Des Moines River Basin Study

Forest Service

Soil Conservation Service

DES MOINES RIVER BASIN

A WATER AND RELATED LAND RESOURCES STUDY OF THE DES MOINES RIVER BASIN

PREPARED BY:

ECONOMIC RESEARCH SERVICE
FOREST SERVICE
SOIL CONSERVATION SERVICE

IN COOPERATION WITH:

DES MOINES RIVER CONSERVANCY DISTRICT
IOWA CONSERVATION COMMISSION
IOWA DEPARTMENT OF SOIL CONSERVATION
IOWA DEPARTMENT OF WATER, AIR AND WASTE MANAGEMENT
MINNESOTA SOIL AND WATER CONSERVATION BOARD

UNDER DIRECTION OF:

USDA FIELD ADVISORY COMMITTEE

DES MOINES, IOWA

1983

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PREFACE

NEED FOR THE STUDY

This study was requested by the Iowa Department of Soil Conservation, Iowa Department of Water, Air and Waste Management, [1/] Iowa Conservation Commission, the Des Moines River Conservancy District, and the Minnesota Soil and Water Conservation Board. The information developed from this study will be used for the programs of the sponsors and participating agencies. Many of the alternatives explored and the recommendations made as part of this cooperative study will be used directly in future planning processes.

AUTHORITY

The Des Moines River Basin Cooperative Study was conducted under authority of Section 6, Public Law 566, as amended. This authorizes the Secretary of the United States 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 serves as a basis for the development of coordinated programs.

USDA RESPONSIBILITIES

Three USDA (United States Department of Agriculture) agencies participated under the terms of the Memorandum of Understanding dated February 2, 1956, and revised April 15, 1968. As outlined in the memorandum, the Economic Research Service is responsible for basin-wide economic aspects and elements of planning.

The Forest Service is responsible for the aspects of planning related to woodlands and forested lands, both federal and non-federal; and 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.

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

1/ An original sponsor, the Iowa Natural Resources Council is now combined in this agency.

SPONSORING AND COOPERATING AGENCY PARTICIPATION

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, and the Des Moines River 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, substate, 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.

The Des Moines River Conservancy District is responsible for developing and implementing a plan for the management of water resources within the Des Moines River 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, informational and educational programs, technical assistance to forestland owners, and administering some funding programs.

The state of Minnesota participated through the Minnesota Soil and Water Conservation Board. They provide administrative and financial assistance to soil and water conservation districts in carrying our their programs for the conservation of soil and water resources.

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

Des Moines River Conservancy District
Iowa Conservation Commission
Iowa Department of Water, Air, and Waste Management
Iowa Department of Soil Conservation
Iowa Department of Transportation
Iowa Development Commission
Iowa Geological Survey
Iowa Office for Planning and Programming
Iowa State University
Minnesota Soil and Water Conservation Board
Office of Historic Preservation
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Geological Survey

SUMMARY

The Des Moines River Basin Cooperative Study was requested by the Iowa Department of Soil Conservation with cooperation and sponsorship of the Des Moines River Conservancy District, Iowa Conservation Commission, Iowa Department of Water, Air and Waste Management and the Minnesota Soil and Water Conservation Board.

The investigations and analyses, preparation of the main report, and six reference reports were completed by the Economic Research Service, Forest Service and Soil Conservation Service of the United States Department of Agriculture with assistance from other cooperating agencies. The six reference reports are: Soil Depletion Study, Representative Farms Report, Drainage Report, Water Impoundment Opportunities, Reservoir Sedimentation, and Environmental Corridors. More detailed information can be obtained from these reports. Copies of each report can be obtained from the Soil Conservation Service, Des Moines, Iowa.

The main report contains a detailed description of the problems and concerns identified at public meetings and by the sponsoring agencies. It also contains three alternative levels of problem solution. Each alternative basically described the probable impact of one funding level on the problems and concerns. In an effort to describe the emphasis of the three different alternatives they were identified as follows: A Practical and Feasible alternative, an Ideal alternative, and the Early Action Plan. The Practical and Feasible alternative is a description of the actions which could reasonably be accomplished by 2020 to reduce the problems. The Ideal alternative presents actions to solve problems by 2020 without regard for cost or social acceptance.

The Early Action Plan is designed to meet the most urgent needs first. It contains actions that can be implemented by the year 2000. The 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 problem and the impact of the Early Action Plan elements on these problems is as follows:

SHEET AND RILL EROSION

Cropland

There are presently 1.5 million acres eroding above tolerable levels.

This is projected to increase to 1.7 million acres by year 2020. The Early Action Plan will direct the erosion control efforts to those 363,000 acres that will be depleted by year 2020. The annual cost of this plan is $13.6 million.

Pasture

Currently 251,000 acres of pasture are eroding excessively. The amount of pasture with excessive erosion is projected to decrease to 153,240 acres by the year 2020. The Early Action Plan will treat 76,560 acres at an annual cost of $5.25 million.

Forest

Currently 31,400 acres of forest land are eroding excessively. This is projected to decrease to 26,000 acres by the year 2020. The early actions will protect 12,900 acres at an annual cost of $1.7 million.

GULLY EROSION

There are now 134,300 gullies. The Early Action Plan is to treat 270 of the worst gullies at an annual cost of $141,000.

WET CROPLAND

There are 1.6 million acres of existing cropland with reduced yields as a result of inadequate drainage. Present drainage activitiy is projected to reduce this area to 1.5 million acres by the year 2020.

A cooperative study done with Iowa State University explored both the physical and social aspects of drainage. The cooperative study revealed a complex subject with no simple solutions. There is no general recognition of need or potential benefits. Most people know drainage improvements are expensive.

The Early Action Plan will cost $2.9 million annually for the next 20 years for research, education, inventory, and interest subsidy. In addition the annual cost to drain 289,000 acres is estimated at $8.7 million. The annual cost of $11.6 million will improve annual crop yields by $28 million. The Early Action Plan emphasized research, demonstration, education, and inventory of existing systems. These actions are planned to improve the public perception of the cost-return relationships involved.

LOSS OF AGRICULTURAL LANDS

The agricultural land base is projected to decline 4,100 acres per year, an average annual production loss of $952,000. These irreversible changes are from agriculture to cities, roads, and reservoirs. Implementation of the Early Action Plan will reduce the loss to 2,500 acres per year for an annual cost of $6,100.

LOSS OF WILDLIFE HABITAT

Wildlife species and numbers have been decreasing and are expected to continue decreasing if no actions are taken. The habitat quality is 29 percent of its potential. The Early Action Plan will maintain the habitat quality at 35 percent of potential with the following additions: windbreaks, 5,000 acres; wetlands, 2,000 acres; and public lands 14,000 acres at an annual cost of $2.4 million.

LOSS OF FOREST LAND

Currently forest land acreage is being reduced 1,890 acres per year. This represents an annual loss of $75,000 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 310 acres per year at an annual cost of $730,000.

EARLY ACTION PLAN

PLAN ELEMENT SUMMARY

Des Moines River Basin

Plan Elements	Unit	Amount	Annual Cost Dollars (1,000's)
Sheet and Rill Erosion			
Cropland			
Reduced tillage	Acre	824,300	- 6,182 1/
No-tillage	Acre	243,200	- 4,803
Terraces	Acre	204,600	20,535
Other	-		3,476
Pastureland			
Pasture Planting	Acre	76,560	2,284
Pasture Management	Acre	76,560	716
Change Pastureland to Forest Land	Acre	50,000	2,250
Forest Land			
Livestock exclusion	Acre	100,000	1,000
Tree planting	Acre	36,000	707
Gully Erosion			
Waterways	Acre	88	9
Grade Stabilization Structures	Number	182	132
Wet Cropland			
Drainage	Acres	289,000	8,654
Research, Education, and Investigation	-	-	1,417
Financial Assistance	-	-	1,168
Loss of Agricultural Lands			
Land protection Zoning	Counties	4	2
Land Evaluation and Site Assessment	Counties	20	4
Loss of Wildlife Habitat 2/			
Farmstead Windbreaks	Acre	5,000	886
Privately-owned Wetland Protection	Acre	2,000	2
Public Land Acquisition	Acre	14,000	1,547
Loss of Forest Land			
Timber Stand Improvement	Acre	36,000	340
Tree Planting	Acre	18,000	390

Price Base: 1982

1/ Negative values indicate reduced cost of production.

2/ These elements are in addition to those included in the erosion control alternative.

CHAPTER 1

PROBLEMS AND CONCERNS

Public meetings were held thoughout the basin to explain broad resource studies and to gather public input (See Appendix F). 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. Water erosion.
   a. Sheet and rill erosion.
   b. Gully erosion.
2. Wet cropland.
3. Loss of wildlife habitat.
4. Loss of forest land.
5. Loss of agricultural land.

These items are quantified in Table 1-1. They represent a definition of present and project the future without project conditions for chosen target years. Data were developed for Iowa (Table 1-2) and Minnesota (Table 1-3). Missouri is not included because of the small area involved. All references to the Des Moines River Basin exclude Missouri.

Inventories made during the study include: use, productivity, and characteristics of the land; capacity of tile outlet drainage districts; social and economic problems of drainage; quality of wildlife habitat; quantification of gully erosion; sedimentation rates of four lakes; 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 the problems in detail and quantify them for analysis.

SHEET AND RILL EROSION

Sheet and rill erosion by water is the most significant cropland 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.

TABLE 1-1

IDENTIFICATION OF PROBLEMS AND CONCERNS
BASIN

Des Moines River Basin

Problem of Concern	Unit	1980	Future Without Project 2000	Future Without Project 2020
Water Erosion				
Sheet and Rill				
Cropland	Acre 1/	1,498,900	1,640,000	1,748,400
Pastureland	Acre 1/	251,000	195,740	153,240
Forest Land	Acre 1/	31,400	29,200	26,000
Gully	Ton/Sq.Mi./Yr.	180	190	200
Wet Cropland	Acre	1,616,000	1,551,000	1,503,000
Loss of Agricultural Lands	Acre/Yr.	10,100	4,100	4,100
Loss of Wildlife Habitat	HSI 2/	3.6	3.0	2.9
Loss of Forest Land	Acres/Yr.	1,890	1,890	1,890

1/ Acres exceeding tolerable levels.

2/ Habitat Suitability Index on a scale of 0 - 10.

TABLE 1-2

IDENTIFICATION OF PROBLEMS AND CONCERNS
IOWA

Des Moines River Basin

Problem or Concern	Unit	1980	Future Without Project 2000	Future Without Project 2020
Water Erosion				
Sheet and Rill				
Cropland	Acre 1/	1,209,700	1,346,500	1,451,700
Pastureland	Acre 1/	245,000	191,000	149,500
Forest Land	Acre 1/	31,100	28,900	25,800
Gully	Ton/Sq.Mi./Yr.	200	210	220
Wet Cropland	Acre	1,359,000	1,305,000	1,264,000
Loss of Agricultural Lands	Acre/Yr.	8,900	3,600	3,600
Loss of Wildlife Habitat	HSI 2/	3.8	3.2	3.0
Loss of Forest Land	Acres/Yr.	1,830	1,830	1,830

1/ Acres exceeding tolerable levels.

2/ Habitat suitability Index on a scale of 0 - 10.

TABLE 1-3

IDENTIFICATION OF PROBLEMS AND CONCERNS
MINNESOTA

Des Moines River Basin

Problem or Concern	Unit	1980	Future Without Project 2000	Future Without Project 2020
Water Erosion				
Sheet and Rill				
Cropland	Acre 1/	289,200	293,500	296,700
Pastureland	Acre 1/	6,000	4,740	3,740
Forest Land	Acre 1/	300	300	200
Gully	Tons/Sq.Mi./Yr.	50	50	50
Wet Cropland	Acre	257,000	246,000	239,000
Loss of Agricultural Lands	Acre/Yr.	1,200	500	500
Loss of Wildlife Habitat	HSI 2/	3.0	2.6	2.5
Loss of Forest Land	Acres/Yr.	60	60	60

1/ Acres exceeding tolerable levels.

2/ Habitat Suitability Index on a scale of 0 - 10.

Inadequate drainage results in reduced crop production.

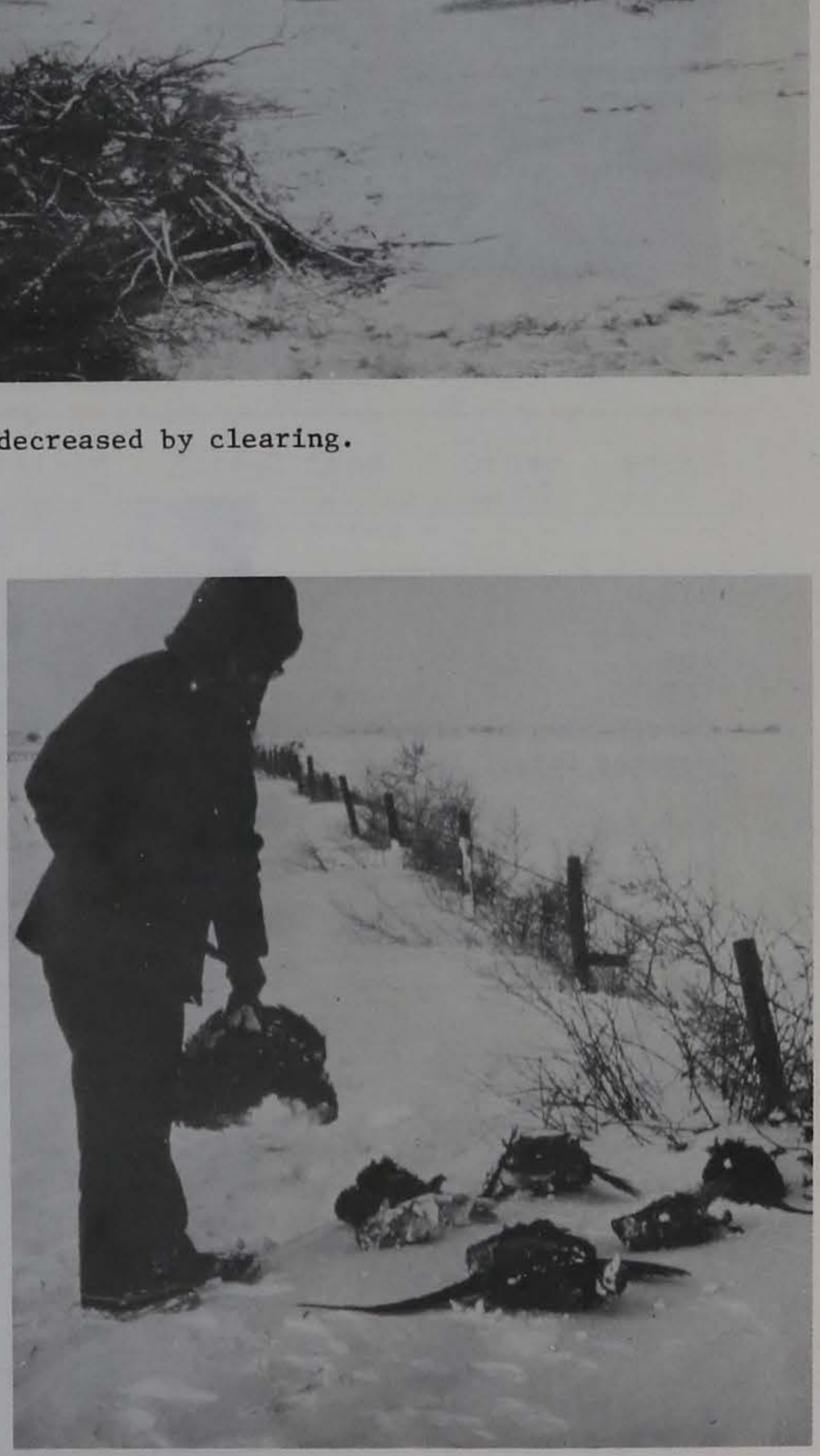
Urban sprawl consumes productive agricultural land.

Overgrazing can result in excessive erosion on pastureland.

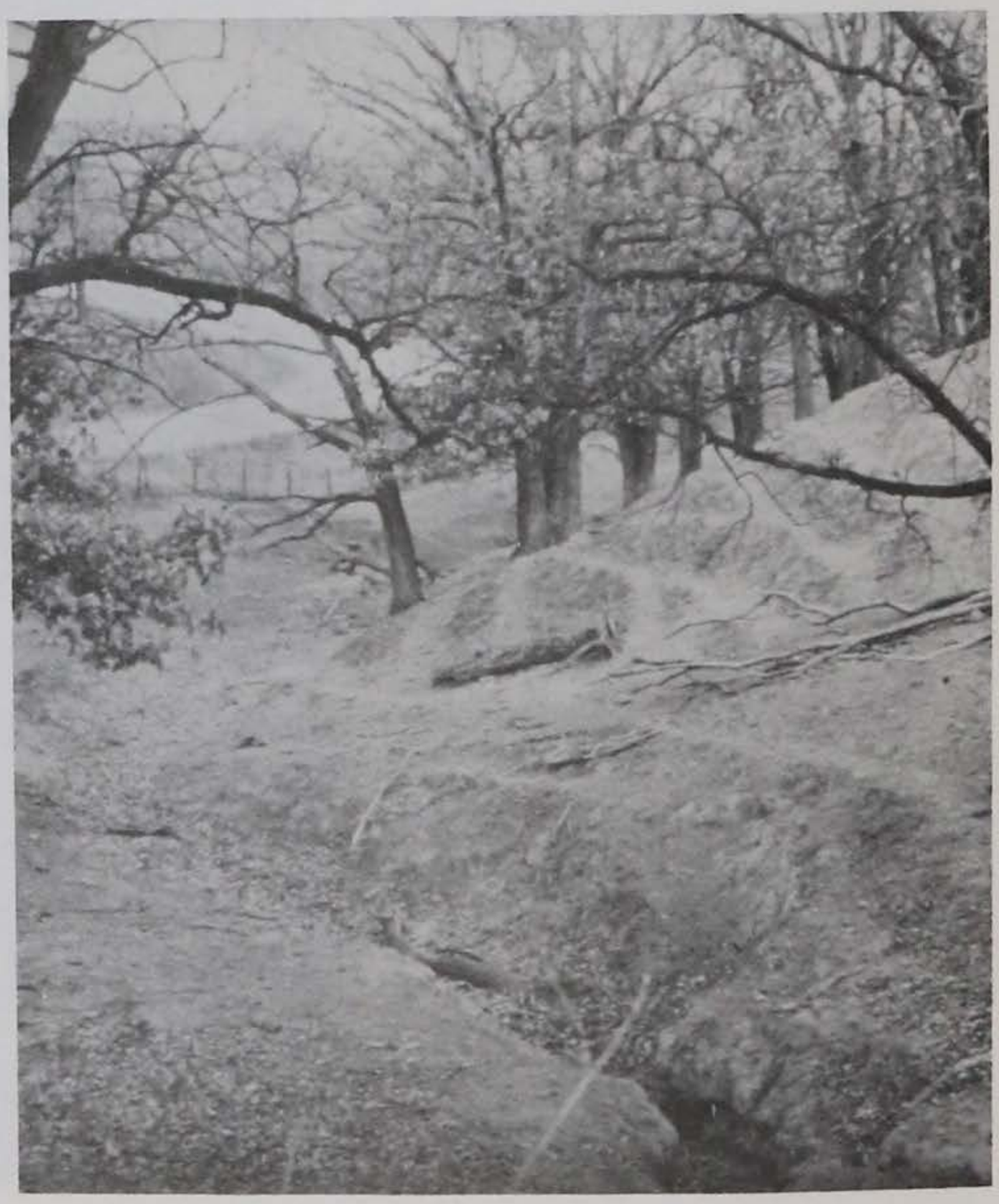
Severe erosion on cropland results in resource depletion.

The forest resource is decreased by clearing.

Loss of wildlife habitat results in decreased wildlife populations.



Gully erosion voids and depreciates the soil resource.



Overgrazing by livestock damages forest lands.

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 on the soil surface. Erosion can also cause off-site problems such as sedimentation and decreased water quality.

Within the Iowa portion of the study area, there are over 3.7 million acres of cropland, pastureland, forest land, and other agricultural lands with erosion as a dominant hazard. This is over 45 percent of the area (Table 1-4).

