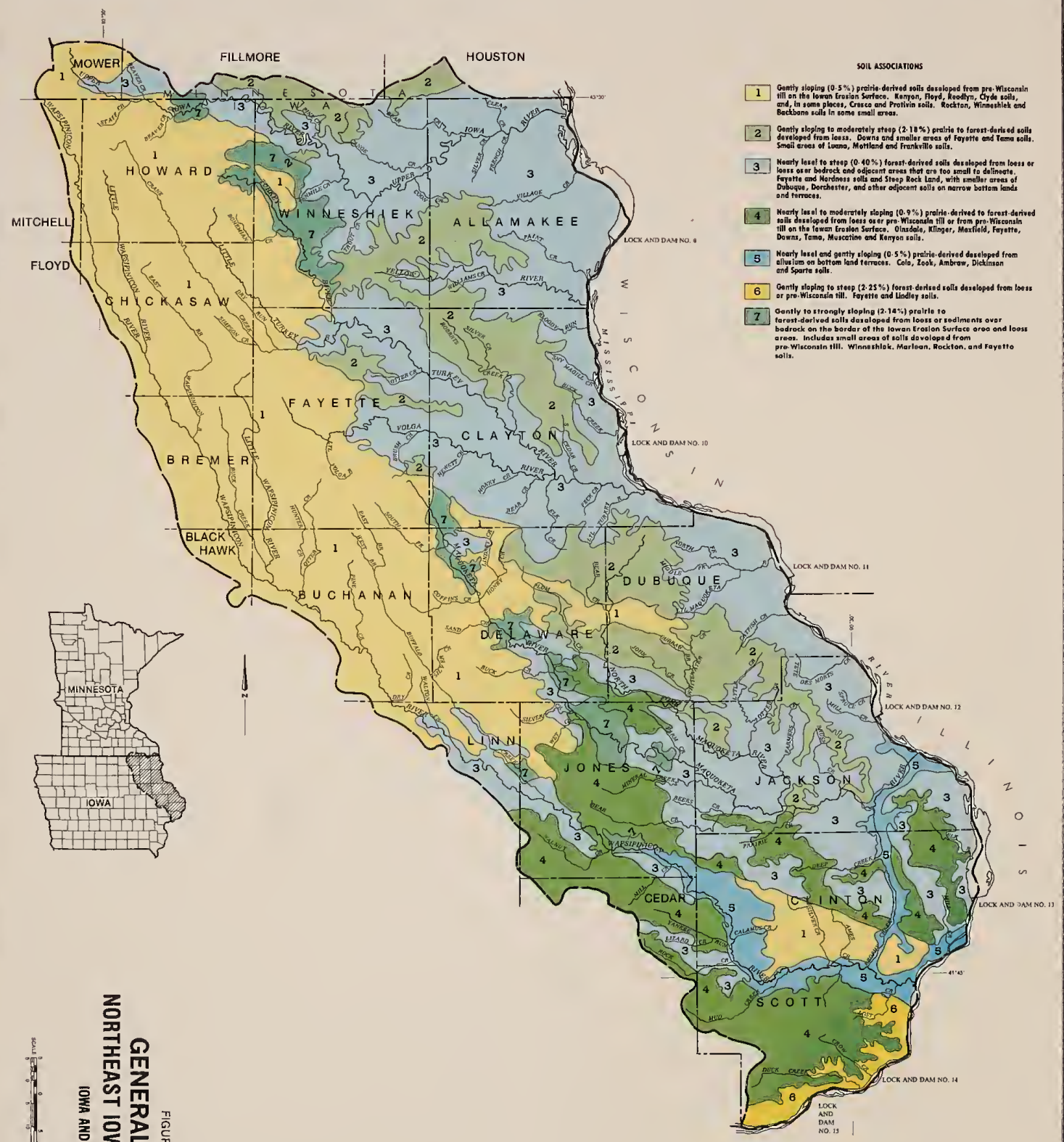


FIGURE A-5
GENERAL SOIL MAP
NORTHEAST IOWA RIVERS BASIN
 IOWA AND MINNESOTA



SOURCE:
 1:000,000 BIOLOGICAL SURVEY BASE MAPS,
 1:500,000 AND 1:250,000 MINNESOTA OFFICIAL IOWA
 TRANSPORTATION MAP AND INFORMATION FROM
 SCS FIELD PERSONNEL
 LAMBERT CONFORMAL CONIC PROJECTION

LAND USE

Cropland is the dominant land use, comprising about 4 million acres or 73 percent of the total. Major crops grown are corn, soybeans, oats, and hay. Land use is shown in the following table.

TABLE A-1

1985 LAND USE

Northeast Iowa Rivers Basin

Land Use	Acres	Percent
Cropland	3,991,400	73
Pasture	478,600	9
Forest Land	426,500	8
Other	132,400	2
Federal	39,000	1
Urban Built-up	310,600	6
Water	57,500	1
TOTAL	5,436,000	100

ECONOMIC RESOURCES

The population of the basin in 1980 was about 522,000, an increase of 5 percent since 1970. This compares with a statewide increase of 3.1 percent. The population is projected to increase to about 550,000 by 1990. The largest cities are Davenport (103,000), Dubuque (62,000), and Clinton (33,000).

Rural nonfarm and rural farm populations continue to experience fewer employment opportunities in agriculture as farmers replace labor with capital investment. The number of people employed in agriculture decreased by 60 percent between 1949 and 1974. During this period the number of farm operators decreased 40 percent. In addition, the number of farm operators with over 100 days worked off the farm has increased 35 percent since 1949. The average acreage of farm units increased from 161 acres in 1949 to 268 acres in 1974.^{1/}

Nonfarm employment opportunities are available in Dubuque, Clinton, and Davenport within the basin and in Austin, Waterloo, and Cedar Rapids just outside the basin. Nonfarm employment has increased about four percent between 1949 and 1974. The area is served by many training and educational institutions.

Commercial farms account for the majority of the 19,200 farms classified. Production of corn and soybeans are predominant activities on farms. A significant portion of feed grain produced on commercial farms is

marketed through livestock. Fattening of cattle and hogs and dairying are the main livestock enterprises. These activities are reflected in Table A-2.