TABLE 1-4

INVENTORY OF AGRICULTURAL LAND WITH EROSION HAZARDS BY CLASS-SUBCLASS-1967
IOWA

Des Moines River Basin

Class 1/	Cropland	Pastureland	Forest Land	Other	Total
	- - - - - - - - -	- - - - -	-1,000 Acres - - - - - - - -		
IIe	1,270	71	12	67	1,420
IIIe	1,059	206	38	55	1,358
IVe	207	160	26	11	404
VIe	94	112	41	10	257
VIIe	43	128	122	10	303
Total	2,673	677	239	153	3,742

1/ See Appendix A for explanation of class and subclass.

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 9 percent from 1960 to 1970 and nearly 27 percent from 1970 to 1980. The 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 for the depletion of natural soil productivity.

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, that state and other programs will remain at present levels, and that increased technology will result in higher yields. It is also assumed that erosion rates and land adequately protected will remain constant over the evaluation period.

The soil depletion model [1] developed for the study can be used to estimate the impact of management decisions on specific soils through time. The first step in the model is to estimate soil erosion caused by water.

The Minnesota portion of the basin now has about 290,000 acres of cropland with erosion exceeding the tolerable level.[2] Erosion rates average 8 tons per acre per year. About 494,000 acres have water erosion rates less than the tolerable level. It is estimated that cropland with an erosion problem will increase to 297,000 acres in 2020.

Currently, there are about 1.2 million acres of excessively eroding cropland in the Iowa portion of the basin. Soil erosion from water on those acres is about 17 tons per acre annually. This is 15 million tons of erosion in excess of the tolerable level, or 15 million tons of soil resource depletion.

An area of 4.9 million acres has water erosion rates less than the tolerable level. These acres have a weighted average soil movement of about one ton per year and include 0-2 percent slope soils where poor drainage is a dominant problem.

About two-thirds of the total erosion is from cropland tilled up and down hill. An analysis of land use trends indicates that cropland with an erosion problem will increase from 1.2 million acres in 1980 to 1.45 million in 2020. The increased cropland will be converted from pastureland and forest land where average slopes are steeper than existing cropland.

The soil depletion model also can be used to estimate the impact of erosion on the soil profile over time. The current acreage of cropland that is depleting is grouped into three erosion phases in Table 1-5. The impact of projected excessive erosion on the number of acres in each erosion phase is projected for the years 2000 and 2020.

The area with severely eroded soils is projected to increase from 75,351 acres to 392,572 acres by year 2020 under present mangement systems. This 317,000 acre increase of severely eroded soils is the most urgent and important erosion problem.

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

1/ Soil Resource Depletion Report, Des Moines River Basin. See Appendix D.

2/ See Appendix A for explanation of tolerable level.

The soil depletion model was used to estimate the impact of land use and management decisions on specific soils through time. Soil mapping units of 10,000 acres or more that are changing erosion phase are shown in Table 1-6. For A more detailed description of soils see Appendix B. These soils represent over 1.0 million acres of the current 1.2 million acres with a problem. If current conditions prevail, 35 percent of these acres would be depleted to the next erosion phase by 2020.

TABLE 1-5

IMPACT OF EROSION ON
TILLED ACRES BY EROSION PHASE

Des Moines River Basin

Erosion Phase 1/	Description	Tilled Land		
		1976	2000	2020
		- - - - - - - - - -Acres - - - - - - - - - -		
1	Slight erosion	349,453	249,622	205,718
2	Moderate erosion	784,923	700,010	611,437
3	Severe erosion	75,351	260,095	392,572
Totals		1,209,727	1,209,727	1,209,727

1/ See Appendix A for explanation of erosion phases.

The depletion of cropland soils by sheet and rill erosion is a problem throughout the basin. The problem is more severe in the area south of Des Moines. The soil resource depletion loss from 1976 to 2020 in the Iowa portion of the basin is estimated to be $10 million in yield loss, $1.9 million in increased fertilizer costs, and $0.4 million in increased fuel costs. Present erosion rates continued to the year 2020 would mean a depletion cost of about $10 per acre per year on the 1.2 million acres of excessively eroding cropland.

While the overall ability to produce continues to increase because of increasing technology, the potential to produce has been decreased significantly by soil resource depletion. Information derived from published soil surveys indicate that the present reduction in potential production because of past depletion in the Iowa portion of the basin is $26.5 million annually. The past depletion estimate assumes that those moderately and severely eroded soils have lost some of their potential to produce regardless of their present use. The past depletion cost and future estimates are only for cropland with excessive erosion.

TABLE 1-6

ACRES CHANGING EROSION PHASE
FOR SOILS WITH MORE THAN 10,000 TILLED ACRES

Des Moines River Basin

Soil	Average Slope	Tilled Land	Amount Depleted-2020	
	(Percent)	(Acres)	(Acres)	(Percent)
Adair	7	22,141	7,813	35.3
Adair	11	11,814	5,217	44.2
Clarion	7	248,904	64,636	26.0
Clarion	11	26,428	14,067	53.2
Clinton	7	23,771	12,303	51.8
Grundy	3	57,584	5,810	10.1
Grundy	7	48,126	23,656	49.2
Ladoga	7	24,097	10,337	42.9
Lindley	11	17,299	10,353	59.8
Marshall	3	12,264	194	1.5
Marshall	7	25,022	9,020	36.0
Marshall	11	23,921	19,718	82.4
Otley	7	24,213	10,887	45.0
Pershing	3	26,555	2,965	11.2
Pershing	7	24,690	10,592	42.9
Sac	3	14,189	787	5.5
Sharpsburg	3	103,815	2,265	2.2
Sharpsburg	7	117,562	55,094	46.9
Sharpsburg	11	16,507	11,024	66.8
Shelby-Adair	11	46,620	16,658	35.7
Shelby-Adair	16	11,154	6,766	60.7
Shelby	11	23,396	10,447	44.7
Shelby	16	14,723	7,767	52.8
Storden	11	11,923	5,087	42.7
Weller	3	16,227	2,761	17.0
Weller	7	54,084	36,922	68.3
TOTAL		1,047,029	363,146	

In the Minnesota portion of the basin the present reduction in gross returns caused by past depletion is $3.5 million annually. Present erosion rates, continued to the year 2020, will increase depletion costs another $1.2 million, about $4.00 per acre per year on 289,200 acres of excessively eroding cropland.

Pastureland

Most of the pastureland is found in the area south of Des Moines where the soils are steeper and shallower than average. Most of the acreage devoted to pastureland in the northern portion of the basin is on steep slopes, along drainageways, or in small areas adjacent to farmsteads.

Erosion rates on pastureland vary depending on cover, soil type, slope, and slope length. Under good cover conditions, pastureland 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 87 percent of excessive pasture erosion occurs on soils with slopes greater than 16 percent with sparse vegetative cover.

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 erosion rate on all pastureland is 3.6 tons per acre per year. Compared to erosion on cropland, these rates are less significant. Approximately 251,000 acres or 25 percent of all pastureland exceeds tolerable soil loss levels from sheet and rill erosion. The erosion rate for pastureland exceeding tolerable levels is 9.7 tons per acre per year. This amounts to 1.45 million tons of erosion on the problem acres.

Ninety-six percent of the pastureland and pastureland problems occur in the Iowa portion of the basin. About 6,000 acres of the excessively eroding pastureland are in Minnesota. No further analysis of this problem was made for the Minnesota portion.

Pastureland acreage is projected to decline about 46 percent by 2020 (Table 1-16). In the future, many acres of pastureland on flatter slopes will be converted to other uses. With this decline in pastureland acreage, the number of acres with an excessive erosion problem can also be expected to decrease.

Many acres of steeper pastureland are associated with the flat areas and will also be converted, thereby shifting the erosion problem from pastureland to cropland. The acres with an erosion problem are expected to decline 39 percent to 149,500 acres by 2020. It is expected that pastureland acreages will not decline significantly beyond the 2020 level of 547,260 acres because of the demand for forage and the class of land on which the remaining pastureland occurs.

The current distribution of acres by slope class is shown in Table 1-7. The acres with an erosion problem (and the erosion rate) increase as the slope increases.

TABLE 1-7

PASTURE ACRES BY SLOPE CLASS
IOWA

Des Moines River Basin

Slope[1/] Class	Total Area	Problem Area	Erosion Rate on Problem Area	Total Tons on Problem Area
	(Acres)	(Acres)	(Tons/Acre)	(Tons)
A	132,900	-	-	-
B	144,300	-	-	-
C	138,000	15,010	5.7	85,560
D	138,050	26,210	6.7	175,610
E	133,400	35,340	11.2	395,810
F	101,100	68,520	12.0	822,240
G	142,700	99,920	10.2	1,019,180
Total	930,450	245,000		2,498,400

1/ Slope classes are defined in Appendix A.

Pastureland acreage decreased 15 percent from 1970 to 1980. The remaining pasture is on steeper, shallower soils. Decreased acreage results in a greater concentration of livestock, which in many cases causes more acres to exceed the tolerable soil loss level.

Forest Land

Improper livestock grazing is the major disturbance found on forest lands. It is estimated that 60 percent (200,600 acres) of forest land is being used for livestock grazing.

There are about 31,100 acres of grazed forest land, in the Iowa portion, eroding at rates in excess of tolerable levels (Table 1-8). This will decrease to about 25,800 acres by 2020 because of the change in land use to pastureland and cropland. These acreages are on steeper forested slopes scattered throughout the basin area. An additional 300 acres of grazed forest land are eroding above the tolerable level in the Minnesota portion of the basin.

The erosion rate on the areas exceeding tolerable levels averages 13.3 tons per acre per year (Table 1-8). Total erosion on excessively eroding forest land within the basin is 417,700 tons per year. Erosion rates on all forest land average 2.8 tons per acre per year.

Based on past trends, conversion of forest land to other uses will continue. This will increase the demands made on the remaining forest land for livestock grazing. Grazed forest land will increase about 18 percent by the year 2020 (Table 1-9), but the average erosion rate for all forest land will remain relatively constant. The total annual erosion from forest land will decrease because of the loss of forest land.

TABLE 1-8

FOREST LAND EROSION - 1980

Des Moines River Basin

Erosion Level	Unit	Iowa	Minnesota	Total	Erosion Rate
					T/A/Y
Forest land less than tolerable	Acres	302,400	3,800	306,200	
Total Erosion	Tons/Yr.	520,400	7,100	527,500	1.7
Forest land exceeding tolerable	Acres	31,100	300	31,400	
Total Erosion	Tons/Yr.	413,600	4,100	417,700	13.3
All forest land	Acres	333,500	4,100	337,600	
Total Erosion	Tons/Yr.	934,000	11,200	945,200	2.8

TABLE 1-9

FOREST LAND PROJECTIONS - BASIN

Des Moines River Basin

Item	Units	Years 1980	2000	2020
Forest land	Acres	337,600	299,900	262,200
grazed	Acres	200,600	215,000	238,000
ungrazed	Acres	137,000	84,900	24,200
Total erosion	Tons/Yr.	945,200	853,300	746,000

GULLY EROSION

Gully erosion is part of the natural process of landscape development. Gullies may form where water concentrates in drainageways. Almost seven percent of all erosion in the Des Moines River Basin is caused by gullying.

Gully erosion degrades the productivity of cropland and pastureland. Land destroyed by voiding is lost to production. Currently 260 acres are lost annually in about 134,300 gullies. This amounts to 2.6 million tons of soil annually. Gully erosion will increase to 285 acres and 2.89 million tons by 2020. In addition, advancing gully heads have isolated or otherwise made various-sized segments of land impractical to farm. Over the next 40 years, income will be lost by gully voiding on 10,000 acres and reduced by depreciation on 14,500 acres. Projected average annual damages are $910,000.

Individual gullies can also damage fences, field crossings, and roads. Vertical banks are a hazard for humans and livestock. Additional time is spent inspecting and repairing fences after heavy rains. When fences are down, livestock stray and intermix. As gullies advance and enlarge, crossings become too expensive to maintain. Farmers must travel greater distances to fields and sometimes must travel through neighboring land. Additional travel is both time consuming and expensive.

Gully erosion, however, is not evenly distributed throughout the basin (Figure 1). Gullies are primarily confined to the upland areas of Land Resource Area (LRA's) 107 and 109. (For a description of LRA's see Appendix A.) LRA's 107 and 109 include only 17 percent of the land area, yet 65 percent of the gully erosion occurs there.

Most of the remaining gully erosion is along the loess ridges in LRA 108 and the steep bluff areas of LRA 103 bordering the Raccoon and Des Moines rivers upstream from the city of Des Moines. The most active ten percent of the gullies account for half of the total annual gully erosion.

Gully erosion is projected to increase in proportion to sheet erosion as more land is changed to cropland use. A comparison of current and projected average annual gullying follows:

Year	Voiding Acres/Year	Depreciation Acres/Year	Erosion Million Tons/Year
1980	260	345	2.65
2000	275	365	2.79
2020	285	380	2.89

WET CROPLAND

There are two aspects of the drainage problem. The physical problem is excess water on the surface and within the soil profile that inhibits crop growth. The associated social problem is that some land owners and operators fail to recognize the benefits of improved drainage.

Physical Component

The wet cropland area studied includes 2.1 million acres in Iowa and 458,600 acres in Minnesota. This entire area is presently cropped intensively and is all privately owned land. It does not include other land uses such as wetlands or wildlife areas. At present one million acres have adequate drainage, however, most of the drainage systems are between 50 and 75 years old.

Other tile mains are of inadequate depth or size or have deteriorated. About 1,000 miles of open channel do not have adequate depth or capacity. Excess water in cropland will reduce production on 1.5 million cropland acres by 2020. Ninety percent of the basin's wet cropland is in the area north of Des Moines (LRA 103). Wet soils reduce crop production an estimated $148 million annually, $126 million in Iowa and $22 million in Minnesota. Reduced crop production is based on the potential of corn and soybeans.

Social Component

Iowa State University and the Soil Conservation Service completed a Cooperative Drainage Study in 1982.1/

1/ See Appendix I for further details

The Study included interviews with 256 farm operators.

The Cooperative Drainage Study survey found 39 percent in agreement with the sentence, "Some landowners within the district fail to recognize the benefits of improved drainage." Nearly 50 percent responded positively to the statement, "Too many operators within the drainage district who have adequate drainage are opposed to spending money for improvements that will not benefit them."

Some owners and operators do not sense a need for improving drainage as they are not well informed concerning the nature of their soils and the potential economic returns which could be achieved. Some accept inferior drainage as something they cannot improve upon -- like the weather.

The Cooperative Drainage Study survey respondents also identified the following four cost items as being important in preventing or delaying needed drainage improvements:

1. The cost of improving district mains and laterals is too great.
2. Too many landowners are senior citizens who do not wish to make long term investments due to retirement needs.
3. Money is not available.
4. There are too many absentee owners who are not interested in investing additional money.

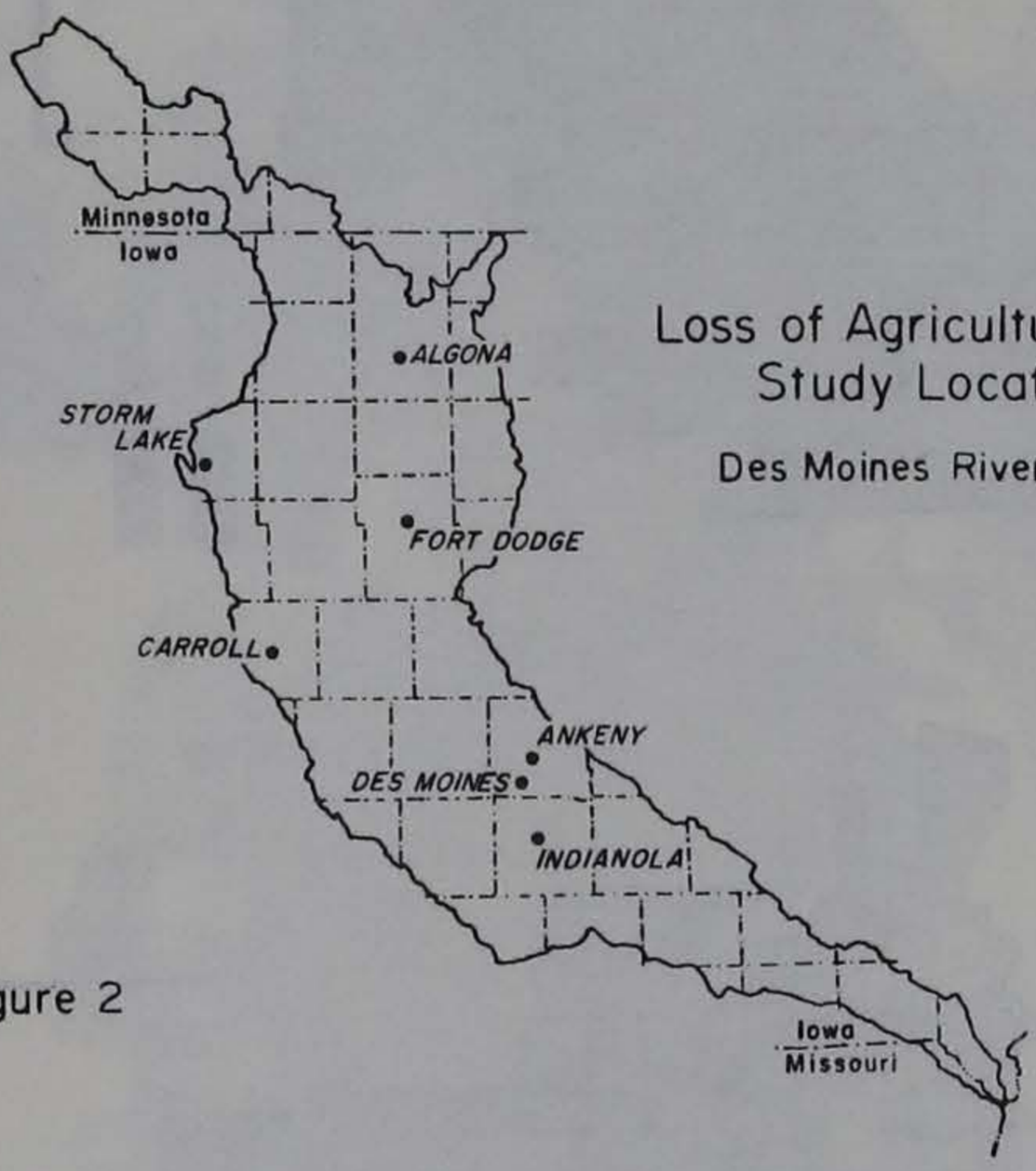
LOSS OF AGRICULTURAL LAND

Land use information developed by the USDA in 1957, 1967, and 1977 shows that the basin's agricultural land base has decreased 202,000 acres in the 20-year period, an average loss of 10,100 acres per year. Iowa's average loss is 8,900 acres, and Minnesota's average loss is 1,200 acres per year. If this rate continues to year 2020, over 400,000 acres would be converted to non-agricultural uses, an annual loss equivalent of 39 million bushels of corn.

Major decreases in the agricultural land base were caused by urban expansion, new roads, and new reservoirs. Urban expansion has averaged 2,000 acres per year; roads and railroads and federal land have expanded about 6,900 acres per year; and major water areas, including two federal reservoirs, averaged 1,200 acres per year. Three interstate highways have been constructed during the last 25 years.

Land use changes and the impact of those changes on prime agricultural land was studied in detail at seven cities in the basin. Figure 2 shows the general location of the seven cities and Figures 3 through 6 show the urban area growth of the seven cities. The urban expansion in the 14 counties that do not have any land use controls was also studied. The 14-county study did not appraise the impact of land use changes on prime agricultural land.

The seven cities' data were used to estimate the changes of prime agricultural land for the entire basin. The seven cities are Storm Lake, Carroll, Algona, Ankeny, Des Moines, Indianola, and Fort Dodge. During the 1950 to 1980 time period, these cities had a population increase of 94,000, going from 237,000 to 331,000. Areas of these cities were measured from historic photographs and maps. The time base was not equal for all. Data summary is shown in Table 1-10.

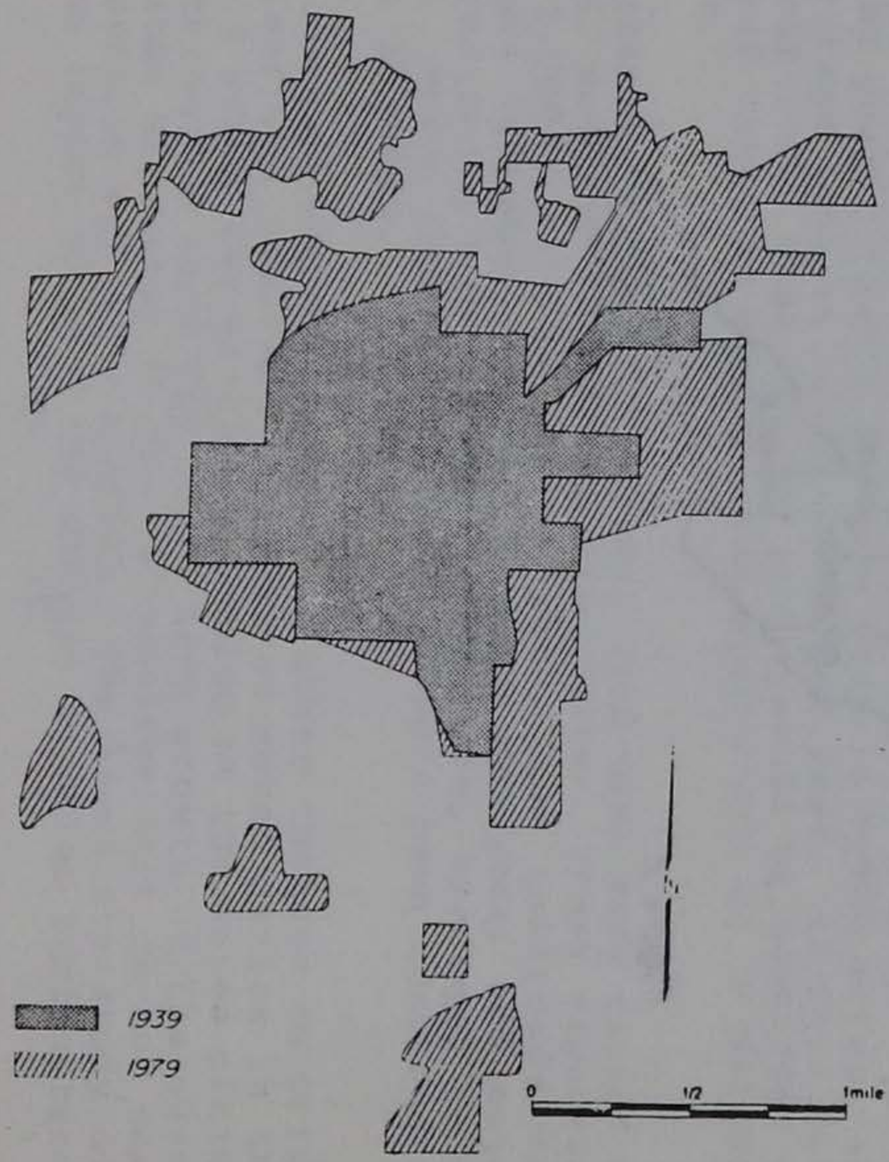


Loss of Agricultural Land
Study Locations

Des Moines River Basin

Figure 2

ALGONA
URBAN GROWTH



ANKENY
URBAN GROWTH

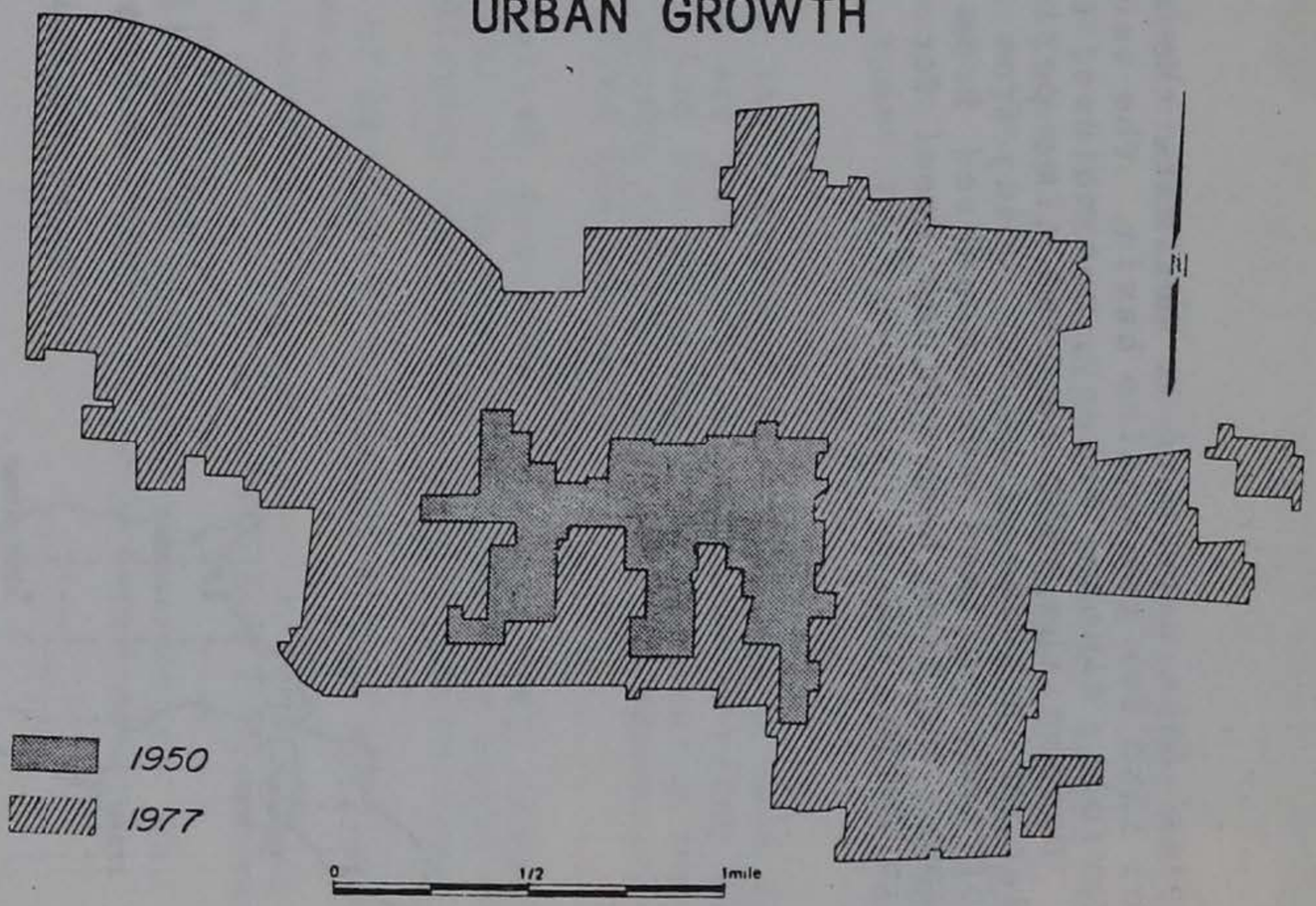


Figure 3

DES MOINES URBAN GROWTH

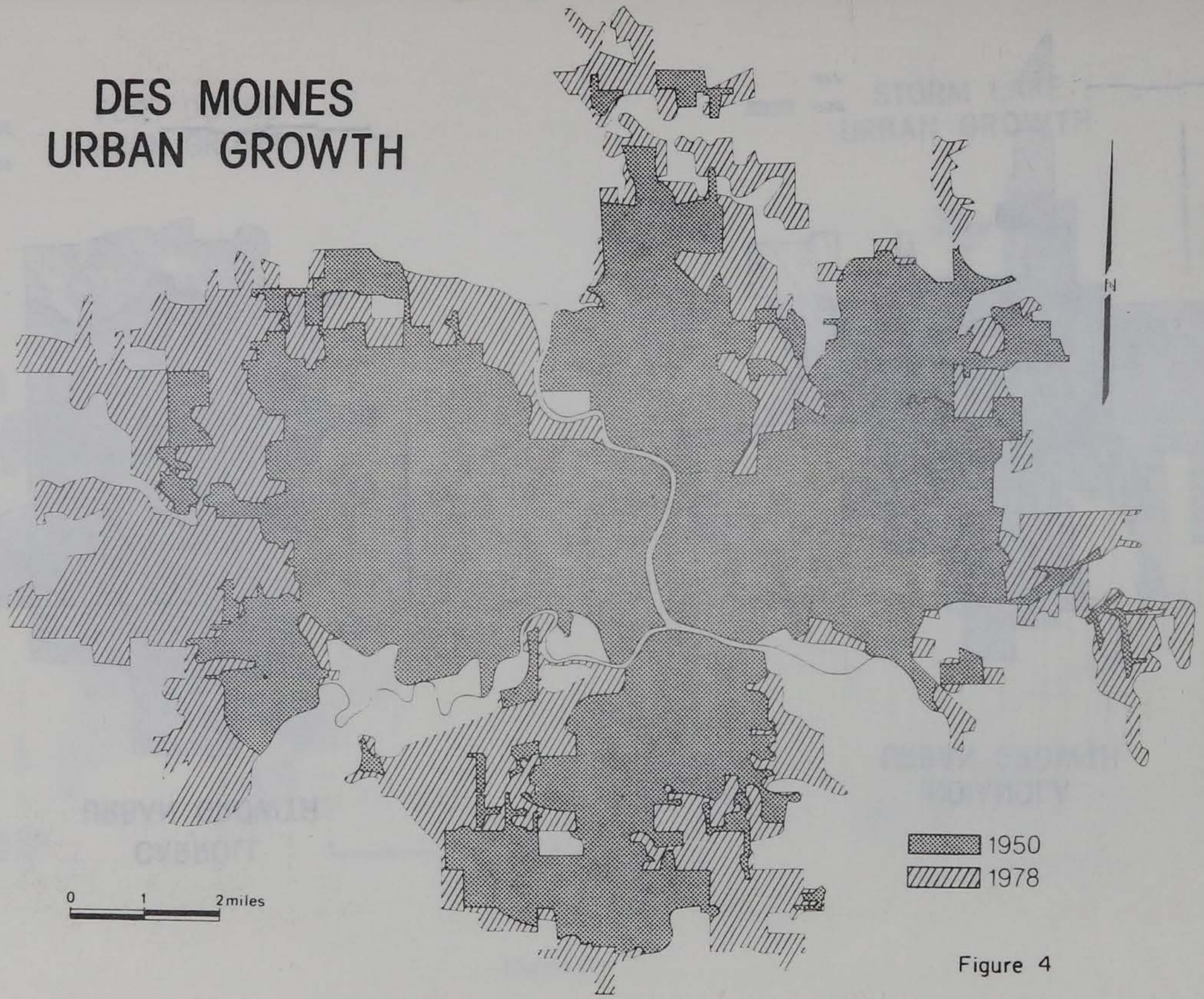
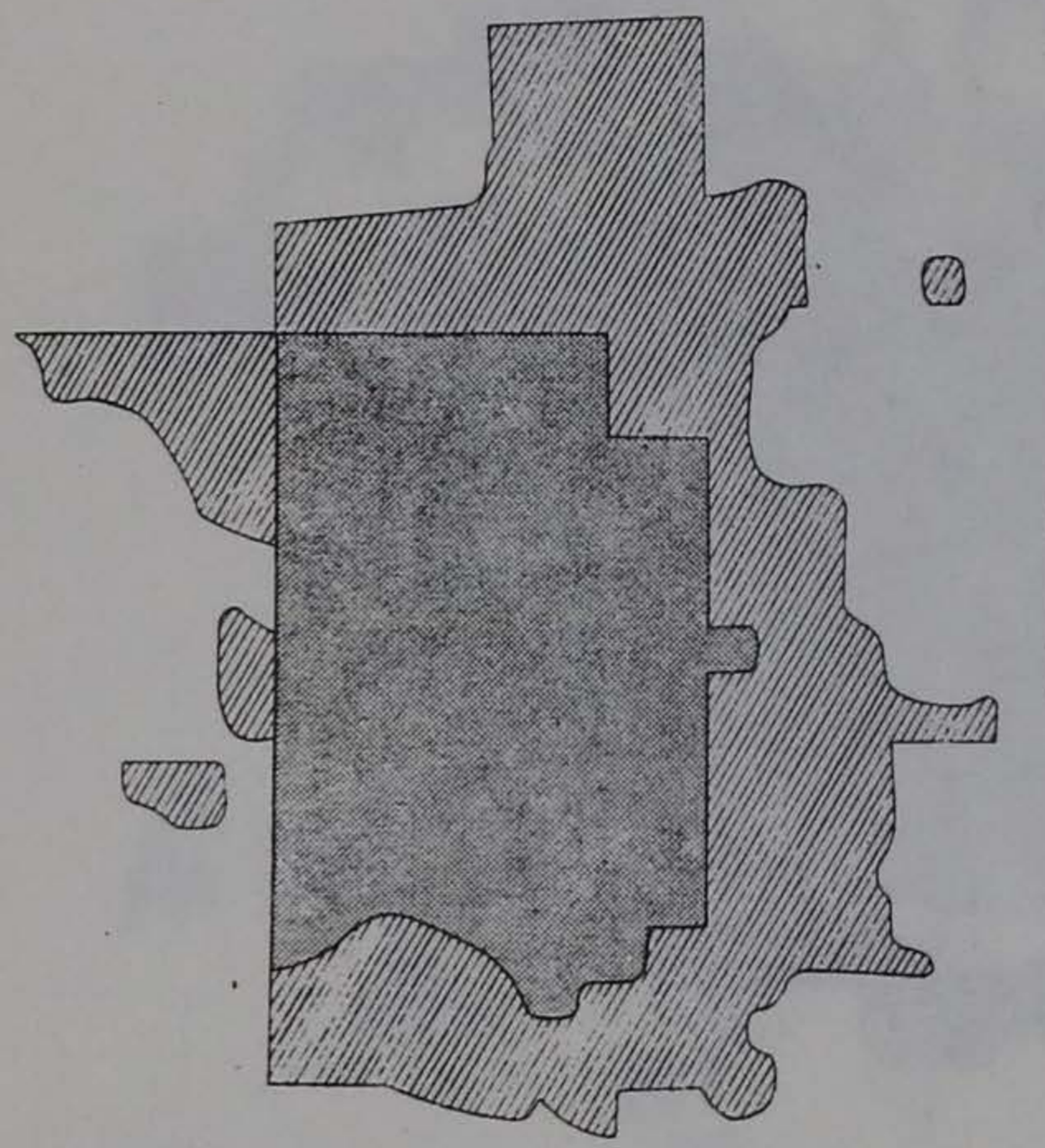


Figure 4

CARROLL
URBAN GROWTH



INDIANOLA
URBAN GROWTH

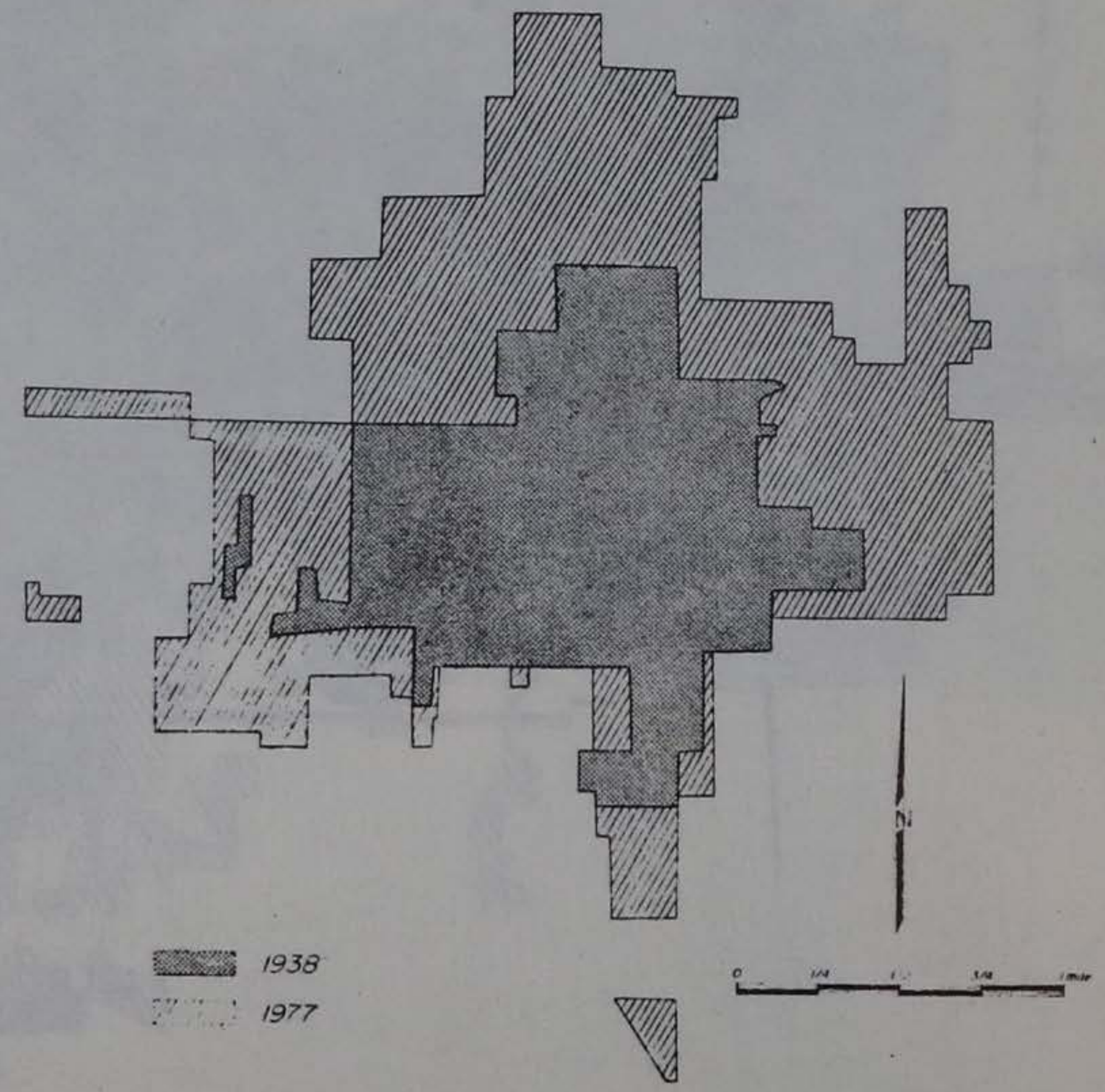
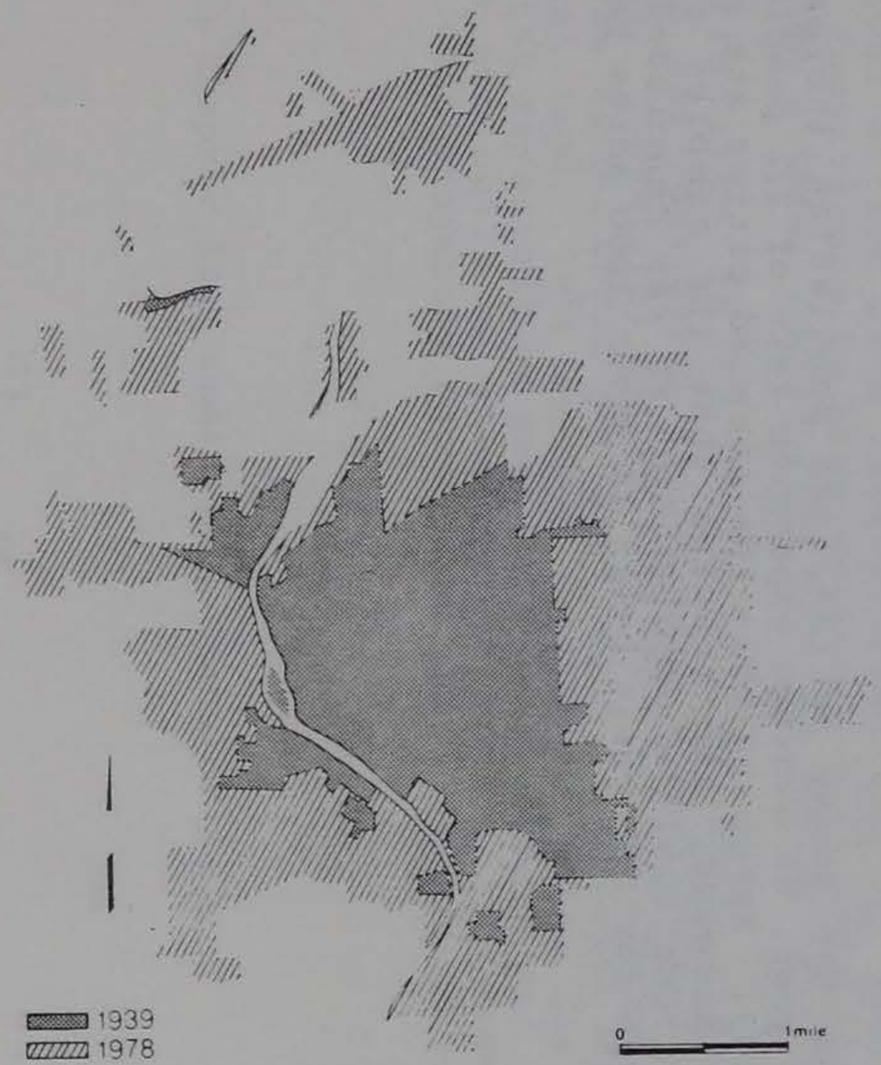