TABLE A-2
ANNUAL VALUE OF AGRICULTURAL PRODUCTS
Northeast Iowa Rivers Basin

Item	Million Dollars
Crops	212
Livestock and livestock products	581
Poultry and poultry products	13
Other	17
Total agricultural products sold	<u>823</u>

Land use has intensified in recent years. Soybean acreage has increased 530 percent while corn acreage has increased 46 percent (1950-1975). Crop yields have trended upwards as shown in the following comparisons:

TABLE A-3
CROP YIELD TRENDS
Northeast Iowa Rivers Basin

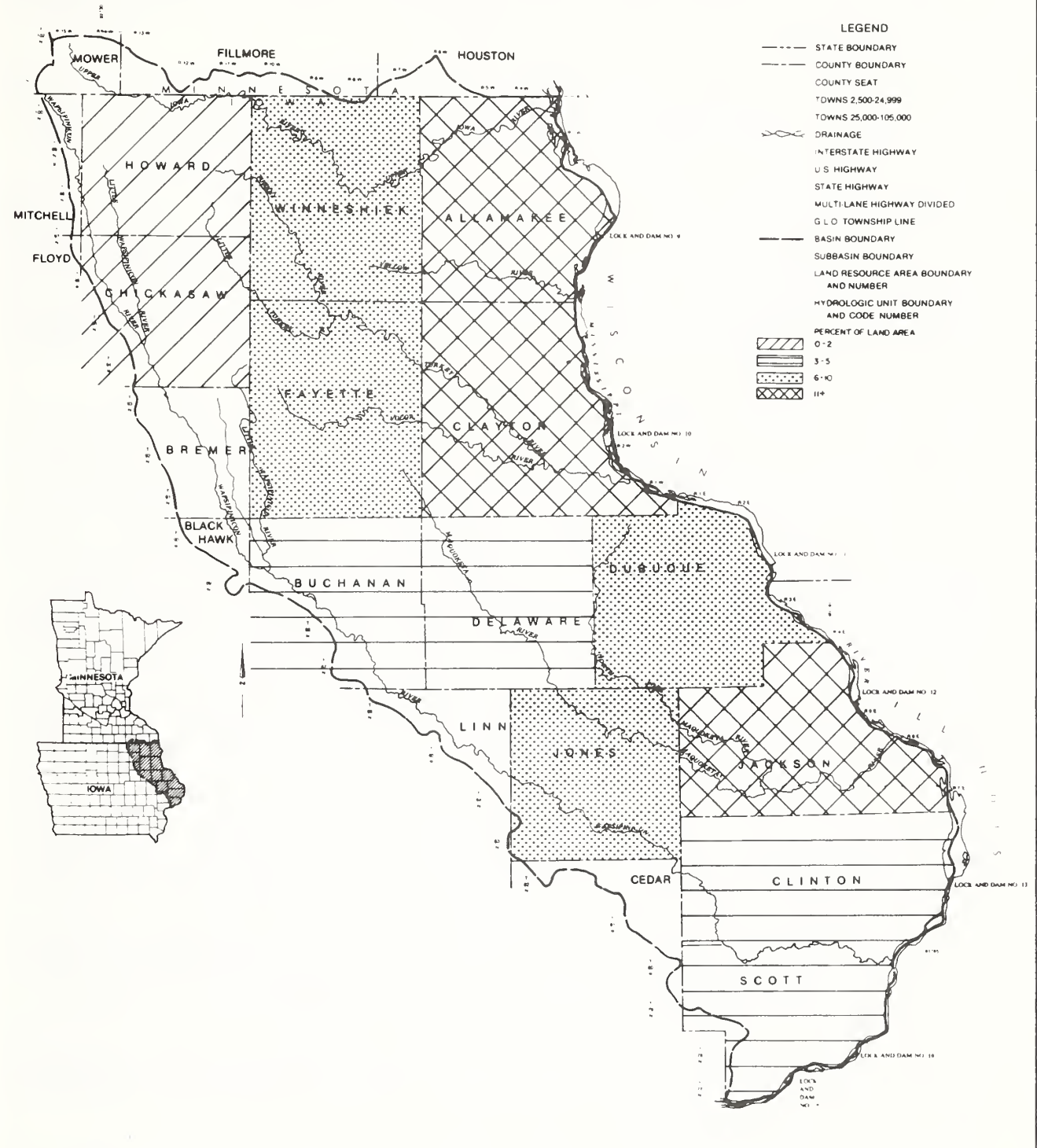
Crop	1950 Yield - Bu/Ac.	1975 Yield - Bu/Ac.
Corn	45	92
Soybeans	15	30
Oats	37	47

FOREST RESOURCES

The basin economic area in 1985 contained 8 percent forest land or 426,500 acres. In addition there are 202,000 acres of land with trees that are classed as non-forest, but which are part of the overall forest resource base. The majority is in private ownership.

The forest resource base has declined by about 31 percent since 1954 and is currently being lost at 1.5 percent per year. Commercial forest area as a percent of land area by county is shown in Figure A-6.

1/ Source: U.S. Department of Commerce, Bureau of Census, Agriculture Census, 1949 and 1974.



COMMERCIAL FOREST AREA, 1974
 NORTHEAST IOWA RIVERS BASIN
 IOWA and MINNESOTA

SOURCE:
 1988 AND 1991 NATIONAL SURVEY OF FOREST MAPS
 1988 AND 1991 MINNESOTA OFFICIAL STATE
 BOUNDARY AND TOWNSHIP MAPS INFORMATION FROM
 1982 FIELD PHOTOGRAPHS
 LAMBERT CONFORMAL CONIC PROJECTION
 UNITS: METERS



The forests are mostly elm, ash, cottonwood, and maple in the bottomlands and mixed oak in the uplands. Some high quality black walnut is scattered through the stands.

Forests of the basin contain 365,957 thousand cubic feet of growing stock and 1,223,300 thousand board feet of sawtimber. There are 16 sawmills which cut a total of approximately 24,400 thousand board feet of hardwoods per year.

WILDLIFE RESOURCES

Wildlife habitat quality is quantified using a Habitat Suitability Index (HSI) that ranges from 0.1 to 1.0. This index evaluates habitat conditions for wildlife species normally occurring in an area, with a value of 1.0 representing optimum conditions. It is directed towards upland and forest habitats and their associated wildlife species. Wetland habitats are less precisely evaluated by the HSI procedures.

The HSI does not evaluate annual species population. However, it is based on the assumption that habitat quality governs the carrying capacity of a species in a given area. Therefore, the closer the area is to its potential capacity the greater the population of resident wildlife species.

Upland species, such as pheasant, partridge, quail, and rabbit, are usually found on lands managed primarily for agriculture. These species usually have a small home range in which to find their living requirements. They depend on a mixture of row crops, pasture, and small wood lots within their home range.

The HSI for the basin averages only 31 percent of its potential for upland species. As field size grows and more forest and pasture is converted to row crop, the HSI for the basin will decline and smaller populations of upland species will result.

Forest wildlife species, such as deer, squirrel, and grouse, require some forest tracts in their home range and are less associated with agricultural lands. They do, however, need and utilize open areas such as crop fields, pastures, and odd areas for some feeding, loafing areas, etc.

Where woodlands occur in the basin they average 69 percent of their potential as forest habitat. Total acres of woodlands are forecast to decline as forested areas are converted to crop or pasture. The HSI will decline slightly on what remains due to increased grazing.

The basin is also used by many species of migrating waterfowl, raptors, and other bird species. The Bald Eagle, an endangered species, is known to migrate through the area.

APPENDIX B

SOIL DEPLETION ON REPRESENTATIVE FARMS

The primary goal of the soil depletion study was to estimate the effect that current levels of soil erosion, if continued, will have on the agricultural productivity of individual soils in the Northeast Iowa Rivers Basin by the year 2025.

The cost-price squeeze in agriculture has caused more intensive farming. Rotations, soil-conserving crops, and livestock enterprises are being replaced by cash grain farming and row crops. The result is increased soil erosion.

Many soils were formed with a shallow layer of topsoil. There are sizeable acreages of these soils that have already been depleted to the point they cannot economically be used for row crop production. Soils with deeper topsoils and those with more fertile subsoils, have been kept productive by substituting increased amounts of fertilizer for the depleting natural soil productivity.