Figure 5

Figure 5

FORT DODGE
URBAN GROWTH



STORM LAKE
URBAN GROWTH

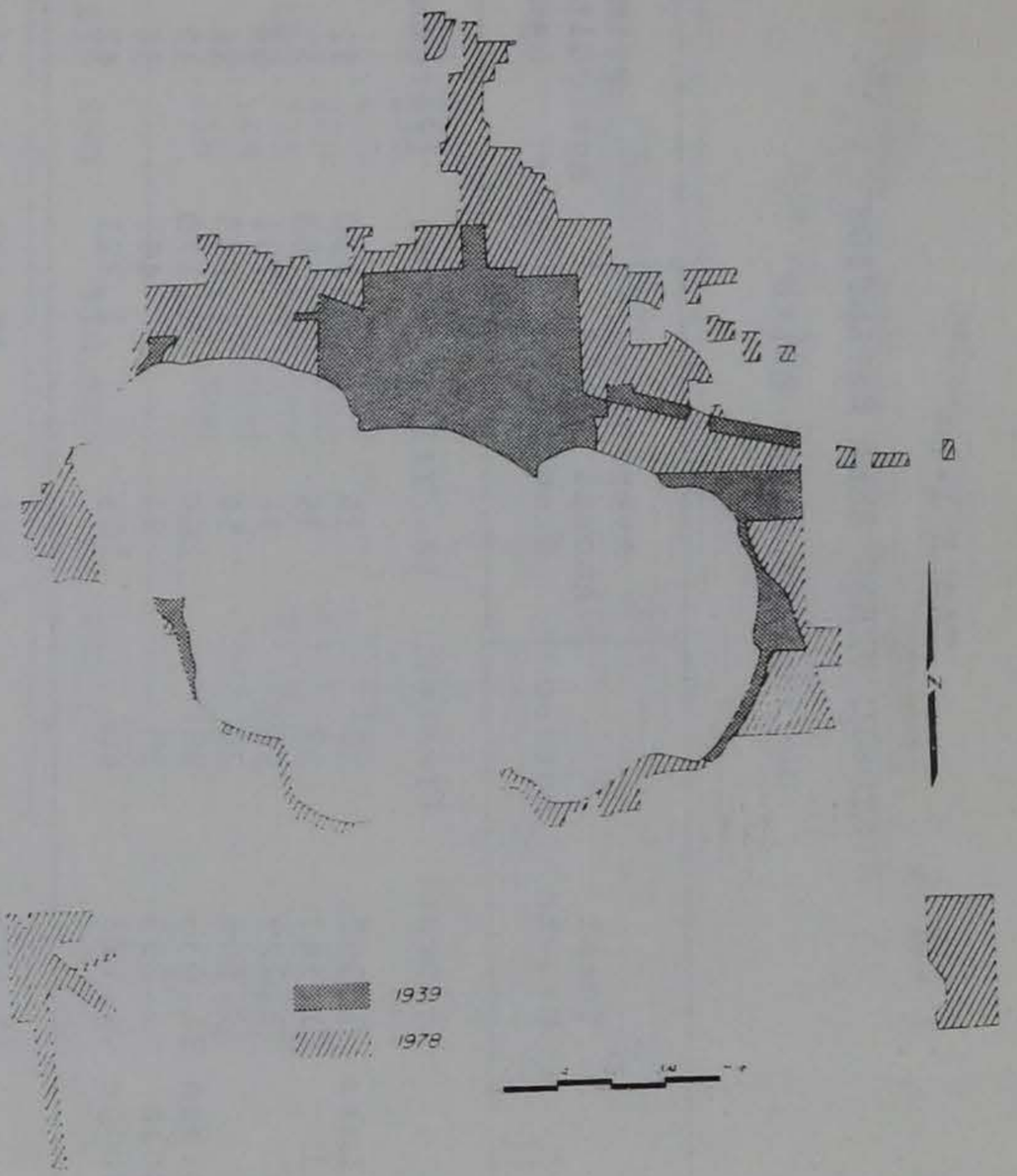


Figure 6

TABLE 1-10

HISTORIC URBAN AREA EXPANSION

Des Moines River Basin

City	Total Growth (Acres)	Period (Years)	Average Annual Total Growth (Ac/Yr)	Prime Agricultural Land (Acres)	(Percent)	(Ac/Yr)
Storm Lake	1,397	39	36	1,130	81	29
Carroll	1,347	37	36	765	57	21
Algona	1,229	40	31	781	64	20
Ankeny	1,506	28	54	1,443	96	52
Des Moines	31,035	28	1,108	12,170	39	435
Indianola	1,295	39	33	467	36	12
Fort Dodge	4,123	40	103	1,721	42	43
Total	41,932		1,401	18,477	44	612

The historic growth rate for the seven cities is 1,401 acres per year with 44 percent being prime agricultural land (Table 1-10). The percentage of prime agricultural land varies from a high of 96 percent around Ankeny to a low of 36 percent around Indianola.

During the study period, the population increased 3,125 people per year, an average expansion rate of 2.2 people per acre (Table 1-11). Assuming that the sampled cities are similar to those not sampled, and knowing that the samples contain 70 percent of the basin's population, it was concluded that the urban growth for the whole basin is about 2000 acres per year.

TABLE 1-11

HISTORIC POPULATION EXPANSION

Des Moines River Basin

City	Population 1950	Population 1980	Change in Population	Change People/Yr.
	- - - - - - - -Number - - - - - - - - - - - - - - - - - -			
Storm Lake	6,954	9,400	2,446	82
Carroll	6,231	9,750	3,519	117
Algona	5,415	6,550	1,135	38
Ankney	1,229	15,700	14,471	482
Des Moines	186,771	245,797	59,026	1,968
Indianola	5,145	11,000	5,855	195
Fort Dodge	25,115	32,400	7,285	243
Total	236,860	330,597	93,737	3,125 Avg.

The 14 counties that do not have any type of land use regulation were examined to determine if problems exist. Ten of the 14 showed either slight or no urban expansion (Table 1-12). Four counties - Adair, Boone, Lee, and Mahaska - showed over ten percent urban area expansion in five years. The accumulated loss of agricultural land from these four counties is 4,282 acres in five years, an average of 856 acres per year. It is for the County Commissions 1/ for Land Preservation and Use and the County Board of Supervisors to examine these data and thereby decide if a problem exists, and if land use regulation is needed.

The historic rate of 10,100 acre per year loss of agricultural land was considered higher than a realistic future long-term average. Therefore, future rate of loss to agriculture was assumed to be 4,100 acres per year with 44 percent being prime agricultural land. The assumed rate would allow for one additional federal reservoir by year 2020, a 2000 acre per year growth in urban and built-up areas and a modest increase in highway acreage. The projected future land use is shown in Table 1-13.

1/ As provided in Chapter 93A, Code 1981, State of Iowa.

TABLE 1-12

URBAN EXPANSION IN COUNTIES NOT ZONED

Des Moines River Basin

County	Urban Area 1977	Urban Area 1982	Urban Expansion (Acres)	Urban Expansion (Percent)
	- - - Acres- - -			
Adair	1854	2302	448	24
Boone	4863	5854	991	20
Clarke	2507	2579	72	3
Davis	1514	1543	29	2
Hamilton	4500	4553	53	1
Jefferson	3409	3495	86	3
Lee	11,533	13,682	2149	19
Lucas	3504	3504	0	0
Mahaska	6488	7182	694	11
Monroe	1820	1893	73	4
Palo Alto	2678	2760	82	3
Sac	3187	3195	8	1
Van Buren	1374	1374	0	0
Winnebago	2672	2697	25	1

Projected growth of urban, road, railroad, federal, and water areas between 1974 and 2020 is 189,530 acres (Table 1-13). The impact on the agricultural base using an average corn yield of 90 bushels per acre shows a loss in productivity of 17 million bushels per year. Annual cost to the agricultural economy of the basin would be $44 million in 2020. This includes over 83,000 acres of prime agricultural land withdrawn from the agricultural resource base.

TABLE 1-13

FUTURE WITHOUT PROJECT LAND USE

Des Moines River Basin

Land Use	Current 1974	2000	2020
	- - - - - - - - - - Acres- - - - - - - - - - - - - - -
Cropland	6,906,900	7,121,940	7,286,600
Pastureland	1,018,880	752,300	547,260
Forest	355,700	306,930	271,650
Other	316,860	309,800	303,300
Urban, Roads, and Railroads	476,580	549,110	604,650
Federal	57,630	71,320	81,830
Water	130,580	151,730	167,840
Total	9,263,130	9,263,130	9,263,130

LOSS OF WILDLIFE HABITAT

Wildlife species existing in the basin have adapted to agriculture and coexist with current farming operations. These lands, along with farmer cooperation, provide most of the food and cover essential in the development, production, and harvesting of wildlife.

Essentially all wildlife species require at least two cover types such as row crops, grassland, and woody cover including brush and forest land. A greater interspersion of various cover types within an area will usually result in a larger variety of species and larger populations. As row crop acreage increases, there is usually a decline in types and interspersion of cover. Consequently, most wildlife populations decline.

Since 1940, the number of farms has declined by about 38 percent, while the area in farms has remained relatively unchanged. At the same time, land use has changed from diversified cropping and livestock operations (163 acre average) to one or two crop monoculture operations (285 acre average). In wildlife cover types, the 1940 farm was about 33 percent row crop, 51 percent grassy (pastureland, small grains, and hay) and 15 percent other (forest land, water, roads, and wetlands). The typical farm today has 70 percent row crop, 16 percent grassy, and 14 percent other cover.

Management of the various land uses as well as the interspersion 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 varies within the basin. Generally, the area south of Des Moines has more diverse land use and better habitat quality than the area north (Figure 7).

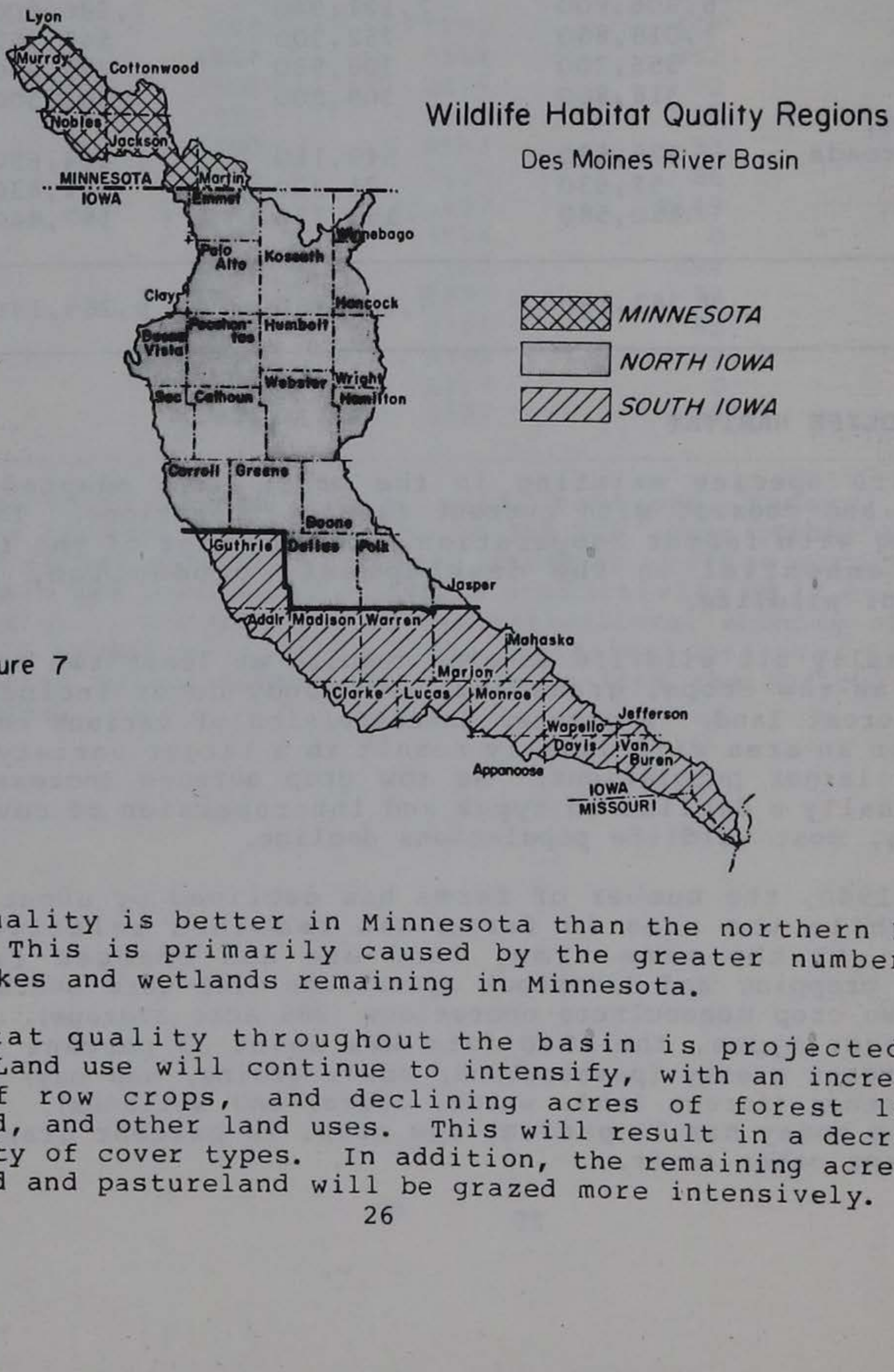


Figure 7

Habitat quality is better in Minnesota than the northern Iowa portion. This is primarily caused by the greater number of shallow lakes and wetlands remaining in Minnesota.

Habitat quality throughout the basin is projected to decline. Land use will continue to intensify, with an increased acreage of row crops, and declining acres of forest land, pastureland, and other land uses. This will result in a decrease in diversity of cover types. In addition, the remaining acres of forest land and pastureland will be grazed more intensively.

Partially offsetting these losses are increases in land treatment practices that benefit wildlife. Conservation tillage has shown dramatic increases in the past four years and is expected to continue. Grassed backslope and narrow-base terraces add grassy areas to crop fields, thus increasing diversity. Additional acres of warm season grasses are being planted as part of rotation grazing systems. These practices, and others, benefit many wildlife species. However, rates of application and favorable effects on wildlife cannot compensate for the reduction of cover type (land use) diversity.

Wildlife habitat quality was quantified using a Habitat Suitability Index (HSI). The HSI evaluates land use, interspersion of land uses, and management of land. A scale of 0-10 was used, with 10 being optimal habitat conditions for wildlife species normally occurring in the area. The current basin HSI is 3.6 (Table 1-14). This means the basin's land provides about 36 percent of its potential wildlife value. Table 1-14 displays HSI values by basin regions and projected changes. Figures 8 and 9 schematically show typical changes in wildlife habitat quality of a 640 acre tract from 1940 to 2020.

TABLE 1-14

HABITAT SUITABILITY INDEX

Des Moines River Basin

Location	Current	2000	2020
	- - - - Index- - - - - - - -		
Basin	3.6	3.0	2.9
Minnesota	3.0	2.6	2.5
Iowa	3.8	3.2	3.0
North Iowa	2.4	1.9	1.6
South Iowa	5.2	4.4	4.2

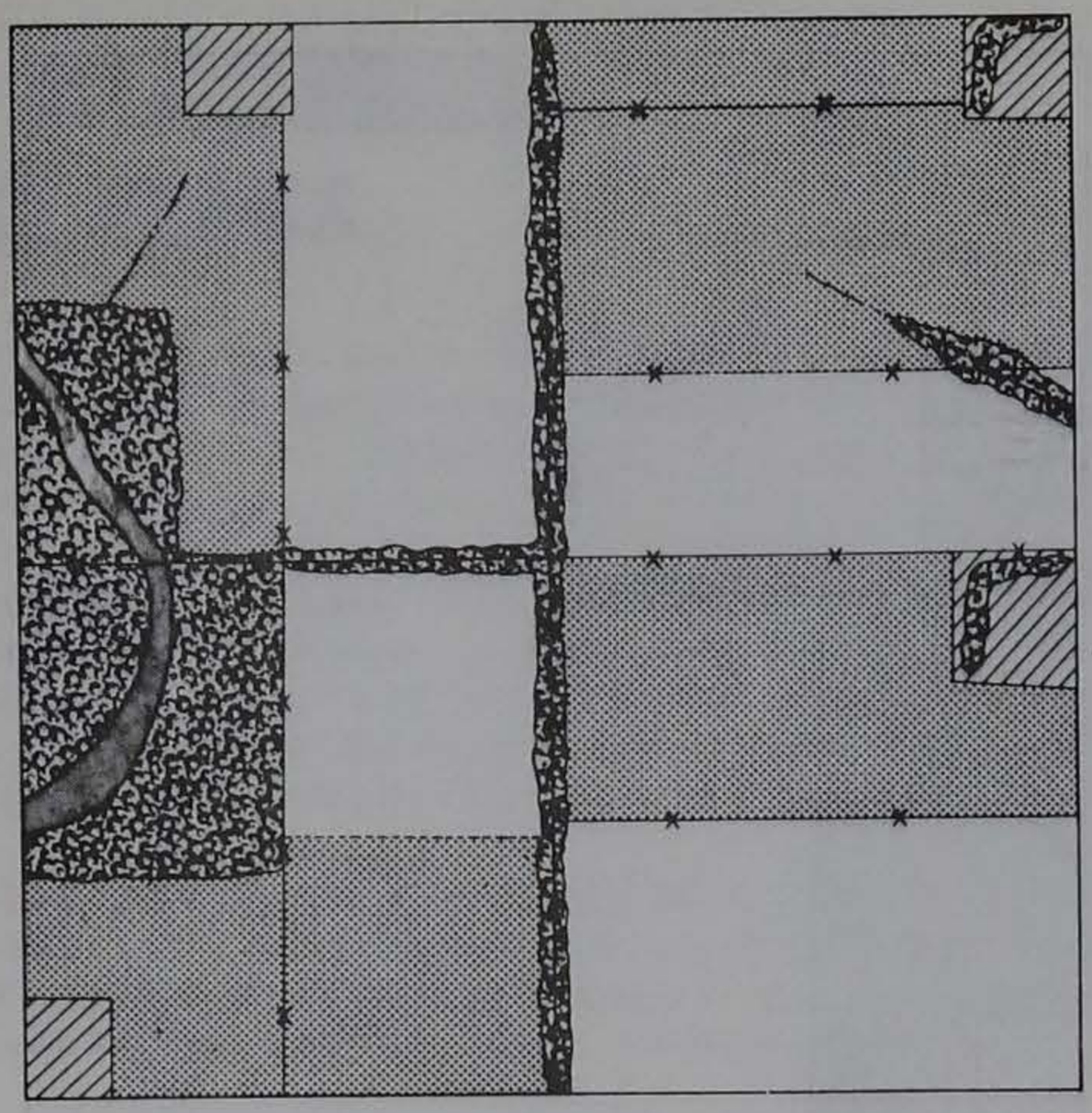
LOSS OF FOREST LAND

Conversion of forest land to other uses threatens the existing forest resources. Based on past trends, forest land will decline from 347,130 acres in 1980 to 271,650 acres by the year 2020, a total loss of 75,480 acres. The Minnesota portion of the basin will decline an estimated 2400 acres during this same period. The decline in forest land will occur throughout the basin with the greatest decline occurring in the area south of Des Moines.

Much of this loss will result from conversion of forest land to other agricultural uses, primarily pastureland. Some of the forest lands are now used solely for forage production and no forest management is practiced. Under this management strategy these lands degrade to such a point that only scattered low quality trees remain. At this stage, the landowners usually find it more desirable to remove the remaining trees and manage more intensively for pastureland or cropland.