This study is an evaluation of the increasing cost of erosion, over a long time period, due to reduced productivity, increased fertilizer, and increased fuel costs. The reduced potential to produce is quite often masked by increasing technology and production inputs and not adequately considered by farm operators or resource planners.

The goal of studying representative farms was to estimate the effect continuing excessive erosion rates over the next 25 years will have on the projected income of representative farms. Income is impacted by reduced productivity, increased fertilizer rates, and increased fuel consumption.

The representative farm is also used to calculate and display the historic and projected future income lost because of soil resource depletion. It was also used to calculate the cost of installing alternative resource management systems for erosion control, and then to estimate the amount of remaining depletion with each alternative.

Representative farms are used to help visualize the relationship and proportion of steep erosive soils with other soils on the landscape. An examination of actual farms permits a graphic display of the relative location of soil mapping units and their relationship to land use.

To accomplish this goal a representative farm was selected for each soil association in the Northeast Iowa Rivers basin. Each representative farm is depicted by the actual 160-acre tracts of land selected to have a typical mix of soil mapping units, land use, and current conservation practices.

For further information about Soil Depletion on Representative Farms contact the Soil Conservation Service, Des Moines, Iowa.

APPENDIX C

GROUNDWATER CONTAMINATION

Groundwater is one of Iowa's most valuable resources. Almost 90 percent of the water used for municipal supplies and rural domestic and livestock production in Iowa comes from the ground.

Northeast Iowa does not have the thick protective layer of glacial till and loess overlying the bedrock aquifers that most of Iowa does. The bedrock aquifers in this area are largely composed of limestone and dolomite (carbonate rocks). These carbonate aquifers transmit water through secondary openings such as fractures and joints. Since carbonate rocks are susceptible to dissolution by groundwater, these openings become enlarged. Locally, large caves may develop. Where soils are thin, sinkholes form as a consequence of rock solution and collapse.

Areas with large numbers of sinkholes are known as Karst areas. Sinkholes allow sediment, bacteria, and other contaminants to run directly into the upper bedrock aquifers. Residents have long been concerned about the quality of the groundwater in the Karst area. Over the past 10 to 15 years, nitrate concentrations in the groundwater have risen sharply. Consequently, many residents have had to drill deeper and much more expensive wells in order to obtain water of adequate quality for domestic and livestock purposes.

Because of the concerns about water quality, the sponsors of the Northeast Iowa Rivers basin study selected groundwater quality as their number one concern. The study of groundwater quality in Northeast Iowa is a cooperative effort of IGS, SCS, DWAWM, and EPA (Environmental Protection Agency) Region 7.

In addition to a broad, regional study of groundwater, a detailed assessment of a single, well defined Karst groundwater basin that outlets at Big Spring along the Turkey River in Clayton County was made.

During the early part of the evaluation, systematic contamination of the groundwater quality was discovered. Well water quality generally improves with increased well depth and with natural geologic protection, such as shale or thick glacial till deposits provide. Nitrate levels were highest in areas where sinkholes were present; areas without sinkholes had somewhat lower levels of nitrate. Early research concluded that most of the nitrate was delivered through normal infiltration and percolation, not runoff into sinkholes. Nitrates are clearly the result of man's activities; natural background levels of nitrate are generally less than detectable.

During the more detailed study in the Big Spring basin, the same systematic nitrate contamination was found along with herbicide contamination, at very low but persistent concentrations. Hydrologic analysis revealed that about 90 percent of the total flow at the Spring was the result of infiltration and that about 95 percent of the nitrate and 50 to

85 percent of the atrazine were delivered by this process. Historic water quality data from Big Spring revealed a 230 percent increase in nitrate concentrations since the late 1960's. The Big Spring basin is an intensively farmed area and the application of nitrogen fertilizer increased 250 percent during this same period of time. Similar data from wells in surrounding areas show the same result. Naturally protected aquifers revealed no increase. Infiltration was revealed as the mechanism for almost all nitrate contamination and much of the herbicide contamination in a Karst area.

The groundwater studies and the general concern for groundwater quality prompted a number of state and federal agencies, university researchers, local groups, and private organizations to form an ad hoc committee in 1983 to take action to reduce the hazards of groundwater contamination. The Ad Hoc Karst Committee (now called the Iowa Consortium on Agriculture and Groundwater Quality) recommended a pilot project to develop and demonstrate BMP's (best management practices) in the field, evaluate the effects of BMPs on both groundwater quality and crop production, assess the economic impact of these practices, and provide a foundation of information and experience from which policies, programs, and institutional arrangements can be built to help agriculture address Iowa's increasing groundwater problems. The seven-year \$7 million demonstration project began in 1985 and cooperating agencies are optimistic about the results of the project. Improvement in groundwater quality is expected within one or two years of the application of BMPs and in proportion to their application.

APPENDIX D

PUBLIC PARTICIPATION AND INFORMATION

Near the beginning of the study two public meetings were conducted to convey information to interested citizens and to invite their comments. Late in the study period, news items relating to findings were printed as Fact Sheets and made available through local soil conservation districts. These Facts Sheets, together with the main report and five reference reports, make up the literature needed for publicizing results of the Northeast Iowa Rivers basin study.

SUMMARY OF PUBLIC MEETINGS AND PROBLEM SOLICITATION RESPONSE SHEETS

Initial public meetings were conducted September 2, 1981, at DeWitt, Iowa, and September 3, 1981, at Fayette, Iowa. General information was presented and comments were solicited. Response sheets were completed during the meetings wherein those attending were questioned about land and water problems and were given opportunity to recommend solutions.

ATTENDANCE BY REGION

<u>Category of Participants</u>	<u>Number</u>	
	<u>DeWitt 9/2/81</u>	<u>Fayette 9/3/81</u>
Public	14	24
USDA Employees	6	16
Other Gov't Employees	<u>5</u>	<u>8</u>
TOTAL	25	48

AGENDA

Welcome and Introduction
River Basin Studies in General and the Northeast Iowa in Particular
Discussion of Typical Soil and Water Problems - Solutions
Audience Participation
Response Sheet Completion

GENERAL COMMENTS

DeWitt

Ed Beardsley, IDSC, mentioned that soil depletion studies are some of the important things that come from river basin studies.

Richard Kelley, IDEQ, said his agency is extremely interested in safeguarding the state's protected streams.

Bob Sheets, ICC, stated that it would be very desirable to have 100-150 feet buffer strips along major rivers to filter sediment and provide bank stabilization. Mr. Sheets turned in a prepared statement from ICC.

Fayette

Paul Sadler, IDSC, made general comments about the good cooperation in river basin studies.

Richard Kelley, IDEQ, made the same comments as at DeWitt but emphasized that essentially all of Iowa's high quality streams are in the Northeast Iowa Rivers basin.

Several comments from the audience were pointed toward sinkholes. There is a strong concern that groundwater contamination occurs through sinkholes. There was discussion about whether they should be filled.

Gary Beyer, ICC, talked about loss of forest land. He said that 80 percent of remaining forest land in Iowa is grazed. Two-thirds of Iowa forest land is privately owned.

Several participants discussed the virtual impossibility of borrowing money for forest land improvement. It seems that financial institutions place zero value on forest land.

There was a question about what SCS does to discourage terracing too steep land. The Soil Conservation Service doesn't make land use decisions but encourages landowners to use land within its capabilities. Terraces are recommended on cropland with land capability classes I, II, III, and IV.

Someone thought there are too many wild turkeys. It was proposed that there be landowner permits and possibly fall seasons.

Recreation is causing problems; some were against recreation along the Upper Iowa River. The ICC needs to talk to landowners during recreation project planning.

There was an opinion that landowners should be allowed a family hunting permit for turkey and deer. It was suggested that the limit be one critter (both species) per farm family rather than just allowing the landowner to hunt. Landowner permits should include antlerless animals.

Streambank erosion was extensively discussed. Most of the comments related to experiences in working with INRC. One contributed, "If public stream water is causing damages to private land, shouldn't INRC pay for fixing those streambank damages?"

Concerns about the loss of prime and average agricultural land were expressed. Land use is becoming very important. The opinion was aired that zoning is not a very good solution. It is too easy to vary due to politics. No one claimed to know how to make zoning work.

RESPONSE SHEETS

Response sheets were completed by 43 people from the public sector. Additionally, nine SCS district conservationists shared their opinions on these forms. The SCS data were tabulated but were not included in the analyses except for comparison with specific items from the public response.

A copy of the response sheet form is attached on which the data have been summarized. The bar graph shows the relative magnitude of each problem.

VO CATIONAL OR AVO CATIONAL INTERESTS OF RESPONDENTS

<u>Organization or Occupation</u>	<u>Region</u>	
	<u>DeWitt</u>	<u>Fayette</u>
Engineer		1
SCD Commissioner	1	1
Farmer	10	19
Wildlife Biologist	1	
State ASCS Committee	1	
Retired	1	
Forester		1
School Teacher		1
Extension Service		4
Environmental Specialist		1
Unidentified	—	<u>1</u>
TOTAL	14	29

The above information was given by the respondents. Some farmers also told of other responsibilities; i.e., SCD Commissioner or others, in which case the other responsibility is shown. Therefore, more landowners and operators (farmers) are represented than is indicated.

Highlights from response sheets have been organized by area of concern. In addition to the numerical summary found on the response sheet attached, attention is called to the discussion below.

1. Other effects of erosion also include:
 - A. Loss of topsoil
 - B. Lower water quality - ground and surface
 - C. Sedimentation in productive wildlife backwaters
 - D. More energy required, such as more fertilizer
 - E. Damage to fish and wildlife habitat
 - F. Devalues land

2. Other reasons why erosion problems continue to exist:
 - A. Excessive rainfall
 - B. Farmers dislike changes - too much trouble
 - C. Loan rates
 - D. Lack of education, not familiar with damages and solutions
 - E. More concern with short-term profit than long-term conservation
 - F. Either the owner or tenant not free to control erosion
 - G. Use of chemical fertilizers
 - H. Apathy
 - I. Cheap food policy
 - J. Economic and social pressures on farmers to produce maximum bushels
 - K. Conservation does not increase yields economically
 - L. Large farms, large machinery

Streambank Erosion

1. Where excessive streambank erosion occurs:

<u>Stream</u>	<u>Location</u>
Deep Creek	Deep Creek Township, Clinton Co.
Crane Creek	Chickasaw Co. and NE Black Hawk Co.
Volga River	Fayette Co.
So. Fork Elk River	North of Teeds Grove, Clinton Co.
Turkey River	Eldorado area and lower end, Fayette and Clayton Cos.
Bear Creek	Waterloo Township, Allamakee Co.
Yellow River	Allamakee Co. and Winneshiek Co.
Waterloo Creek	Waterloo Twp, Allamakee Co.
No. Fork Maquoketa River	10 miles upstream of Maquoketa, Jackson Co.
Maquoketa River	NW of Manchester, Delaware and Jackson Cos.
Little Maquoketa River	Dubuque Co.
Buffalo Creek	Linn Co. north of U.S. 20
Wapsipinicon River	All counties
Wapsipinicon River	Between Quasqueton and Independence North of iron bridge
Silver Creek	Allamakee Co.
Upper Iowa River	All counties
Bear Creek	Jones Co.
Kitty Creek	Jones Co.

2. Where streambank repair work has been done:

<u>Stream</u>	<u>Comment</u>
So. Fork Elk River	Not given
Crane Creek	Riprap and junk
Crane Creek	Chickasaw Co. - straightened successfully
Crane Creek	NE Black Hawk Co. - straightened successfully
Silver Creek	DeWitt
Big Mill Creek	Bank grading and riprap
Maquoketa River	Riprap
Buffalo Creek	Streambank protection
Buffalo Creek	Linn Co. - straightened successfully
Wapsipinicon River	Riprap
Wapsipinicon River	Tires roped together
Yellow River	Fairview Twp - shift gravel bars
Upper Iowa River	Riprap

3. Suggestions for special programs to prevent or repair streambank erosion:

- A. Leave 100-foot strip of grass or trees each side
- B. Information and education
- C. Straighten
- D. More conservation along streams
- E. Stop logging in creeks
- F. Cost share for riprap and other
- G. Have this a part of regular SCS work, not an untouchable
- H. ASCS program
- I. Planning assistance
- J. Tax incentive
- K. Make it a county program
- L. Develop a standard and specification for statewide use
- M. Restrict straightening
- N. Incentive payments to limit livestock damage
- O. Low interest loans

4. Description of working with government agencies on a streambank problem:

- A. INRC needs more police power to stop and repair damage
- B. Asked for and received permission of INRC to move gravel bar

Loss of Prime Farmland

1. Examples of which respondents were aware:

- A. Country housing, houses dotting countryside helter skelter
- B. Highways
- C. Livestock confinement buildings
- D. Factories
- E. Urban sprawl
- F. City expansion
- G. Utility construction
- H. Commercial business

- I. Airports
- J. Waste treatment plants
- K. Park and recreation areas
- L. John Deere plant
- M. Iowa Development Commission encourages use of land for factories

An incidental suggestion was to use highway median strips for planting corn.