The projected loss of over 75,000 acres of forest land will result in a decline of 16.8 million cubic feet of potential timber production from the basin by the year 2020. This reduced production will represent about a $3 million loss to the local forest-based economy. This estimate represents only those losses associated with stumpage values and not the total loss which would include secondary processing, such as lumber, veneer, pallet stock, and other wood products.

If the demand for wood for energy use continues at the projected rates there will be an even greater demand for timber. Current data indicates that the rate of removal already exceeds the rate of annual growth. If this imbalance continues, or increases, timber will have to be imported to meet local needs. In addition the wood using industries might have to relocate, causing a change in the economic base.

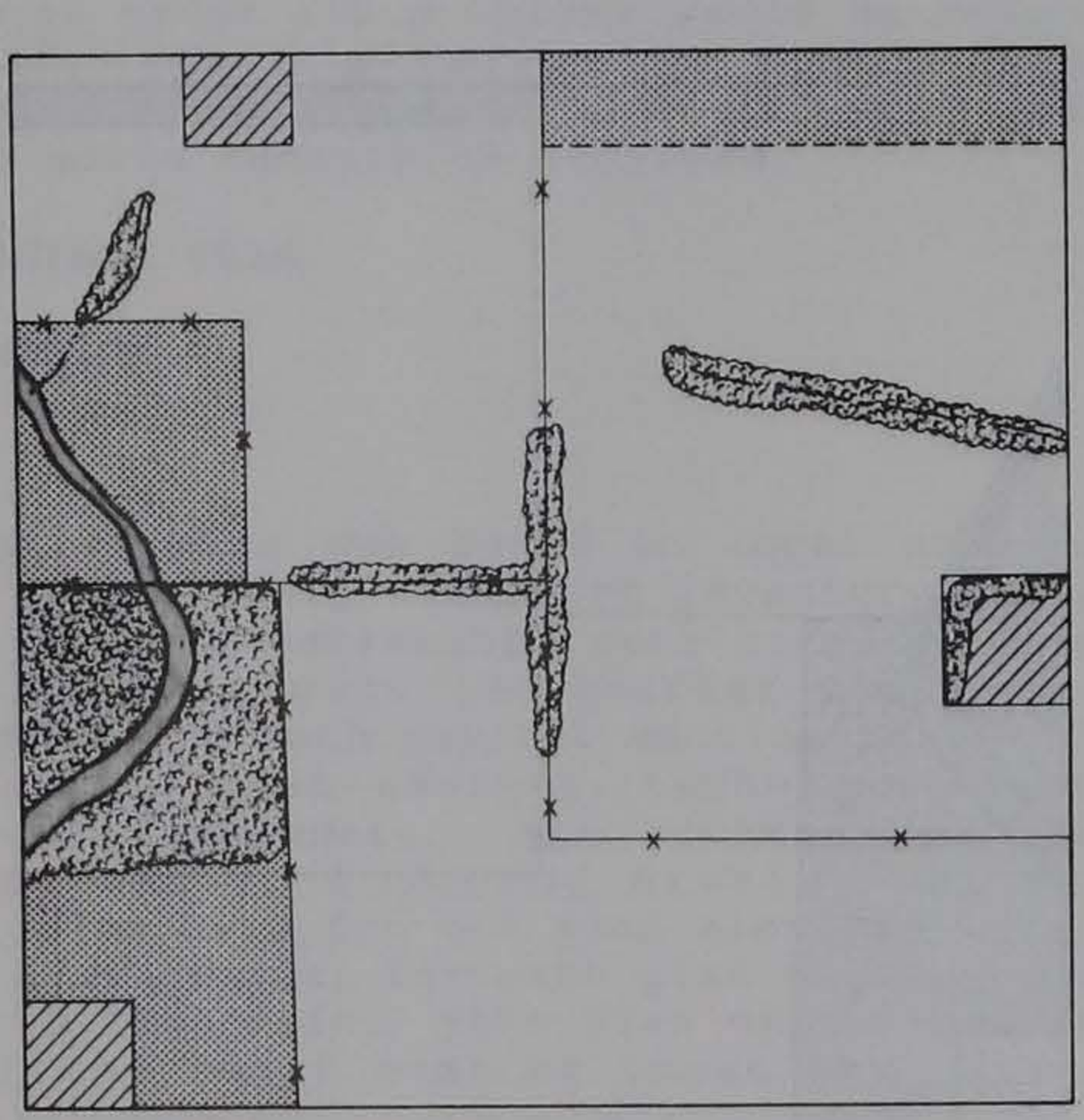


1940
HSI – 4.1

Figure 8

HABITAT SUITABILITY INDEX SCHEMATICS

1940 and 1980



1980
HSI – 3.6

WOODY COVER
Forest land
Brushy land
Windbreaks

GRASSY COVER
Pasture land
Small Grains
Hay

ROW CROPS
Corn
Soybeans

BUILDINGS

WATER

HABITAT SUITABILITY INDEX SCHEMATICS

2000 and 2020

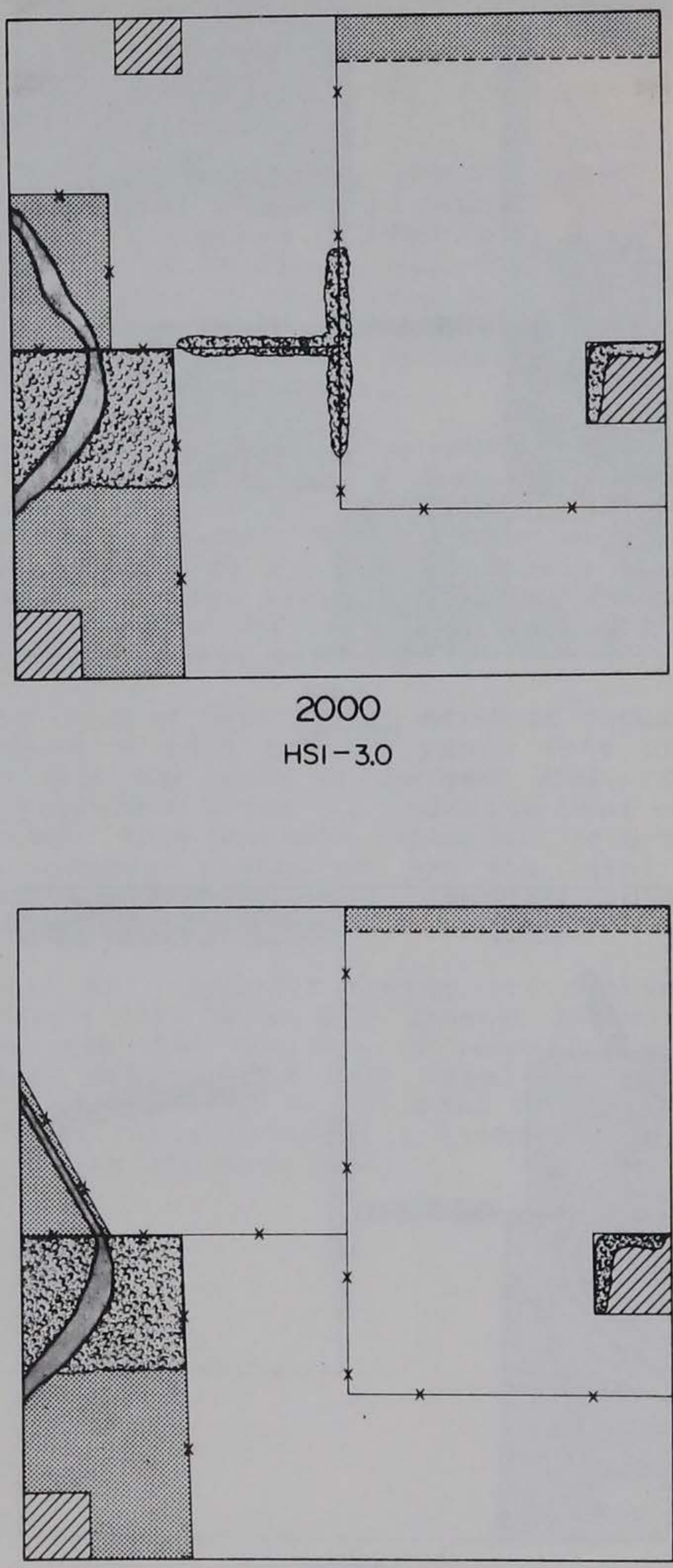


Figure 9

CHAPTER 2

ALTERNATIVE PLANS

Two alternative plans 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 between a Practical and Feasible Alternative and an Ideal Alternative. The needed plan elements are based on a future without additional actions. 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 Practical and Feasible Alternative is one that could readily be installed or implemented in the near future (20-40 years). The alternative considers current and projected technical assistance, cost-sharing levels, and acceptance by the public.

The Ideal Alternative was developed to minimize the problems. This alternative would enhance or preserve the natural resources and avoid irreversible or irretrievable commitments of resources.

Neither alternative completely eliminates 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.

PRACTICAL AND FEASIBLE PLAN

SHEET AND RILL EROSION

Cropland

This alternative plan was based on local soil conservation district input. During early stages of inventory and analysis of the basin, district conservationists were asked to develop a plan for each of 100 randomly selected quarter sections. The plan elements recommended for each quarter section were to be based on current conditions for cost-sharing, technical assistance, and acceptance by local landowners. The recommended plan elements were not constrained to reducing erosion on each acre to tolerable levels. The data for all plan elements were aggregated and the weighted average cost for each plan element was developed for all cropland in the basin. This plan emphasized treatment of those acres with the least cost or those that are easiest to treat first.

The total direct cost for the Iowa portion of this plan is nearly $42 million annually (Table 2-1). If this cost is distributed over all cropland (Iowa portion of basin), the cost on a per acre basis is $6.80.

TABLE 2-1

PLAN ELEMENTS
PRACTICAL AND FEASIBLE PLAN

Des Moines River Basin

Plan Elements	Unit	Amount	Annual Cost Dollars
Sheet and Rill Erosion			
Cropland			
Reduced tillage	Acre	3,397,000	-25,477,500 1/
No-tillage	Acre	118,400	- 2,338,400
Terraces	Acre	576,400	59,146,000
Other	-	-	8,588,200
Pastureland			
Pasture planting	Acre	132,000	2,938,300
Pasture Management	Acre	132,000	1,663,200
Forest Land			
Livestock exclusion	Acre	175,000	1,750,000
Tree Planting	Acre	53,000	1,053,000
Gully Erosion			
Waterways	Acre	13,500	580,600
Grade Stabilization Structures	Number	27,800	8,950,000
Wet Cropland			
Drainage	Acres	902,000	27,046,000
Research, Education, and Investigations	-	-	1,000,000
Financial assistance	-	-	1,600,000
Loss of Agricultural Lands			
Land Protection Zoning	Counties	4	1,940
Land Evaluation and Site Assessment	Counties	20	4,160
Loss of Wildlife Habitat 2/			
Farmstead Windbreaks	Acre	10,000	1,772,000
Privately-owned Wetland Protection	Acre	2,000	2,000
Public Land Acquistion	Acre	14,000	1,547,000
Loss of Forest Land			
Timber stand improvement	Acre	72,000	679,000
Tree planting	Acre	36,000	780,000

Price Base: 1982

1/ Negative values indicate reduced cost of production.

2/ These elements are in addition to those included in the erosion control alternative.

If the cost is distributed over only the acres treated, the per acre cost rises to almost $10 per acre. Additional costs beyond the direct costs will be 1,500 staff years of technical assistance or 42 staff years per year.

The plan element acreages listed in Table 2-1 total to more than those identified as a problem (Table 1-1) because more than one treatment is needed on some acres. For example, tile is needed on some acres before erosion control measures can be installed. 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 were treated to protect the problem areas from erosion.

The costs listed in Table 2-1 are estimated 1982 values. Table 2-1 is estimated total cost and does not reflect any cost-sharing or potential benefits. The negative numbers for reduced tillage and no-tillage reflect the reduced cost to the farmer for adopting these practices.

For the Minnesota portion of the basin there is a cost reduction of $1.6 million annually or $2.09 per cropland acre. The reason for the cost reduction or additional income is large amounts of reduced tillage were used as a land treatment measure. This alternative would provide a considerable amount of erosion control with increased income resulting from reduced cost of production.

This plan would provide a significant impact on the cropland in the Des Moines River Basin. In the Iowa portion of the basin, this plan would reduce the erosion rate on all cropland from 4.5 tons per acre per year to 2.3 tons per acre per year. Total tons of erosion would be reduced from 27.7 million tons per year to 14.3 million tons per year. In addition, this alternative would reduce wind erosion to insignificant rates. Depletion costs would be reduced from $12.3 million in 2020 to $6.4 million. For every acre of soil mapping unit that is identified as depleting, a total of 3.5 acres will be treated. This is a combination of more than one treatment per acre and treating associated acres in the field.

Consequently in order to treat the 1.2 million acres with excess erosion, 4.2 million acres would be treated at an annual cost of $41.6 million. This would reduce annual depletion costs by $5.9 million. The direct cost to the farmer of $41.6 million would be reduced $5.9 million by preventing depletion for a net cost of $35.7 million annually. The cost of $41.6 million does not take into account cost-sharing of any kind.

In the Minnesota portion of the basin, the erosion rate on all cropland would be reduced from 3.0 tons per acre per year to 1.6 tons per acre per year. Total tons of erosion would be reduced from 2.4 million tons per year to 1.3 million tons per year. Depletion costs would be reduced from $1.2 million in 2020 to $0.6 million.

Pastureland

The objective of this plan is to control excessive erosion on pastureland. The pasture planting element in this alternative consists of utilizing cool season grasses, legumes, and warm season grasses in pasture programs. Additional management of the plantings will be required. Approximately 132,000 acres of the 149,500 problem acres would be treated with this alternative.

The total cost of this plan is $4.6 million annually or $35 per problem acre treated. If the cost is spread over all pasture acres it is $4.50 per acre annually. This alternative would require an additional staff year of technical assistance per year to install and maintain the erosion control measures in this plan. (See Table 2-1 for list of plan elements.)

The installation of the erosion control measures would reduce erosion to tolerable levels on each treated acre. These measures would eliminate overgrazing and allow vegetative cover to adequately protect the soil. In addition to providing erosion control, this plan would provide an additional 143,900 animal unit months of grazing annually with an estimated annual value of $2.9 million. 1/

The remaining untreated acres would have an average erosion rate of 10.4 tons per acre per year. This rate is higher than current conditions because the flatter slopes would be treated first. Total erosion on the remaining untreated acres would amount to 182,000 tons.

Forest Land

This alternative emphasizes increased erosion reduction on forest resources. Livestock grazing will be excluded by fencing 165,000 acres of the forested D, E, F, and G slopes and 10,000 acres of the flatter A, B, and C slopes as well as reforesting 53,000 acres. This amount of acres is larger than the defined problem. It is necessary to treat large blocks of forest land to control the problem area. The annual cost for livestock exclusion on 175,000 acres is estimated at $1,750,000. Of this annual cost, $1,225,000 is for fencing and an additional $525,000 would result from loss of forage. Approximately 53,000 acres of understocked or open land would be planted at an annual cost of $1,053,000. Total annual installation cost of this alternative is $2.8 million. In addition, technical assistance would be increased by two staff-years at an annual cost of $50,000. In addition to providing the technical assistance necessary to accomplish the planned fencing measures and tree planting it is expected there will be an increased effort toward educating landowners on benefits of proper forest land management.

1/ Value of animal unit month based on value of production when marketed through a cow-calf operation.

Forested acres exceeding tolerable levels will be reduced from 26,000 acres to 5,200 acres, a reduction of 80 percent. With the installation of the planned measures, the erosion from forest land exceeding tolerable limits would be reduced from 346,000 to 69,000 tons by the year 2020, a reduction of 277,000 tons.

These measures will significantly reduce the amount of sediment impacting the waterways within the basin. Wildlife will benefit through improved habitat conditions. Timber production on the treated areas will be increased. This increased production will annually return about $2,863,000 to the landowners through increased stumpage values. Even greater economic benefits will be derived through secondary wood-processing industries.

GULLY EROSION

As part of the survey of the 100 quarter sections, the district conservationists were also asked to recommend plan elements and estimate costs for treating gully erosion. The total cost of this plan is $343.1 million or $9.5 million annually and would control 37 percent of the gullies. The plan elements are listed in Table 2-1. This plan will require an additional 440 staff years of technical assistance or 12 staff years per year.

The 50,000 gullies with the highest erosion rates account for 94 percent of the total voiding and tons of erosion. Treating the worst gullies first would not cost any more, using the following elements:

Element	Gullies Controlled Number	Percent	Cost Million Dollars
Waterways	13,500	10	20.9
Grade Stabilization Structures	27,800	21	322.2
Terraces and Diversions	8,700	6	1/
Total	50,000	37	343.1

Price Base: 1982

1/ Cost allocated to sheet erosion control.

WET CROPLAND

Physical Elements

The Practical and Feasible Plan would eliminate the drainage problem on 902,000 acres - 758,000 acres in Iowa and 144,000 acres in Minnesota. The entire area is presently cropped intensively and is all privately owned land. It does not include other land uses such as wetlands or wildlife area.

Needed drainage improvements are 1,800 miles of tile relief mains, 335 miles of new open channel, and 560 miles of reconstructed open channel. These improvements would be constructed by legal drainage district organizations or other group action. Private owners will also install 6,750 miles of lateral tile in existing cropland. Table 2-1 lists plan elements.

Total installation cost is $324 million - $276 million in Iowa and $48 million in Minnesota. The annual cost of proposed improvements is $27 million with Iowa's share $23 million and Minnesota's share $4 million. Private landowners would have a cost of $35.6 million for in-field lateral tile.

Drainage improvement will increase annual production on 902,000 acres of existing cropland for an increased gross income of more than $88 million - $75 million in Iowa and $13 million in Minnesota. Table 2-2 shows the comparison of gross income with costs.

TABLE 2-2

COMPARISON OF GROSS INCOME AND COSTS
DRAINAGE
PRACTICAL AND FEASIBLE PLAN

Des Moines River Basin

State	Gross Income	Annual Costs
	- - - - - 1,000 Dollars- - - - -	
Iowa	75,217	23,020
Minnesota	13,412	4,026
Total	88,629	27,046

Price Base: 1982

Social Elements

The Cooperative Study made by Iowa State University shows that land users fail to realize the full production potential of improved drainage. To accomplish the acceleration of drainage the public needs additional information on costs and returns. A special farm loan program could be used to encourage farmers to take advantage of drainage to increase production efficiency. The following project promotion activities are needed to accelerate the installation of drainage improvements.

Information needs can be met by a research and education program to demonstrate the cost-returns of drainage and a study to determine the condition of existing drainage. Drainage requires a large capital investment and a program to subsidize interest costs for long-term loans could be used to encourage drainage developments.

Research would be established as a continuing process to determine the long-term effects of different levels of drainage on crop production. Research and demonstration results would be made available to the public.

Research and education costs total $4.9 million or $135,000 annually. Research costs are estimated at $3.8 million, or an annual cost of $105,000. Education costs are $1.1 million or an annual cost of $30,000.

A comprehensive study by drainage district could determine the capacity and condition of existing drainage systems. These studies could determine the needed capacity and the present capacity as well as condition. These studies are estimated to cost $31.1 million, about $10 per acre.

A financial assistance program could be designed to accelerate drainage improvements by subsidizing interest costs for long-term loans. A loan interest subsidy is an example of a type of financial incentive that could be considered.Interest subsidies could substantially reduce user investment costs. This program could induce a larger percentage of owners to install drainage.

An interest subsidy of $58 million would finance one-half the drainage improvements, an annual rate of 1.6 million for the 36-year project term (Table 2-3). A summary of the cost of project promotion activities is shown in Table 2-4.

Environmental impacts have not been completely evaluated. The major impacts are caused by the conversion of some inadequate tile mains to open ditches, and increasing width of some existing open ditches.

TABLE 2-3

COST OF LOAN INTEREST SUBSIDY
DRAINAGE
PRACTICAL AND FEASIBLE PLAN

Des Moines River Basin

State	Installation Cost	Amount Financed 1/	Average Balance Financed 2/	Total Subsidy 3/	Ave. Ann. Subsidy 4/
			-1,000 Dollars-		
Iowa	276,275	103,603	55,255	49,730	1,381
Minnesota	48,172	18,065	9,635	8,671	241
Total	324,447	121,668	64,890	58,401	1,622

Price Base: 1982

1/ Amount financed is installation cost X owner participation (0.50) X part financed (0.75), thus the factor is 0.375. Amount financed equals the estimated total loan principal.
2/ Average balance financed is amount financed X 8/15.
3/ Total subsidy is average balance financed X 0.06 X 15 years.
4/ Average annual subsidy is total subsidy divided by 36 years.