Forest Land Concerns

- 1. Additional concerns written in by respondents:
 - A. Need additional technical assistance
 - B. Need harvesting and marketing cooperatives
 - C. Education in timber management
 - D. Require an acre planted for each acre cleared
 - E. Bankers don't recognize value of forests
 - F. Not enough publicity on forest cost share sign-ups
 - G. Need monetary supports to keep forest land in forests
 - H. Dishonest timber buyers
 - I. Oak wilt disease
 - J. Too much government control

Polluted Groundwater

- 1. Examples of polluted groundwater:
 - A. Nitrates
 - B. Bad tastes
 - C. High sulphur
 - D. Livestock
 - E. Chemicals
 - F. Sinkholes
 - G. Bacteria which precipitates iron
 - H. High iron
 - I. Hardness
 - J. Livestock facilities
 - K. Faults and fractures in limestone
 - L. Shallow wells contaminated
- 2. Additional sources of groundwater pollution:
 - A. Sanitary land fills
 - B. Inadequate septic tanks and drain fields
 - C. Industrial spills
- 3. Other possible sources of pollution through sinkholes:
 - A. Burning trash in sinkholes
 - B. Junk, farm machinery
 - C. Septic tank dumping

Surface Water Pollution

1. Other causes:

- A. Overuse of fertilizers and chemicals
- B. Salt from city streets
- C. Construction sites

2. Where stream pollution is a problem:

<u>Stream</u>	<u>Location</u>
Deep Creek	Not given
Bear Creek	North of Arlington
Crane Creek	Not given
Elk River	Not given
Mink Creek	North of Wadena
Silver Creek	DeWitt
Hickory Creek	Franklin Twp, Allamakee Co.
Wapsipinicon River	Not given
Yellow River	Not given
Otter Creek	Lower end W. Central Fayette Co.
Both Maquoketa Rivers	Not given
Upper Iowa River	Not given
Big Cedar	Not given
Little Cedar	Not given
Turkey River	Not given
Little Turkey River	Not given
Volga River	Not given

SCS PERSONNEL

Nine SCS district conservationists completed response sheets. Information from these is not included in the prior discussion. These SCS employees saw the situation somewhat differently as stated below.

<u>Public Rank</u>	<u>Problem</u>	<u>SCS Rank</u>
1	Sheet and Rill Erosion	1
10	Wind Erosion	12*
4	Gully Erosion	9*
3	Streambank Erosion	12*
5	Sedimentation	2*
7	Flooding	9*
2	Improper Land Use	2*
12	Agricultural Drainage	7*
11	Pasture Management	6
6	Woodland Management	9*
8*	Ground Water Quality	7*
8*	Surface Water Quality	2*
13	Lack of Wildlife Cover	2*

* Represents a tie count

The public and SCS both think sheet and rill erosion to be the greatest problem. Ranking was different on the gully and streambank erosion items. Public concern was much greater for these. Employees of SCS thought agricultural drainage was more of a problem than the public recognizes. In fact, two SCS response sheets showed drainage to be of greatest importance. In general, SCS people think pasture management to be more of a problem. The SCS'ers also show surface water quality and lack of wildlife cover to be more serious problems than does the public. There was a significant finding that all nine SCS people thought that fish and wildlife populations were inadequate. Several of the public think there are plenty of fish and wildlife.

Reports Available

At the conclusion of the study, Fact Sheets for each of the seven concerns were printed and distributed through field offices of soil conservation districts. A Fact Sheet is a one page summary explaining the problem, presenting two levels of problem solution, and presenting a brief statement of information about the Northeast Iowa Rivers basin study.

The principal publications available to concerned individuals are:

Main report, including appendixes

Reference reports

Soil Depletion on Representative Farms

Groundwater Contamination

Forest Resources

Pollution of Coldwater Streams

Streambank Erosion

APPENDIX E

POLLUTION OF COLDWATER STREAMS

This appendix is an abstract of the following paper.

YELLOW RIVER
RAINFALL RUNOFF AND LOW FLOW
WATER QUALITY STUDIES

Report No. 83-3

Jack O. Kennedy, Head, Limnology Section
Roger C. Splinter, PhD, Associate Director

The University Hygienic Laboratory
The University of Iowa
Iowa City, Iowa 52242

The water quality of the Yellow River was studied during summer and fall 1982. The primary objectives of the study were to 1) evaluate the effects of rainfall runoff during the planting season on water quality, 2) evaluate the effect of rainfall runoff on water quality during a high recreational use period, and 3) determine the effects of point source discharges on water quality during low flow summer conditions. Water samples were collected from the Yellow River on three separate occasions, twice during rainfall runoff periods and once during low flow non-runoff conditions. Flow-activated automatic samplers and flow meters located at seven sampling stations were used to monitor the runoff events. The impact of the rainfall runoff was found to be very dependent on the amount and intensity of rainfall and the quantity of runoff delivered to the receiving stream. The most notable effects of the runoff on water quality were the increases in total solids and associated parameters (organic nitrogen, total phosphate, BOD, metals, and pesticides). The impact of these solids and associated contaminants on stream biota is not known. The more water-soluble contaminants, i.e., ammonia nitrogen and soluble phosphate, experienced only minor increases in concentrations compared to the solids associated parameters, during the runoff events. Pesticide concentrations found in the Yellow River were greatest during the June event, which occurred shortly after spring planting. Four of the five pesticides reported were herbicides and included one organophosphate insecticide. The pesticide values reported were all low and much lower than presently identified acute toxic levels. Because of the short duration and localized nature of the July event, its impact on recreational activity during the high use period was minimal.

Water quality at Station 2 was the most affected of the seven stations by rainfall runoff. The highest concentrations of most parameters, including metals and pesticides, were observed at Station 2 for both runoff events. The total load values for most parameters were greatest at the most downstream stations where the highest flows occurred. Except for the poor water quality exhibited at Station 2 for both runoff events, it is not possible to make a comparison between the two runoff events because of the variation in rainfall amounts and intensities in the watershed. Results of the low flow non-runoff study demonstrated very good water quality throughout the entire Yellow River reach, with only minor changes in parameter values. Compared to the two runoff events ammonia, total phosphorus, BOD, and solids values for the low flow study, were substantially lower and represent background conditions. The point source waste discharge from Postville had an immediate impact on Williams Creek water quality, by increasing ammonia nitrogen and BOD and decreasing dissolved oxygen. However, the effect was of relatively short duration as the water quality of Williams Creek at the mouth was similar to that of the Yellow River. Based on the benthic macroinvertebrate data obtained during the survey the water quality of the Yellow River was good. The wide species diversity with moderate numbers of individuals reflected a healthy, stable community and is comparable to previous benthic surveys.

APPENDIX F

STREAMBANK EROSION

PRINCIPAL DATA SOURCES

The physical and financial impacts of streambank erosion were developed from these sources:

INFORMATION FROM PUBLIC MEETINGS - Initial public meetings were conducted September 2, 1981, at Dewitt, Iowa, and September 3, 1981, at Fayette, Iowa. General information about cooperative river basin studies was presented and comments were solicited. Individuals attending completed response forms on which questions pertaining to land and water problems were presented. Locations where respondents knew of streambank erosion were noted (Figure F-1). During the open meetings streambank erosion was extensively discussed. Several comments related to experiences in working with governmental regulatory agencies having jurisdiction over streams.

INFORMATION FROM YELLOW RIVER SCS STUDIES - Early in 1980 the SCS inventoried 22 former or present streambank erosion problem sites along the Yellow River in Allamakee County (Figure F-2). Streambank changes due to unstable bank conditions were extensively photographed and data recorded to show texture of earth materials, channel roughness, stream vegetation, approximate dimensions, suspended or bedload sediments, presence or absence of livestock fence, and apparent cross-section alignment dynamics. Flood plain land use was documented. Collected data were summarized and rates of loss computed (Table F-1). Acreages were measured on overlays traced from photographs with a scale of eight inches per mile. Photos from the years 1940, 1957, 1971, and 1979 were examined. Significant changes at several sites were apparent over this time span.

INFORMATION FROM FOUR SPECIFIC SITES - Four streams where streambank erosion occurs were reviewed during this study (Figure F-3). Kitty Creek and Bear Creek in Jones County and Maquoketa River and North Fork Maquoketa River in Jackson County were studied in the field and the erosion rates analyzed at the office. Aerial photographs for different chronological dates were used to detect streambank changes and rates of land loss. Where loss rate is significant the cost for control was calculated.

INFORMATION FROM INVENTORY DATA - The 1977 NEI (National Erosion Inventory) was an important source for quantifying the streambank erosion problem (Table F-2). County data were tabulated for total length of streams, bank eroding length, rate of land voiding, and amount of annual erosion. Primary Sample Unit data were extrapolated to the whole county and then factored by percent of the county in the Northeast Iowa Rivers Basin.

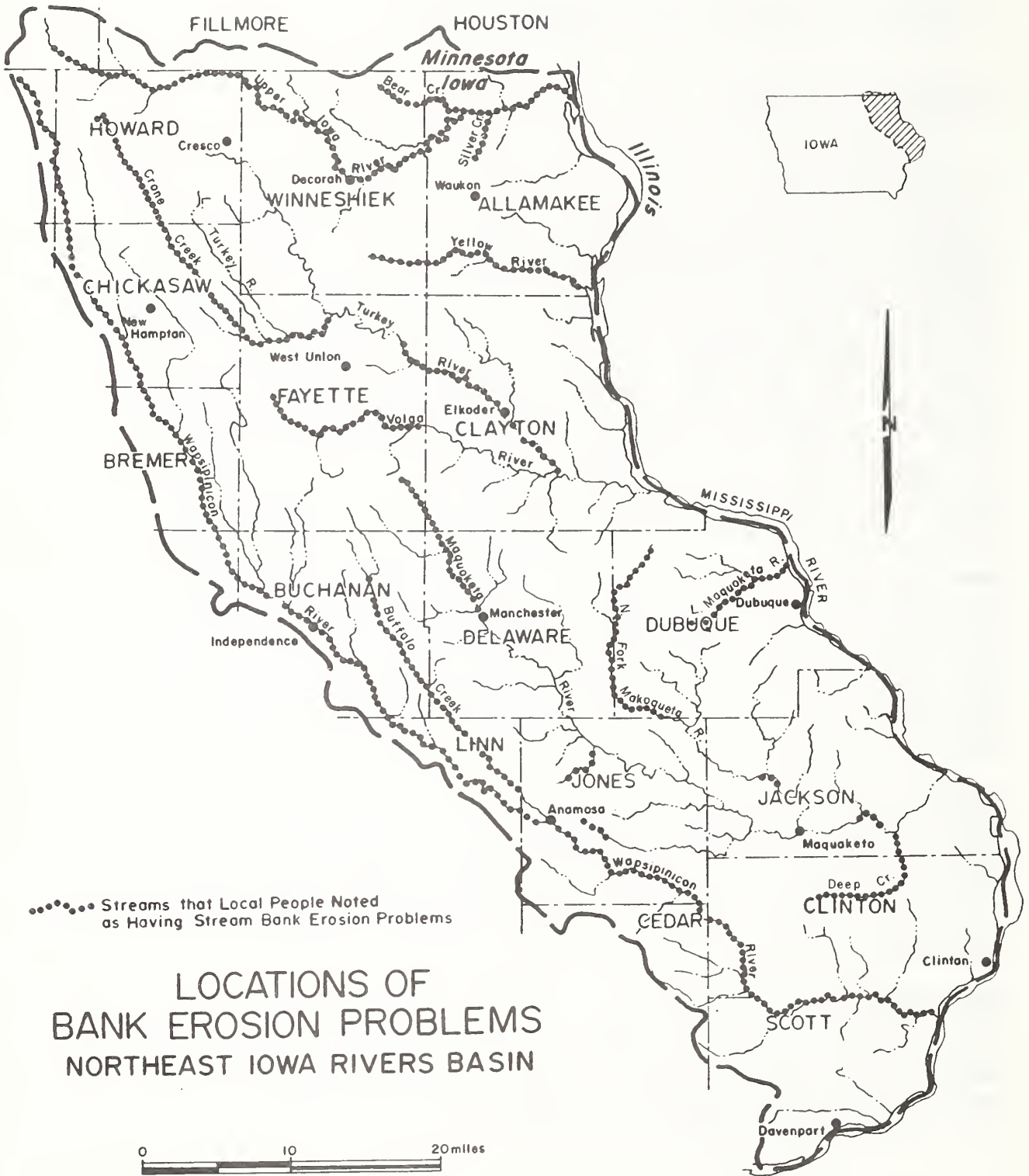
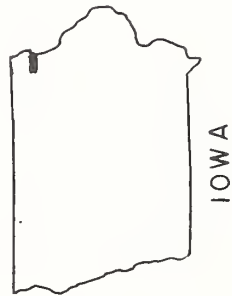
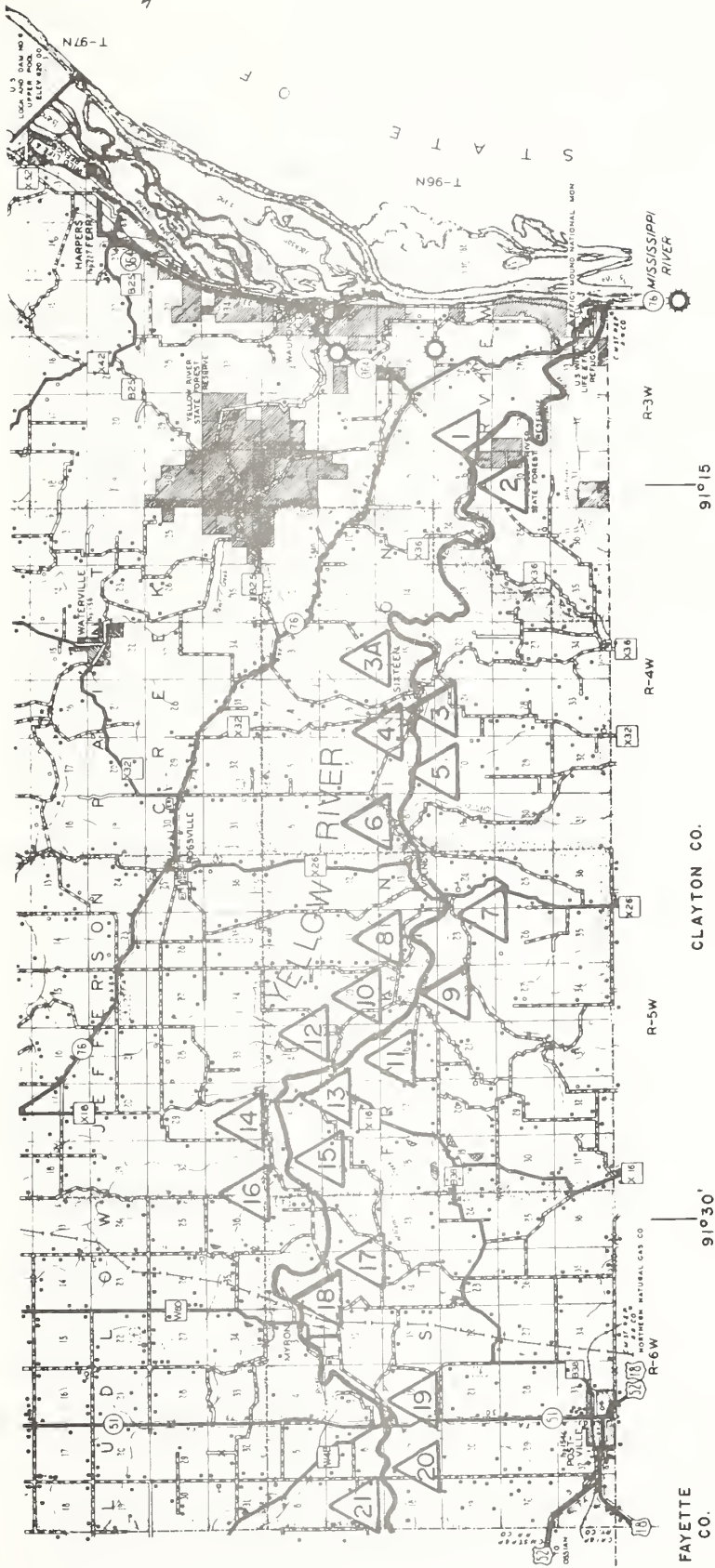