TABLE 2-4

COST OF PROJECT PROMOTION ACTIVITIES
DRAINAGE
PRACTICAL AND FEASIBLE PLAN

Des Moines River Basin

State 1/	Research & Education	Comprehensive Survey	Financial Assistance	Total
		-1,000 Dollars-		
Iowa	4,131 (115) 2/	26,469 (735)	49,730 (1,381)	80,330 (2,231)
Minnesota	729 (20)	4,671 (130)	8,671 (241)	14,071 (391)
Total	4,860 (135)	31,140 (865)	58,401 (1,622)	94,401 (2,622)

Price Base: 1982

1/ State costs were apportioned by benefits received - Iowa 85%, Minnesota 15%.

2/ Amounts in parenthesis are annual costs.

LOSS OF AGRICULTURAL LANDS

This alternative seeks to improve the farmland protection capability to protect 1600 acres per year by the year 2020. The first step is to select those Iowa counties where the loss of agricultural land to other uses is a problem. There are four unzoned counties that have need for farmland protection now. It would cost about $70,000 to establish zoning in these counties. In addition, after the initial review of the land use data it is assumed that not all 39 Iowa counties will want to establish a land evaluation and site assessment procedure. If 20 counties decide to go ahead with the land evaluation and site assessment, it is estimated to cost $150,000.

If these actions are taken, it is estimated that by 2020 the loss of agricultural land can be reduced by 40 percent from 4100 acres to 2,500 acres per year. Projected to year 2020, this is a loss of 118,800 acres and a total annual loss equivalent of 10.7 million bushels of corn, about $27.6 million a year.

The agricultural land protected would total 1600 acres per year by 2020. The loss prevented would total 28,800 acres, equivalent to 2.6 million bushels of corn, or about $6.7 million.

LOSS OF WILDLIFE HABITAT

The objective of this alternative is to maintain existing wildlife habitat values. It is based on the Practical and Feasible erosion control alternative and information supplied by the soil conservation districts and Iowa Conservation Commission. The plan elements are based on current conditions for cost-sharing, technical assistance, and acceptance by local landowners.

The total annual cost of this plan is $3,321,000. It would require an additional 8.5 staff years of technical assistance per year. These costs are in addition to those included in the erosion control alternative. Table 2-1 lists the plan elements. See Appendix H for description of Environmental Corridors report.

Implementation of this alternative would provide a basinwide HSI of 3.4. Table 2-5 compares HSI values between without project and with project conditions by state and planning region.

This alternative does not fully meet the objective of maintaining existing habitat. This result occurs from the expected increase in cropland acreage and accompanying decline in interspersion of wildlife cover types. Implementation of this alternative will improve management of various cover types, as well as provide for public acquisition of important habitat areas. Together, these actions would maintain habitat values in the basin at about 95 percent of the current levels as opposed to 80 percent of current values without project.

It can be expected that populations of some wildlife species would disappear from some parts of the basin. Total populations of most species would decline. Associated human activities such as hunting, bird watching, and nature study would decline.

TABLE 2-5

HABITAT SUITABILITY INDEX
PRACTICAL AND FEASIBLE PLAN

Des Moines River Basin

Location	Current	Future Without Project	Future With Project
	- - - - - - - - Index- - - - - - - - - - - - -		
Basin	3.6	2.9	3.4
Minnesota	3.0	2.5	2.8
Iowa	3.8	3.0	3.6
North Iowa	2.4	1.6	2.3
South Iowa	5.2	4.2	4.9

LOSS OF FOREST LAND

The principal measure for reduction of forest land conversion is additional technical assistance. Under this alternative technical assistance would be increased by four staff-years at an annual cost of $100,000. The additional technical assistance would provide a major effort promoting retention of forest land. Through these efforts, the new tax legislation exempting certain forest lands can be effectively utilized. In addition, 72,000 acres of forest land would receive timber stand improvement (TSI) treatment and 36,000 acres would be planted to trees. Landowners would find these treatments are necessary to improve established forest lands if they are to be retained as productive, profitable areas. Installation of these measures would have an estimated annual cost of $1,459,000 in addition to the $100,000 for additional technical assistance.

Installation of the proposed measure would provide direct annual benefits of $1,751,000 in timber stumpage payments to private landowners. Economic benefits would be even greater if the benefits from secondary processing were evaluated. Other benefits derived would be improved wildlife habitat, aesthetics, and recreational opportunities. Implementation of the planned forestry measures is expected to reduce the annual loss of forest land by 735 acres, about a 39 percent reduction. This would insure protection for about 29,400 acres of forest land that would have otherwise been converted to other uses by the year 2020.

IDEAL PLAN

SHEET AND RILL EROSION

Cropland

The amount of conservation treatments in the Ideal plan are based on reducing erosion to tolerable levels on each acre of cropland. The combination of plan elements is based on the same 100 randomly selected quarter sections as the Practical and Feasible plan. Although this plan was constrained to allowable soil loss levels, it was developed using commonly acceptable practices and combinations of practices.

The total cost for the Iowa portion of this plan is $54 million annually. It will require an additional 2100 staff years of technical assistance or 58 staff years per year. Table 2-6 lists plan elements.

The plan elements listed in Table 2-6 total to more acres than are identified as a problem. In some cases, more than one treatment is needed on the same acre. The erosion control alternative was based on treating fields not merely soil mapping units, therefore, many acres of nonproblem areas were treated to protect the problem area from erosion. This plan emphasizes treatment of all acres on an equal basis. Because all acres are treated to tolerable levels, there is no priority based on cost or ease of treatment.

The Plan for the Minnesota portion of the basin results in a cost reduction of $2.1 million annually or a reduction of $2.70 per cropland acre. The reason for the cost reduction or additional income is because large amounts of conservation tillage or no-till were used as a land treatment measure. This alternative will provide erosion control to the acceptable level on all acres of cropland with increased income.

This plan will reduce excessive erosion on all acres of cropland to the tolerable level. In the Iowa portion of the basin, this plan will reduce the erosion rate on all cropland from 4.5 tons per acre per year to 0.8 tons per acre per year. Total tons of erosion will be reduced from 27.7 million tons per year to 5.1 million tons per year. In addition, this alternative will reduce wind erosion to insignificant rates. Depletion costs of $12.3 million in 2020 would be eliminated with this alternative.

In the Minnesota portion of the basin, the erosion rate on all cropland will be reduced from 3.0 tons per acre per year to 0.5 tons per acre per year. Total tons of erosion will be reduced from 2.4 million tons per year to 0.4 million tons per year. Depletion costs of $1.2 million in 2020 would be eliminated with this alternative.

TABLE 2-6

PLAN ELEMENTS
IDEAL PLAN

Des Moines River Basin

Plan Elements	Unit	Amount	Annual Cost Dollars
Sheet and Rill Erosion			
Cropland			
Reduced Tillage	Acre	1,182,200	- 8,866,500 1/
No-tillage	Acre	2,456,200	-48,509,900
Terraces	Acre	931,600	90,490,000
Other	-	-	18,693,200
Pastureland			
Pasture planting	Acre	103,200	2,860,700
Pasture management	Acre	103,200	1,500,300
Change Pastureland to Forest Land	Acre	50,000	2,250,000
Forest Land			
Livestock exlusion	Acre	200,000	2,000,000
Tree planting	Acre	78,000	1,550,000
Gully Erosion			
Waterways	Acre	36,400	1,500,000
Grade Stabilization Structures	Number	61,600	23,900,000
Wet Cropland			
Drainage	Acres	1,500,000	45,000,000
Research, Education, and Investigation	-	-	1,617,000
Financial Assistance	-	-	5,700,000
Loss of Agricultural Lands			
Zoning	Counties	14	6,700
Land Evaluation and Site Assessment	Counties	39	8,300
Loss of Wildlife Habitat 2/			
Farmstead Windbreaks	Acre	18,000	3,190,000
Privately-owned Wetland Protection	Acre	3,700	3,700
Public Land Acquisition	Acre	52,000	6,146,400
Loss of Forest Land			
Timber Stand Improvement	Acre	144,000	1,350,000
Tree Planting	Acre	72,000	1,550,000

Price Base: 1982

1/ Negative values indicate reduced cost of production.

2/ These elements are in addition to those included in the erosion control alternative.

Pastureland

The objective of this plan is to control excessive erosion on all pastureland and enhance environmental quality. This alternative consists of utilizing a mix of warm season grasses, and cool season grasses and legumes in pasture programs. In addition, 50,000 acres would be planted with trees and livestock grazing would be eliminated.

The total cost of this plan is $6.6 million annually or $43 per problem acre treated. This plan would treat the entire problem area of 153,240 acres. If the cost is spread over all pasture acres, it is seven dollars per acre annually. This alternative would require an additional staff year of technical assistance per year to install and maintain the erosion control measures in the plan. (See Table 2-6 for list of plan elements.)

The installation of the erosion control measures would reduce erosion to tolerable levels on each treated acre. The diversity of pasture plantings and tree planting would enhance the environmental quality. 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 96,600 animal unit months of grazing with an estimated annual value of $1.9 million.1/ It will also provide an additional $100,000 annual value of forest products.

Forest Land

This alternative emphasizes maximum protection to the forest resources. Livestock grazing would be excluded by fencing 185,000 acres of the forested D, E, F, and G slopes and 15,000 acres of the flatter A, B, and C slopes as well as reforest 78,000 acres. This acreage is larger than the defined problem. It is necessary to treat large blocks of forest land to control the problem area. The annual cost for livestock exclusion on 200,000 acres is estimated at $2,000,000. Of this annual cost, $1,400,000 is due to fencing and an additional $600,000 would result from loss of forage. Approximately 78,000 acres of understocked or open land would be planted at an annual cost of $1,550,000. The total annual installation cost of this alternative is $3.55 million. In addition, technical assistance would be increased by three staff-years at an annual cost of $75,000. In addition to providing the technical assistance necessary to accomplish the planned fencing and tree planting measures, it is expected there will be an increased effort toward educating landowners on benefits of proper forest land management.

1/ Value of animal month based on value of production when marketed through a cow-calf operation.

The installation of the planned measures would reduce excessive erosion on 26,000 acres. This would significantly reduce the amount of sediment impacting the waterways within the basin. Wildlife would benefit through improved habitat conditions. Timber production on the treated areas would be increased with an estimated annual return of about $3,638,000 to the landowners through increased stumpage values. Even greater economic benefits would be derived through secondary wood processing industries.

GULLY EROSION

This plan would treat all of the gully erosion. The cost of treating all gullies was estimated at $914.2 million.

In the Practical and Feasible Alternative, 94 percent of the gully erosion is controlled by treating 37 percent of the gullies with the highest erosion rates for a cost of $343.1 million. The last six percent increment to control 84,300 gullies costs $571.1 million. This plan would require an additional 1180 staff years of technical assistance or 33 staff years per year.

WET CROPLAND

Physical Elements

The Ideal Plan would eliminate the drainage problem on 1.5 million acres - 1.3 million acres in Iowa and 239,000 acres in Minnesota.

Drainage improvements are 3,000 miles of tile relief mains, 560 miles of new open channel, and 930 miles of reconstructed open channel.

These improvements would be constructed through legal drainage district organizations or other group action. Private owners would install 11,250 miles of lateral tile. Private owners would have a cost of $59.4 million for in-field lateral tile.

Total installation cost is $540 million - $460 million in Iowa and $80 million in Minnesota. The annual cost of proposed improvements is $45 million with Iowa's share $38 million and Minnesota's share $7 million.

Drainage improvement would increase annual production on 1.5 million acres and increase gross income more than $147 million; $125 million in Iowa and $22 million in Minnesota. Table 2-7 shows the comparison of gross income and costs.

TABLE 2-7

COMPARISON OF GROSS INCOME AND COSTS
DRAINAGE
IDEAL PLAN

Des Moines River Basin

State	Gross Income	Annual Costs
	- - - - - - - -1,000 Dollars- - - - - -	
Iowa	125,362	38,364
Minnesota	22,353	6,709
Total	147,715	45,073

Price Base: 1982

Social Elements

To accomplish the acceleration of drainage for this plan, the public needs additional information on costs and returns. A special farm loan program could also be used to encourage farmers to take advantage of drainage to increase production efficiency. The following promotion activities are needed to accelerate the installation of this alternative.

Their information needs can be met by a research and education program to demonstrate the cost-returns of drainage and a study to determine the condition of existing drainage. Drainage requires large capital investment and a program to subsidize interest costs for long-term loans could be used to encourage drainage developments.

Research would be established as a continuing process to determine the long-term effects of different levels of drainage on crop production. Research and demonstration results would be made available to the public. Research and education costs total $6.3 million or $175,000 annually. Research costs are estimated at $4.2 million, or an annual cost of $115,000. Education costs are $2.1 million, or an annual cost of $60,000.

A comprehensive study by drainage district would determine the capacity and condition of existing drainage systems. These studies would determine the needed capacity and the present capacity as well as condition. These studies are estimated to cost $51.9 million, about $10 per acre.

A financial assistance program could be designed to accelerate drainage improvements by subsidizing interest costs for long-term loans. A loan interest subsidy is an example of a type of financial incentive that could be considered. Interest subsidies could substantially reduce user investment costs. This program could induce a larger percentage of owners to install drainage. The example proposes a higher interest subsidy under the Ideal alternative to stimulate greater participation.

An interest subsidy of $206 million would finance 70 percent of the drainage improvements, an annual rate of $5.7 million for the 36-year project term (Table 2-8). A summary of the cost of project promotion activities is shown in Table 2-9.

TABLE 2-8

COST OF LOAN INTEREST SUBSIDY
DRAINAGE
IDEAL PLAN

Des Moines River Basin

State	Installation Cost	Amount Financed[1/]	Average Balance Financed[2/]	Total Subsidy[3/]	Average Annual Subsidy[4/]
	----------	-1,000 Dollars-	----------	----------	----------
Iowa	460,459	273,973	146,118	175,341	4,871
Minnesota	80,287	47,771	25,478	30,574	849
Total	540,746	321,744	171,596	205,915	5,720

Price Base: 1982

1/ Amount financed is installation cost X owner participation (0.70) X part financed (0.85), thus the factor is 0.595. Amount financed equals the estimated total loan principal.
2/ Average balance financed is amount financed X 8/15.
3/ Total subsidy is average balance financed X 0.08 X 15 years.
4/ Average annual subsidy is total subsidy divided by 36 years.

TABLE 2-9

COST OF PROJECT PROMOTION ACTIVITIES
DRAINAGE
IDEAL PLAN

Des Moines River Basin

State 1/	Research & Education	Comprehensive Survey	Financial Assistance	Total
	-1,000 Dollars-			
Iowa	5,328(148) 2/	43,600(1,211)	175,341(4,871)	224,269(6,230)
Minnesota	972(27)	8,300(231)	30,574(849)	39,846(1,107)
Total	6,300(175)	51,900(1,442)	205,915(5,720)	264,115(7,337)

Price Base: 1982

1/ State costs were apportioned by benefits received - Iowa 85%; Minnesota 15%.
2/ Amounts in parenthesis are annual costs for each of 36 years.

Environmental impacts have not been completely evaluated. The major impacts are caused by the conversion of some inadequate tile mains to open ditches, and increasing width of some existing open ditches.

LOSS OF AGRICULTURAL LAND

There are 14 unzoned counties in Iowa. All counties in Minnesota are zoned. Ideally, each county should have some means to protect farmland from conversion to other uses. This alternative would be for each of the 14 Iowa counties to adopt land use controls or zoning. The cost of establishing controls is estimated to be $240,000. In addition, each of the 39 counties would establish a County Commission for Land Preservation and Use. The Ideal alternative would be for each of the counties to establish a land evaluation and site assessment procedure. If all 39 counties do this, it is estimated to cost $300,000.

If the above actions are taken by 2020, it is assumed that the projected loss of agricultural land can be reduced by one-half to 2060 acres per year. Projected to the year 2020, this would represent a loss of 111,000 acres and at that time an annual loss equivalent to 10 million bushels of corn, about $25.8 million per year.

The agricultural land protected would total 2040 acres per year by 2020. The loss prevented would total 36,700 acres, equivalent to 3.3 million bushels of corn, about $8.5 million.

LOSS OF WILDLIFE HABITAT

The objective of this alternative is to improve existing wildlife habitat values basinwide. It is based on the Ideal erosion control alternative and information supplied by the soil conservation districts and Iowa Conservation Commission. The plan elements are based on reducing soil loss to tolerable levels, increasing cover type diversity where possible, and public acquisition of important habitat areas.

The total cost of this plan is $9,340,000 annually. It will require an additional 24 staff years of technical assistance. These costs are in addition to those included in the erosion control alternative. Table 2-6 lists the plan elements.

Implementation of this alternative will provide a basinwide HSI of 3.7. Table 2-10 compares HSI values between without project and with project conditions.

This alternative meets the objective of improving wildlife habitat values, although it is a small improvement. Cover type interspersion is maintained at about the current level because of the conversion of 263,000 acres of cropland to grassland and 50,000 acres of pastureland to forest land. Management of all cover types will improve, and essentially all remaining important habitat areas will be publicly acquired. These areas include large tracts of upland forest, riparian forest land, wetlands, and prairie remnants. Habitat values will improve about three percent over existing conditions but will be about 27 percent greater than would be expected without project.

Most existing wildlife species will remain in the basin. Total populations of most species should be maintained or increase slightly. Associated human activities such as hunting and bird watching will be maintained at current levels.

TABLE 2-10

HABITAT SUITABILITY INDEX
IDEAL PLAN

Des Moines River Basin

Location	Current	Future Without Project	Future With Project
	- - - - - - - - - Index- - - - - - - - - - - - -		
Basin	3.6	2.9	3.7
Minnesota	3.0	2.5	3.1
Iowa	3.8	3.0	3.9
North Iowa	2.4	1.6	2.5
South Iowa	5.2	4.2	5.4

LOSS OF FOREST LAND

The principal measure for reduction of forest land conversion is additional technical assistance. Under this alternative, technical assistance would be increased by eight staff years at an annual cost of $200,000. The additional technical assistance would provide a major effort promoting retention of forest land. Through these efforts the new tax legislation exempting certain forest lands could be effectively utilized. In addition, 144,000 acres of forest land would receive timber stand improvement (TSI) treatment and 72,000 acres would be planted to trees. Landowners would find these treatments necessary to improve established forest lands if they are to be retained as productive, profitable areas. Installation of these measures would have an estimated annual cost of $2.9 million in addition to the $200,000 for additional technical assistance.

Installation of the proposed measures would provide direct annual benefits of $3.5 million in timber stumpage payments to private landowners. Economic benefits would be even greater if the benefits from secondary processing are evaluated. Other benefits derived would be improved wildlife habitat, aesthetics, and recreational opportunities. Implementation of the planned forestry measures is expected to reduce the annual loss of forest land by 1315 acres, about a 70 percent reduction. This would insure protection for about 52,600 acres of forest land that would have otherwise been converted to other uses by the year 2020.

CHAPTER 3

EARLY ACTION PLAN

The Early Action Plan contains elements that can be readily implemented by the year 2020. The plan was developed from input by local people, and local, regional, state, and federal agency personnel. Three public meetings were held at locations within the basin to discuss altervative plans.

Comments received from the public were incorporated, where possible, to develop an acceptable plan. There was no major controversy or major adverse comments. The degree of plan acceptance is high. This plan will provide for water and related land resource needs in the future. Tradeoffs among various elements were necessary to minimize conflicts in resource use.

The Early Action Plan reflects economic, physical, technological, and public policy constraints identified by the sponsoring state organizations, and the USDA planning agencies. Inclusion of measures generally reflects a high degree of local interest or an expression of interest by some agency, organization, or unit of government. Implementation of the Early Action Plan will require detailed investigation of biological, cultural, archeological and historical resources.

The Early Action Plan includes a mix of elements with implementation opportunities for individual plan elements through a variety of federal, state, and local programs. The priorities and schedule for installation of various 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. Technical and financial assistance for most plan elements can be obtained through existing programs of local, state, and federal agencies. Some plan elements can only be accomplished with significant increases in levels of funding and additional local, state, or federal legislation or program authorities. Additional information on methods of implementing these elements is described in the following sections.