FIGURE F-1



IOWA

SCALE 1 0 1 2 3 4 5 MILES

SOURCE:
1976 GENERAL COUNTY HIGHWAY MAP
POLYCONIC PROJECTION

FIGURE F-2

TABLE F-1

YELLOW RIVER STREAMBANK EROSION SITES

Northeast Iowa Rivers Basin

Site Number	Length ft <u>1/</u>	Land Area Change		Flood Plain Land Use	Reference Year	Rate of Loss ac/yr
		Lost ac <u>2/</u>	Gained ac <u>3/</u>			
1	8,250	2.7		Crop	1957	.12
2	1,580	2.8		Crop	1940	.07
3A			6.5	Crop	1971	
3	1,650	0.8		Crop	1940	.02
4	1,980	2.7		Pasture	1940	.07
5			4.4	Wildlife	1971	
6	4,290	0.6		Crop	1971	.08
7	2,240	1.8		Crop	1940	.05
8	3,230	3.9		Crop	1940	.10
9	3,160	0.6		Crop	1971	.08
10	3,360	1.4		Crop	1971	.18
11	1,320	0.3		Crop	1971	.04
12	2,100	0.9		Pasture	1971	.11
13	3,800	0.4		Crop	1971	.05
14			1.2	Crop	1940	
15	3,960	2.0		Crop	1940	.05
16	2,400	0.5		Crop	1957	.02
17	1,650	1.1		Pasture	1971	.14
18	1,980	1.0		Pasture	1957	.05
19			3.2	Crop	1940	
20			2.0	Crop	1940	
21			5.0	Crop	1957	
Total	46,950 <u>4/</u>	23.5	22.3			1.23

1/ Length is the approximate greatest meander distance through which streambank erosion was studied at the site.

2/ Land lost is the total between the reference year and 1979.

3/ In all instances the land area gained resulted from stream straightening wherein former oxbow areas were reclaimed.

4/ Total length of all sites approximates 25 percent of the 36-mile total length of the Yellow River in Allamakee County.

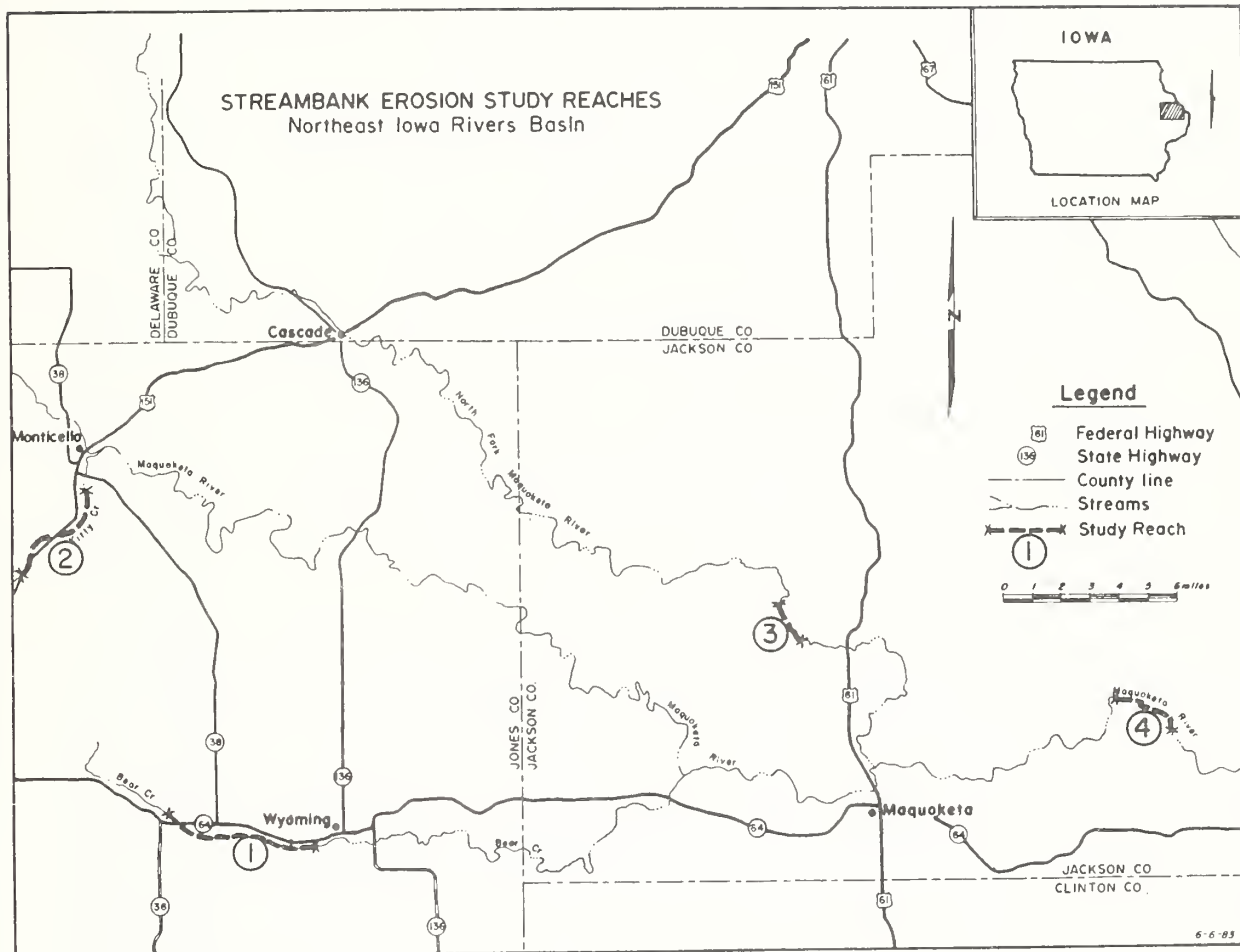


FIGURE F-3

EROSION RATE IS INCREASING

Several considerations influenced a decision that streambank erosion was accelerating a small amount. Knowledgeable people in the public sector and in government sense the problem is growing. An increasing number of requests to assist in bank repairs come to field offices of involved agencies. The permitting office in the State regulatory agency has experienced increased activity. More intense land use has resulted in removal of permanent vegetation near streams which normally precedes increased bank erosion. Less permanent cover on watersheds often allows greater and faster runoff increasing erosive action on streambanks. Annual bank erosion at the North Fork Maquoketa River site studied indicated the average annual rate from 1970 to 1979 was about 50 percent greater than the 1957 - 1970 rate. Time between the median years is 11 years indicating an annual increase of four percent. Observations at most locations do not support such an acceleration. A modest rate increase of 0.2 percent annually was selected to best represent basinwide streambank erosion conditions.

TABLE F-2

STREAMBANK EROSION SUMMARY DATA FROM 1977 NATIONAL EROSION INVENTORY

Northeast Iowa Rivers Basin

County Name	Part in Basin percent	Erosion		Area		Eroding Length		Total Length	
		County PSU 1/ Total	Amount 2/ Eroded in Basin tons/yr	County PSU 1/ Total	Area 2/ Voided in Basin ac/yr	County PSU 1/ Total	Length 2/ Eroding in Basin bank miles	County PSU 1/ Total	All 2/ Streams in Basin
Allamakee	100.0	701.05	100,000	0.0777	11.2	4.35	626	29.19	4,203
Black Hawk	11.8	0.00	0	0.0000	0.0	0.00	0	1.02	17
Bremer	54.3	146.41	11,000	0.0279	2.1	0.88	69	4.34	339
Buchanan	76.8	855.12	95,000	0.1242	13.7	1.57	174	5.35	592
Cedar	24.7	10.33	0	0.0027	0.1	0.28	10	8.95	318
Chickasaw	83.9	85.71	10,000	0.0225	2.7	1.03	124	4.59	555
Clayton	100.0	858.72	124,000	0.1180	17.0	4.96	714	10.33	1,488
Clinton	100.0	241.59	35,000	0.0420	6.0	5.00	720	9.56	1,377
Delaware	100.0	346.50	50,000	0.0468	6.7	1.89	272	4.01	577
Dubuque	100.0	162.58	23,000	0.0346	5.0	3.12	449	7.29	1,047
Fayette	100.0	239.05	34,000	0.0299	4.3	1.10	158	5.96	858
Floyd	0.6	0.00	0	0.0000	0.0	0.00	0	0.00	0
Howard	100.0	1,383.39	199,000	0.1445	20.8	2.75	396	7.98	1,149
Jackson	100.0	940.81	135,000	0.1015	14.6	9.80	1,411	28.67	4,128
Jones	99.5	444.49	64,000	0.0661	9.5	6.24	894	11.07	1,586
Linn	22.6	148.33	5,000	0.0388	1.3	1.61	52	2.23	73
Mitchell	12.0	0.50	0	0.0002	0.0	0.02	0	1.14	20
Scott	94.9	910.99	125,000	0.1662	22.7	11.05	1,510	14.12	1,930
Winneshiek	100.0	82.59	12,000	0.0180	2.6	1.12	161	13.25	1,908
TOTAL			1,023,000		140.3		7,740		22,165

1/ PSU is abbreviation for Primary Sampling Unit, 160 acres. (one PSU per township; represents 1/144 of total).

2/ Amounts and Lengths were calculated by multiplying the preceding PSU column by the percent in basin times 144.

TABLE F-3

AVERAGE CONSTRUCTION COST PER LINEAR FOOT
FOR STREAMBANK EROSION CONTROL

Northeast Iowa Rivers Basin

Practice Measure	Construction Cost, Bank Height Range and Percent in each Range				Weighted Construction Cost	Percent Practice is of Total Use	Weighted Cost
	4'-6'	6'-9'	9'-13'	13'-18'			
	27%	27%	24%	22%			
-----Dollars/Linear Foot-----							
Reshape Bank and Vegetate	12	20	28	38	23.72	25	5.93
Reshape Bank and Riprap	49	67	91	123	80.22	40	32.09
Rock Jetties	10	22	60	123	50.10	5	2.51
Fence Retard	33	33	50	75	46.32	10	4.63
Kellner Jacks	60	60	85	85	71.50	5	3.58
Dead Trees Anchored to Bank	17	20	24	31	22.57	5	1.13
Permeable Fence Jetties	75	75	100	100	86.50	5	4.33
Reshape and Apply Tire Mattress	23	31	42	55	36.76	<u>5</u>	<u>1.84</u>
TOTAL						100	56.04

STREAMBANK EROSION DAMAGE

Monetary loss to streambank erosion totals \$790,000 annually. This amount is projected to increase to \$854,000 by 2025.

STREAMBANK EROSION CONTROL - Engineering practices for controlling streambank erosion usually utilize one or more of these features:

1. Reshaping bank slopes
2. Establishing vegetation
3. Overlaying of durable, heavy material (armoring)
4. Redirecting flow
5. Moving the attacking water away from the endangered bank

Measures selected for analyses utilize the first four features. The fifth feature applies to situations in which the stream is moved away from the erosive site. That alternative was not considered in these analyses. Eight engineering practice measures were studied for determining a weighted average construction cost of \$56.04 per linear foot (Table F-3).

Environmental corridors of trees, periodically interspersed with one-third of the length being grass segments, are recommended to be established in conjunction with the structural measures. In addition to values in lessening or preventing streambank erosion, additional benefits to landowners and the public would accrue. These linear, water-oriented parcels of land can enhance man's environment in terms of scenic beauty, wildlife habitat, natural areas, open space, recreational opportunities, flood damage reduction, water quality improvement, and other desirable aspects. Corridor location may be coincident with construction practices, or, corridors alone may adequately defend against streambank erosion.

For cost estimates, corridors were assumed to be an average of 100 feet wide (some will be wider and some narrower depending upon the situation). As it may be desirable for the corridor to be classed forest land, crown cover needs to be 120 feet.

Species recommended are black walnut, cottonwood, green ash, and black ash. Cost for planting stock, labor, weed control, and land easement was estimated to total \$12,100 per bank mile. Land cost was about 90 percent of this total.

APPENDIX G

IOWA GOVERNMENT REORGANIZATION

Agency Name Prior To July 1, 1986	Agency Name Beginning July 1, 1986
Northeast Iowa Conservancy District	Northeast Iowa Water Resource District
Department of Soil Conservation (DSC)	Iowa Department of Agriculture and Land Stewardship Division of Soil Conservation
Department of Water, Air and Waste Management (DWAWM)	Iowa Department of Natural Resources Environmental Protection Division
Iowa Conservation Commission (ICC)	Iowa Department of Natural Resources Fish and Wildlife Division Forests and Forestry Division
Iowa Geological Survey (IGS)	Iowa Department of Natural Resources Energy and Geological Resources Division Geological Survey Bureau
Office of Planning and Programming (OPP)	Iowa Department of Economic Development
Office of Historic Preservation	Iowa Department of Cultural Affairs Historical Division



R0001 146037

oa



R0001 146037