SHEET AND RILL EROSION

Cropland

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 2020.

The cropland erosion reduction measures in the Early Action Plan are shown in Table 3-1. These measures will be installed in areas where they are best adapted to solving the specific types of erosion problems. The specific area selected for early action are those soil mapping units that are depleting and identified in Table 1-6.

TABLE 3-1

PLAN ELEMENTS
EARLY ACTION PLAN

Des Moines River Basin

Plan Elements	Unit	Amount	Annual Cost Dollars
Sheet and Rill Erosion			(1,000's)
Cropland			
Reduced tillage	Acre	824,300	- 6,182 1/
No-tillage	Acre	243,200	- 4,803
Terraces	Acre	204,600	20,535
Other	-	-	3,476
Pastureland			
Pasture Planting	Acre	76,560	2,284
Pasture Management	Acre	76,560	716
Change Pastureland to Forest land	Acre	50,000	2,250
Forest Land			
Livestock exclusion	Acre	100,000	1,000
Tree planting	Acre	36,000	707
Gully Erosion			
Waterways	Acre	88	9
Grade Stabilization Structures	Number	182	132
Wet Cropland			
Drainage	Acres	289,000	8,654
Research, Education, and Investigation	-	-	1,417
Financial Assistance	-	-	1,168
Loss of Agricultural Lands			
Land protection Zoning	Counties	4	2
Land Evaluation and Site Assessment	Counties	20	4
Loss of Wildlife Habitat 2/			
Farmstead Windbreaks	Acre	5,000	886
Privately-owned Wetland Protection	Acre	2,000	2
Public Land Acquisition	Acre	14,000	1,547
Loss of Forest Land			
Timber Stand Improvement	Acre	36,000	340
Tree Planting	Acre	18,000	390

Price Base: 1982

1/ Negative values indicate reduced cost of production.

2/ These elements are in addition to those included in the erosion control alternative.

Annual installation costs for protecting 363,100 problem acres are estimated at $13.6 million or $37.40 per excessively eroding acre. (See Table 3-6 for comparison of Early Action Plan to future without conditions.) Installation of these land treatment measures will preserve the resource base and enhance the landscape appearance.

Implementation of the plan elements to achieve soil conservation will not shift production within the basin. The area with highly erosive 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 $95 million for the installation of terraces and tile. 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 $95 million capital cost expended equally over a 16-year period will require an annual capital outlay of $5.9 million. This could be a combined input from landowners and federal, state, and local cost sharing.

In addition it will require 500 staff years of technical assistance, an additional 31 people per year. This plan does not solve all problems within the basin. The long-range critical need is for treatment of the 1.2 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 17 tons per acre per year to 11 tons per acre per year. Soil losses will be reduced from about 30 tons per acre per year to 5 tons per acre per year on the depleting soils. Total tons of erosion on excessively eroded cropland will be reduced from 28.9 million tons per year to 13.2 million tons per year. Implementation of the Early Action Plan will reduce wind erosion to insignificant rates.

Depletion costs will be reduced from $13.5 million to $8.7 million. This plan will treat those soils with the highest erosion rates and most serious depletion, therefore, by implementing this plan a larger proportion of depletion would be reduced.

Those soils listed in Table 1-6 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.

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 any 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 in acres of a soil mapping unit times the depletion cost 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.

Implementation costs for 87,700 acres in the Minnesota portion are estimated to have an overall cost reduction of $543,500 or $6.19 per acre. Implementation of this plan will have a capital cost of nearly $4 million for the installation of terraces and tile. This cost expended equally over a 16-year period would require an annual capital outlay of $250,000.

This plan for Minnesota will require about 40 staff years of technical assistance, an additional three people per year. There is a critical need for treatment on an additional 202,300 acres of cropland.

Pastureland

The Early Action Plan consists of treating 76,560 problem acres with 5 through 18 percent slopes. These acres are the easiest to work without special machinery. The 50,000 acres of tree planting on over 18 percent slopes should be emphasized immediately. Slopes over 18 percent are too steep for mechanical operations, therefore, large amounts of hand labor will be required to get the trees planted.

The annual cost of pasture planting and management is $3.0 million or $39 per acre. The annual cost of tree planting is $2.25 million. The total capital investment cost of installing the plantings for this alternative is $6.1 million. This cost is an addition to the current ongoing program. This amount will be provided by local landowners and local, state, and federal cost-sharing sources. One additional staff year of technical assistance per year to install and maintain the erosion control measures will be required.

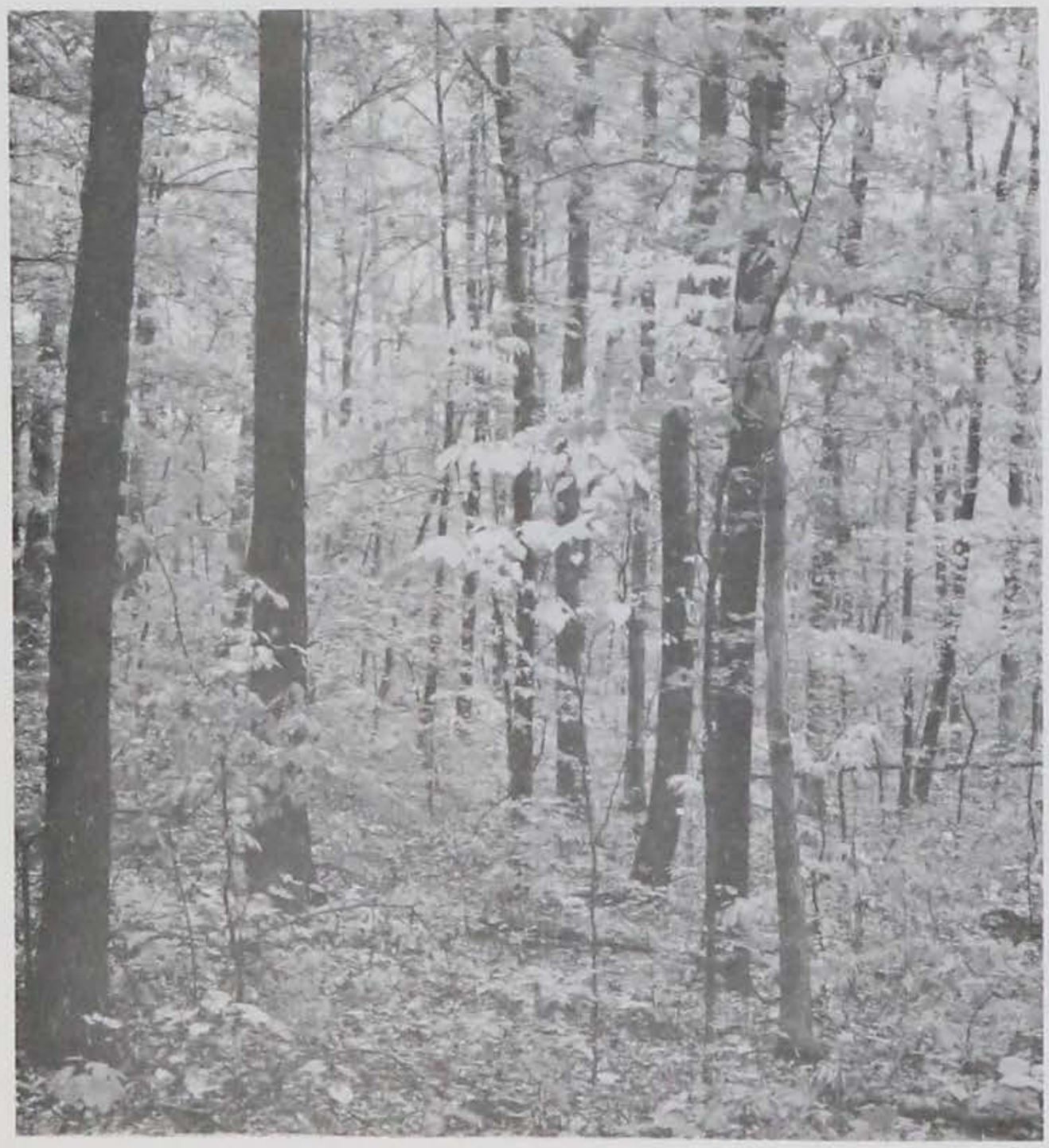
The implementation of the Early Action Plan will reduce erosion to tolerable levels on all treated acres. In addition, it will provide an additional 109,700 animal unit months of grazing with an estimated value of $2.2 million.1/

1/ Value of animal unit month based on value of production when marketed through a cow-calf operation.

Terraces are used to reduce soil losses and protect the soil resource base.

Grade stabilization structures are used to reduce gully erosion.

Residue on the surface from the previous year's crop protects the soil from water erosion.



Woodland management provides economic and environmental benefits.

Improved wildlife habitat will sustain larger wildlife populations.

Tree planting will improve and maintain the forest resource.

Artificial drainage can increase crop production.

Pasture planting and management will increase forage production and protect the soil resource.

Forest Land

Under this alternative, livestock grazing will be excluded from 92,000 acres of land with more than 14 percent slopes and 8,000 acres of 0 through 14 percent slopes. It is estimated that the annual cost for livestock exclusion on 100,000 acres will be $1,000,000. About $700,000 is for fencing costs and an additional $300,000 cost is caused by the loss of forage. Approximately 36,000 acres of understocked or open land will be planted. The annual cost for tree planting will be about $707,000. Total annual installation cost for this alternative is $1.7 million. In addition, technical assistance will be increased by one staff year at an annual cost of $25,000. In addition to providing the technical assistance necessary to accomplish the planned fencing and tree planting measures, it is expected there will be an increased effort toward educating landowners on benefits of proper forest land management.

Implementation of this alternative will reduce the total forest land erosion from 746,000 tons to 469,300 tons by the year 2000, a reduction of 37 percent (276,700 tons). Forested acres eroding at rates exceeding tolerable levels will be reduced from 26,000 acres to 13,100 acres, a reduction of almost 50 percent.

These measures will reduce the amount of sediment entering the streams and rivers of the basin. There will be an increase in wildlife habitat quality. The proposed measures will also provide for increased timber production from these areas. It is expected that treated areas will annually return about $1,756,000 to landowners through increased stumpage values. This increased timber production will also provide additional economic benefits to the basin through the secondary processing effort.

GULLY EROSION

The cost of gully erosion control is economically justified in very few instances. Control is usually justified when improvements such as farmsteads or roads are threatened.

The Early Action Plan proposes treating 270 gullies or about 0.2 percent of the most active gullies. Land damages caused by voiding and depreciation are usually sufficient for economic justification when the average annual voiding rate is 0.04 acres per year or higher and drainage area is up to 100 acres. The total estimated cost for this plan is $2.25 million or $141,000 annually. The plan elements are shown in Table 3-1. The following is a comparison of impacts from installation of the plan elements:

Element	Gullies Treated		Cost
	Number	Percent	$ Million
Waterways	88	.07	0.14
Grade Stabilization Structures	182	.13	2.11
Total	270	.20	2.25

Price Base: 1982

This plan will treat 5.5 percent of the total gully erosion. Gully erosion will be reduced by 152,000 tons per year, voiding by 14.9 acres per year, and depreciation by 20 acres per year. Gully erosion damage will be prevented on 795 acres. Implementation of the plan elements will require 16 staff-years or one staff-year per year.

WET CROPLAND

The total annual cost of the Early Action Plan for drainage is $11.2 million. It includes both the physical and social elements.

Additional technical assistance needs are four staff years per year, approximately one position for each four counties. The staff assistance will be providing soils data and drainage interpretations. Engineering design and construction inspection will be provided by others.

Physical Elements

The Early Action Plan will eliminate the drainage problem on 289,000 acres; 243,000 acres in Iowa and 46,000 acres in Minnesota. The entire area is presently cropped intensively and is all privately owned land. It does not include other land uses such as wetlands or wildlife areas.

Drainage improvements will consist of 580 miles of tile relief mains, 110 miles of new open channel, and 180 miles of reconstructed open channel. The above improvements will be constructed through legal drainage district organizations or other group action. Private owners will install 2,160 miles of lateral tile. Table 3-1 lists plan elements.

Total installation cost is $103 million - $88 million in Iowa and $15 million in Minnesota. The annual cost of proposed improvements is $8.7 million - $7.4 million in Iowa and $1.3 million in Minnesota. The cost to local landowners for private in-field tile systems is estimated at $11.4 million. Increased gross income due to drainage improvement on a total of 289,000 acres is $28 million - $24 million in Iowa and $4 million in Minnesota (Table 3-2).

TABLE 3-2

COMPARISON OF GROSS INCOME AND COSTS
DRAINAGE
EARLY ACTION PLAN

Des Moines River Basin

State	Gross Income	Annual Costs
	- - - - - - - -1,000 Dollars- - - - -	
Iowa	24,070	7,366
Minnesota	4,291	1,288
Total	28,361	8,654

Price Base: 1982

Social Elements

Special efforts are required to accomplish the acceleration of drainage improvements outlined in this plan. Three acitivites are planned to assist more rapid installation of drainage. Research and Education, Comprehensive Study, and Financial Assistance.

Research and education will incur annual costs of $171,000 with $130,000 of this for research related activities and $41,000 for the education phase.

Comprehensive surveys cost $1,246,000 per year for a total of $19,936,000. Areas totaling about 2 million acres will be analyzed. Drainage districts selected will likely be those where the problems are most severe. The first surveys can be used as pilot projects for demonstrating the value of this activity to all of LRA 103.

Financial assistance can be available in the form of interest subsidies on long-term loans. A subsidy program could be directed to indivudial or group projects. A loan interest subsidy is an example of a type of financial incentive that could be considered. Table 3-3 lists a total annual need of $1,168,000. The benefits from drainage improvement are largely local and regional. Costs for financial assistance are shown as state and local costs. A summary of project promotion activities costs is in Table 3-3.

TABLE 3-3

COST OF PROJECT PROMOTION ACTIVITIES - SUMMARY
DRAINAGE
EARLY ACTION PLAN

Des Moines River Basin

Source	Research and Education	Comprehensive Survey	Financial Assistance	Total
	- - - - - - - - - - 1,000 Dollars- - - - - - - - - - - -			
Iowa				
State	532(33)[1/]	4,574(286)	6,366(398)	11,472(717)
Counties	486(30)	6,776(423)	9,548(597)	16,810(1050)
Individuals	- -	5,590(350)	- -	5,590(350)
USDA [2/]	1,295(82)	- -	- -	1,295(82)
Subtotal	2,313(145)	16,940(1059)	15,914(995)	35,167(2199)
Minnesota				
State	94(6)	807(50)	1,110(69)	2,011(125)
Counties	86(6)	1,196(75)	1,665(104)	2,947(185)
Individuals	- -	986(62)	- -	986(62)
USDA	228(14)	- -	- -	228(14)
Subtotal	408(26)	2,989(187)	2,775(173)	6,172(386)
Total	2,721(171)	19,929(1246)	18,689(1168)	41,339(2585)

Price Base: 1982

[1/] Amounts in parenthesis are annual costs for each of 16 years.

[2/] Participating agencies within the U.S. Department of Agriculture will be the Soil Conservation Service, the Agricultural Research Service, and the Cooperative Extension Service.

LOSS OF AGRICULTURAL LANDS

The two major land use codes in Iowa are: Chapter 358A which is the authority for the County Zoning Commission and Chapter 93A, Code 1981 which is the State land use authority. Chapter 358A authority allows land use regulations by zoning. Chapter 93A authority allows (a) Agricultural Land Preservation Ordinances, (b) County Land Use Plans, and (c) Agricultural Areas. One of the stated purposes of Chapter 93A is to, "Preserve the availability and use of agricultural land for agricultural production. . . .".

The farmland protection actions in this plan should be accomplished by the year 2000. The farmland protection actions are:

1. All 39 Iowa counties will convene their County Commissions 1/ for Land Preservation and Use.

2. Four additional Iowa counties will adopt some form of farmland protection.

3. Twenty Iowa counties will do a land evaluation and site assessment.

The County Commissions for Land Preservation and Use involve the county agricultural extension council, the soil conservation district, the county board of supervisors, and representatives of city government. The "Commissions" are to complete their county land use inventory by January 1, 1984 1/ . This inventory is to include the amount of change in agricultural land between 1960 and 1984.

The plan assumes the counties most likely to adopt farmland protection are those with the greatest historic loss. In Iowa the four counties are Adair, Boone, Lee, and Mahaska.

The County Commissions for Land Preservation and Use will make recommendations to the County boards of supervisors. The County boards will take actions that appear most appropriate to them.

The total estimated cost of these early action items is $220,000. The probable impact is to prevent the conversion of 1600 acres each year of farmland to nonagricultural uses. If 1600 acres per year are protected by year 2000, the average annual production value protected is $289,000 with an average annual cost to implement of $6,100.

1/ As provided in Chapter 93A, Code 1981, State of Iowa.

LOSS OF WILDLIFE HABITAT

The Early Action Plan includes part or all of the elements from the Practical and Feasible and Ideal alternatives. Wetland protection and public acquisition is targeted in those areas that are most vulnerable to destruction or severe degradation.

The total cost of this plan is $2.4 million annually. These costs are in addition to those included in the erosion control alternative. Table 3-1 lists the plan elements. Table 3-4 displays a division of costs based on past participation by the various groups.

Implementation of this plan will provide a basin-wide HSI of 3.5. Table 3-5 compares HSI values between without project and with project conditions.

This plan results in a small decline in wildlife habitat values. Cover type interspersion will decline because of the continued conversion of other cover types to cropland. Protection of important habitat areas and improved management of most cover types help to offset this decline. Basin habitat values will be maintained at about 97 percent of current levels by implementing this alternative. Wildlife populations and numbers of species should remain at about the current levels.

TABLE 3-4

INSTALLATION FUNDS NEEDED - LOSS OF WILDLIFE HABITAT
EARLY ACTION PLAN

Des Moines River Basin

Source	Amount
Individuals	$ 445,000
Federal	$ 443,000
State	$1,392,000
Counties	$ 154,860

Price Base: 1982

Implementation of the Early Action Plan to protect wildlife habitat will require an additional eight staff years of technical assistance each year. This is in addition to the ongoing program. The total annual cost of technical assistance is $240,000.

Implementation of the Early Action Plan to protect wildlife habitat will require significant amounts of capital from all sources. Sources include county, state, and federal cost-sharing and grant programs as well as individual's personal capital.

TABLE 3-5

HABITAT SUITABILITY INDEX
EARLY ACTION PLAN

Des Moines River Basin

	Current	Future Without Project	Future With Project
	- - - - - - - - - Index- - - - - - - - - - - - - - -		
Basin	3.6	2.9	3.5
Minnesota	3.0	2.5	2.9
Iowa	3.8	3.0	3.7
North Iowa	2.4	1.6	2.3
South Iowa	5.2	4.2	5.0

LOSS OF FOREST LAND

Technical assistance will be increased by two person-years to promote retention of forest land through utilization of tax incentive programs. In addition, 36,000 acres of forest land will receive timber stand improvement (TSI) treatment and 18,000 acres will be planted to trees. Implementation of these measures will have an estimated annual cost of $730,000 in addition to the $50,000 for the additional technical assistance.

It is anticipated that these efforts will provide direct annual benefits of $832,000 in timber stumpage payments to private landowners. Economic benefits will be even greater if the benefits from secondary processing are evaluated. Implementation of the planned forestry treatment is expected to reduce the annual loss of forest land by 310 acres -- about a 17 percent reduction. This will insure protection for about 4,960 acres of forest land, which would otherwise have been converted to other uses by the year 2000.

TABLE 3-6

COMPARISON OF ALTERNATIVE PLANS

Des Moines River Basin

Item	Unit	Future Without Project	Practical & Feasible Plan	Ideal Plan	Early Action Plan
Sheet and Rill Erosion					
Cropland					
Amount exceeding tolerable levels	Acres	1.7 Million	620,000	-	1.4 Million
Additional protection planned	Acres	-	1.1 Million	1.7 Million	363,000
Annual erosion rate on acres exceeding tolerable level	T/A/Yr	17.0	8.3	-	11.0
Cost of depletion	Dollars	13.5 Million	7.0 Million	-	8.7 Million
Depletion prevented	Dollars	-	6.5 Million	13.5 Million	4.8 Million
Annual installation cost	Dollars	-	39.9 Million	51.8 Million	13 Million
Additional staff years needed,annual	Number	-	42	58	31
Pastureland					
Amount exceeding tolerable levels	Acres	153,240	21,240	-	26,680
Additional protection planned	Acres	-	132,000	153,240	126,560
Annual installation cost	Dollars	-	4.6 Million	6.6 Million	5.25 Million
Additional AMU's produced, annual	Numbers	-	143,900	96,600	109,700
Value of additional forest products, annual	Dollars	-	-	100,000	100,000
Additional staff years needed,annual	Number	-	1	1	1
Forest Land					
Amount exceeding tolerable levels	Acres	26,000	5,200	-	13,100
Additional protection planned	Acres	-	20,800	26,000	12,900
Value of increased forest production, annual	Dollars	-	2.9 Million	3.6 Million	1.8 Million
Annual installation cost	Dollars	-	2.8 Million	3.55 Million	1.7 Million
Additional staff years needed,annual	Number	-	-	2	1
Gully Erosion					
Gullies treated	Number	-	50,000	134,300	270
Erosion per year	Tons	2.89 Million	173,400	-	2.74 Million
Annual installation cost	Dollars	-	9.5 Million	25.4 Million	141,000
Additional staff years needed, annual	Number	-	12	33	1
Wet Cropland					
Inadequately drained areas	Acres	1.5 Million	601,000	-	1.21 Million
Annual loss	Dollars	147.7 Million	59.1 Million	-	119.3 Million
Annual installation cost	Dollars	-	29.6 Million	52.3 Million	11.2 Million
Additional staff years needed, annual	Number	-	12	21	4
Loss of Agricultural Land					
Amount lost per year	Acres	4,100	2,500	2,060	2,500
Agricultural production lost, annual	Dollars	952,000	766,000	715,000	663,000
Annual cost of installation	Dollars	-	6,100	15,000	6,100
Loss of Wildlife Habitat					
Habitat Suitability Index (HSI)	Index	2.9	3.4	3.7	3.5
Annual installation cost	Dollars	-	3.3 Million	9.3 Million	2.4 Million
Additional staff years needed, annual	Number	-	8.5	24	8
Loss of Forest Land					
Annual loss of forest land	Acres	1890	1155	575	1,580
Value of increased timber production	Dollars	-	1.75 Million	3.5 Million	832,000
Annual installation cost	Dollars	-	1.5 Million	2.9 Million	730,000
Additional staff years needed, annual	Number	-	4	4	2

Price Base: 1982

IMPLEMENTATION

Implementation opportunities for individual plan elements of the major objectives are available through a variety of federal, state, and local programs. The priorities and schedule for installation of various elements will depend upon the willingness of local people to undertake the responsibility. Technical and financial assistance for most elements can be obtained through existing programs of local, state, and federal agencies.

The Early Action Plan requires an acceleration of existing programs. The cost of the plan measures is over and above the ongoing programs. This acceleration relates to existing state and federal agencies and programs and involves several areas of resources and efforts. These include:

1. Public information - Increased communication of natural resource needs, problems, and possible solutions are essential. The public must have more information and understanding of resource needs and problems if society is to speed up solutions to problems. Demonstration projects and technical assistance from trained and experienced people are examples needing emphasis.

2. Assistance and services from well trained and experienced personnel. The application of practices and measures to solve natural resource problems requires people who know how to do the job effectively. Contractors, who normally construct the soil conservation practices, will be trained by the SCS on staking and checking of construction.

3. Funding for application and cost sharing - the programs must be funded at a rate to attract participation. The program must also be consistently available so landowners and users can make long-range plans for implementing their conservation program.

Some elements can only be installed with significant increases in levels of funding. Additional local, state, or federal legislation, and program authorities may be needed.

Financial

Implementation of the Early Action Plan will require significant amounts of capital from all sources. Sources include individuals and county, state, and federal cost sharing programs. (See Table 3-7 for estimated distribution of funds). The amounts shown in Table 3-7 are annual amounts and are in addition to the current funding level.

TABLE 3-7

SOURCES OF CAPITAL
EARLY ACTION PLAN

Des Moines River Basin

Problem or Concern	Individuals[1/]	County	State	Federal	Total
	- - - - - - - 1,000 Dollars- - - - - - - - - - - - - - -				
Sheet & Rill Erosion					
Cropland	2,950	240	1,140	1,570	5,900
Pastureland	820	0	30	0	850
Forest land	1,350	0	0	350	1,700
Gully Erosion	70.5	5.7	27.2	37.6	141
Wet Cropland	9100	1200	800	100	11,200
Loss of Agricultural Lands	0	60	0	0	60
Loss of Wildlife Habitat	445	155	1400	443	2443
Loss of Forest Land	365	0	0	365	730
Total	15,100.5	1,660.7	3,397.2	2,865.6	23,024

1/ Includes drainage districts

The amount of capital committed by individuals in past years is unknown. The amount of cost share funds provided in 1982 is shown in Table 3-8. These cost share funds are used almost exclusively for erosion control measures.

TABLE 3-8

SOURCE OF COST SHARE FUNDS - 1982

Des Moines River Basin

Source	Iowa	Minnesota	Total
	- - - - - - - - - -Dollars- - - - - - - - - - - - - -		
ACP, USDA	1,180,327	64,978	1,245,305
States	869,139	30,000	899,136
Counties	193,306	0	193,306
Total	2,242,769	94,978	2,337,747

Cost sharing rates for cropland erosion control are based on historic rates with individuals paying 50 percent of the cost and the remaining 50 percent allocated among county, state, and federal sources.

The primary cost-sharing program useful for pastureland erosion control is the Iowa Conservation Commission's switchgrass program. It may be used only to establish switchgrass pastures. Currently, about $30,000 of cost-share funds are available annually in the basin for that program. This would provide enough cost-sharing to establish about 16,000 acres by 2000. Unless major changes occur in the present cost-share programs, the remaining capital costs must be provided by individuals.

Funding sources for gully erosion control measures are 50 percent from individuals and the remaining 50 percent allocated in the same proportion as erosion control on cropland.

Individuals, which includes drainage districts, will pay the entire construction cost for wet cropland treatment measures plus one-third of the cost of a comprehensive survey of existing drainage facilities. The remaining costs, including the interest subsidy program, are allocated to other sources, which have the ability and capability to participate.

Political divisions of government, such as counties, are the primary source of funding for the installation of measures to reduce the loss of agricultural land. They are also the organization most likely to implement a plan.

The states are the primary source of funds for land acquisition to reduce loss of wildlife habitat. Individuals will pay for 50 percent of plan elements, such as tree planting. Federal sources will cost share the remaining 50 percent of tree planting. County and state sources will participate in land acquisition.

Federal sources will cost-share 50 percent of the cost of tree planting to protect the loss of forest lands. The remaining costs of tree planting and timber stand improvement are individual costs.

Technical Assistance

Implementation of the Early Action Plan will require additional technical staff time to design and install the needed plan elements. Technical assistance is provided by federal, state, and local agencies. The number of staff years of technical assistance provided in 1982 by source is shown in Table 3-9.

TABLE 3-9

SOURCE OF TECHNICAL ASSISTANCE - 1982

Des Moines River Basin

Source	Iowa	Minnesota	Total
	- - - - - - - - Staff Years- - - - - - - - - - - - - -
SCS	44.0	2.0	46.0
States	37.0	1.0	38.0
Counties	4.0	2.0	6.0
Total	85.0	5.0	90.0

Implementation of the Early Action Plan will require an additional 53 staff years of technical assistance each year. This amount is in addition to the current ongoing programs. Assuming an annual cost of $30,000 to include salaries and overhead, the total annual cost of technical assistance is $1,590,000.

If the additional technical assistance needs are apportioned based on 1982 data, the allocation is as follows:

Source	Staff Years Per Year
Federal	28
State	22
Counties	3
Total	53

ENVIRONMENTAL IMPACTS OF EARLY ACTION PLAN

The Early Action Plan is a combination of plan elements to be completed by year 2000. These measures will treat water and related land resource problems and needs of the Des Moines River Basin. In general, most plan elements will contribute to the overall improvement of environmental quality within the basin. Subsidy programs could be used to gain control over environmental damage and needed mitigation. Erosion and sediment damages will be reduced. Revegetation of critical areas, planting of trees, installation of terraces, and other conservation practices will help improve the aesthetic quality of the landscape. Water quality will be improved as a result of the reduction in erosion.

Implementation of the Early Action Plan will improve habitat conditions for most animal life by decreasing row crops and increasing grassland by a comparable amount. Poorly managed pastureland is inherently low value wildlife habitat. The pasture management program will have an overall beneficial effect on wildlife.

Other plan elements involve accelerated land treatment programs and reallocating land use within soil capabilities. The environmental impacts of these elements will be to reduce erosion on 502,500 acres of cropland, pastureland, and forest land through land treatment measures and proper land use. There will be no major environmental impacts on water and related land resources outside the basin.

RELATIONSHIP OF EARLY ACTION PLAN TO LAND USE PLANS, POLICIES, AND CONTROLS

Soil conservation districts, with assistance of the Iowa Department of Soil Conservation, established soil loss limits for each county. Planned elements will be designed to conform with these limits. The plan elements are compatible with state land use legislation.

The potential impact to Archeological and Historic resources from the implementation of this plan will be determined at the time of installataion. Prior to the selection of any project construction sites an intensive site investigation should be made. The Office of Historic Preservation should be consulted to determine what the resource base might be or what effects might be expected.

The development of new programs and continued use of existing programs should have the involvement of all conservation agencies such that policies involving all natural resources are included.

SHORT-TERM VS. LONG-TERM USE OF RESOURCES

Trends in the basin indicate future land use will be dominated by agriculture with increased rural-residential development. The Early Action Plan is expected to be compatible with short-term uses of land, water, and other natural resources in the basin without precluding any significant long-term options. Short-term food and fiber needs can be met through continuation of the present allocation of land resources. Changes in land use and the acceleration of conservation treatment application is essential, however, to preserve the quality of the land resource base for use in meeting long-term needs. Continued depletion of the soil resource would have serious detrimental effects on the capacity to sustain food and fiber production for future generations.

Major interaction of short-term versus long-term uses is summarized below.

1. Accelerated land treatment and use of soils within their inherent capability will contribute to both an immediate and long-range improvement of water quality in the basin's streams through reduction of sediment entering the waters.

2. The measures to reduce the loss of forest land, plus the additional forest land acreage resulting from the planting of trees on steep 14 to 25 percent pastured slopes will increase timber production. Wildlife habitat and aesthetics will be improved and soil erosion will be reduced.

3. Improved management of pastures will insure an adequate production of forage for livestock needs and improve wildlife habitat.

IRREVERSIBLE AND IRRETRIEVEABLE COMMITMENTS OF RESOURCES

An additional 540 acres of land will be involved in structure sites and water areas for 270 grade stabilization structures.

If no additional actions are taken, 147,600 acres of agricultural land will be committed to nonagricultural uses by 2020. These uses are irreversible and irretrievable. If the Early Action Plan is implemented, the irreversible loss of agricultural land by 2020 will be reduced to 102,800 acres.

EXISTING AGENCIES AND PROGRAMS

Existing programs and projects which have an important influence on the conservation, development, and management of water, and related land resources are identified. Also identified is the federal, state, or local agency or group having administrative responsibility for the resource programs or projects.

Soil Conservation Districts

Soil Conservation Districts are legally constituted units of state government created to administer soil and water conservation activities within their boundries. 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.

Conservancy Districts

The Des Moines River 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.

Boundaries of the District correspond to the drainage boundaries of the Des Moines River Basin with the addition of the Blue Earth River Basin which drains to Minnesota. 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 Iowa Department of Soil Conservation 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 Department, 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 Public Law 566 Watershed Program.

(2) Review and make recommendations for action on Resource Conservation and Development Project.

The Iowa Department of Soil Conservation 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 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 Soil Conservation Committee. The Iowa Cost Share Program allocation for the basin in fiscal year 1982 was $869,000.

Iowa Department of Water, Air, and Waste Management

Major departmental activities include:

(1) Prevents, abates and controls air pollution.

(2) Public water supply program.

(3) Flood plain management.

(4) Solid and hazardous waste management.

(5) Prevents, abates and controls water pollution.

(6) Ensures the orderly development, wise use, protection and conservation of the surface and groundwater resources.

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

(3) The department 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) The department 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 department also establishes minimum standards for private sewage disposal systems, which are regulated by local boards of health.

(6) The department 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.

Minnesota Soil and Water Conservation Board

The Minnesota Soil and Water Conservation Board is within the Department of Agriculture. The agency provides administrative and financial assistance to soil and water conservation districts in carrying out their programs for the conservation of soil and water resources. The agency administers a state cost-share program that allows a local soil and water conservation district to provide up to 75 percent funding for permanent erosion control practices with approved land occupiers. This cost-share program also provides for grants to control streambank, lakeshore, and roadside erosion.

USDA Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service 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 1982 ACP allocation for the basin was $1.57 million.

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 FIP counties in the basin are Jefferson and Lee. The cost of such practices is shared between the federal government and the land user.

The Soil Conservation Service and the Forest Service are responsible for the technical assistance for ACP practices. The Forestry Section of the Iowa Conservation Commission provides the technical assistance for forestry practices.

USDA Soil Conservation Service

Under authority of Public Law 46 of the 74th Congress as amended, the Soil Conservation Service 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 Service 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 Soil Conservation Service administers the Soil Survey Program, which surveys the soil resource for 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 Soil Conservation Service 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 Iowa Conservation Commission are responsible for the forestry phase of PL-566 watershed projects and for soil and water conservation applicable to land used for forestry purposes. Cost-sharing is provided for flood prevention, irrigation, drainage, sedimentation control, fish and wildlife development, and public recreation. 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 14 PL-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 Soil Conservation Service 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 our eligible measures having community benefits. All or part of 12 counties in the basin are in RC&D areas.

USDA Forest Service

Under authority of PL 95-313 (RFA), forestry assistance is provided by the Iowa Conservation Commission 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.

Iowa Conservation Commission

The Iowa Conservation Commission 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 commission 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 commission may provide cost-sharing assistance to county conservation boards for recreation and fish and wildlife area acquisition and development.

County Conservation Boards

Each county in the basin 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 windbreak planting, roadside ditch seeding, and farm wildlife area establishment.

APPENDIX A

RESOURCE BASE

LOCATION

The Des Moines River Basin begins in southwestern Minnesota where the West Fork of the Des Moines River rises from Lake Shetek. It extends southeasterly across west-central Iowa 535 miles to the Mississippi River near Keokuk, Iowa. The Des Moines River Basin includes all or parts of 39 Iowa counties, seven Minnesota counties and one Missouri county, an area of over nine million acres (Figure A-1). The basin is bordered on the west by the Western Iowa Basin and on the west and south by the Southern Iowa Basin. It is bordered on the east by the Iowa-Cedar Basin and the Skunk basin. The major subbasins are long and narrow. Streams flow generally from the northwest to southeast. The size and area of the major subbasins are shown in Table A-1.

TABLE A-1

SUBBASIN DRAINAGE AREAS

Des Moines River Basin

Subbasin	Drainage Area Square Miles	Acres
Upper West Des Moines	1,249	799,420
West Des Moines	1,065	681,610
East Des Moines	1,313	840,560
Upper Des Moines	1,717	1,099,050
Middle Des Moines	2,444	1,564,310
Lower Des Moines	2,151	1,376,720
North Raccoon	2,485	1,590,410
South Raccoon	1,142	731,030
Boone	906	580,020
Total	14,474	9,263,130

DES MOINES RIVER BASIN
IOWA, MINNESOTA, AND MISSOURI

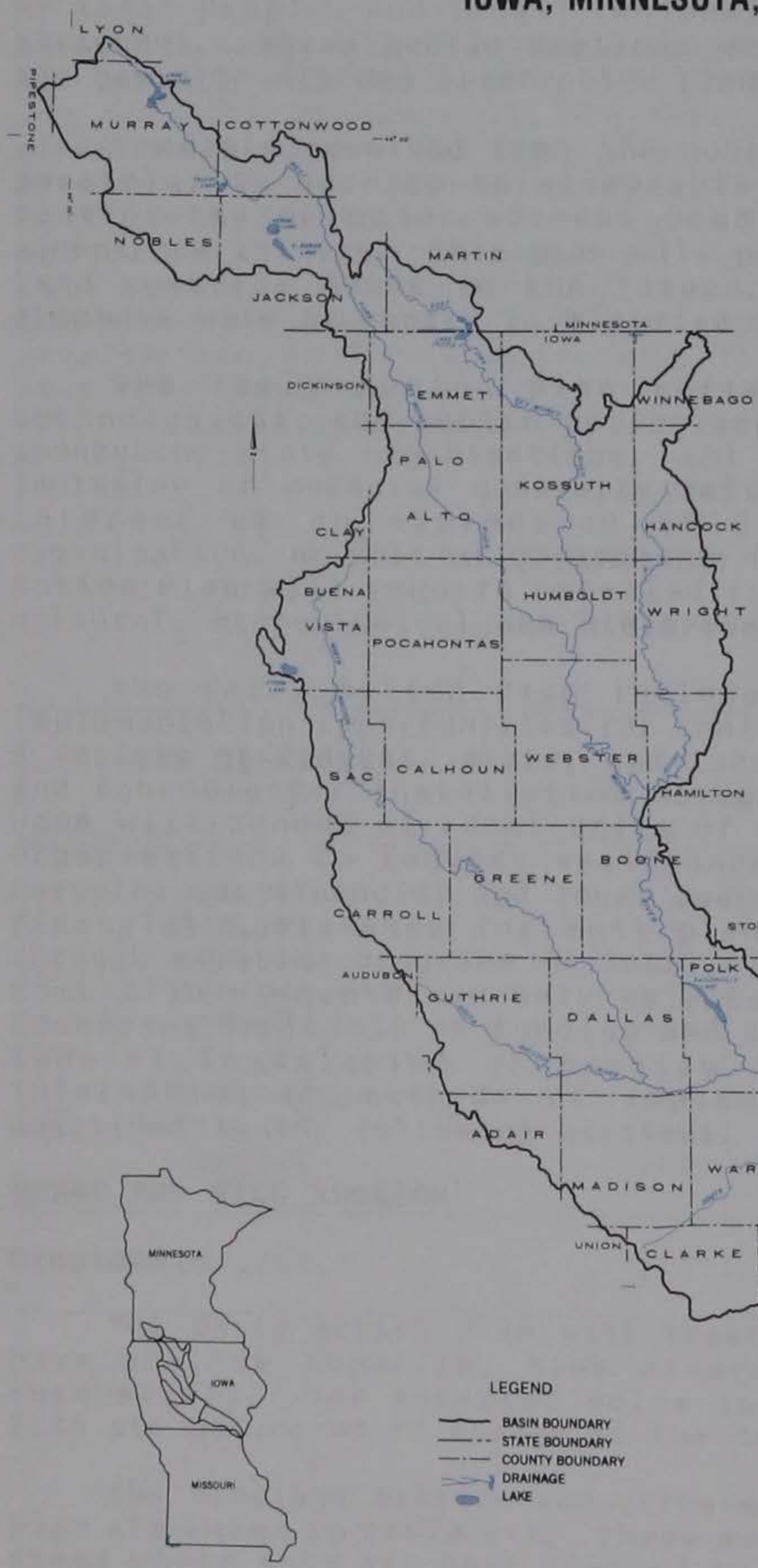


FIGURE A-1

SCALE 0 10 20 30 40 50 MILES
0 10 20 30 40 50 60 70 80 KILOMETERS

SOURCE
FAMILY OF MAPS, SCS DRWG. NO. S.R-36,523 (9-78) AND
INFORMATION FROM SCS FIELD PERSONNEL
LAMBERT CONFORMAL CONIC PROJECTION
USDA-SCS-FORT WORTH, TEXAS 1983

CLIMATE

The climate and the variations of weather impact the soil and water problems in the basin. Erosion by both wind and water and the drainage problems are related to climate.

Figure A-2 shows the monthly distribution of temperatures. The seven months, April through October, are generally considered the growing season and the season when soils are most vulnerable to erosion.

Figure A-3 shows that much of the annual precipitation occurs during the growing season. Rainfall, particularly thunderstorms common to the area, causes sheet and rill erosion because it occurs when crops are relatively small and do not provide a protective canopy. Figure A-4 shows that monthly runoff is similar to monthly rainfall. Drainage systems must be able to remove excess precipitation in a timely manner.

GEOLOGIC AND PHYSIOGRAPHIC FEATURES

The geologic formations are of two types, marine and continental deposits. They differ widely in character, origin, and age.

The underlying rocks consist principally of shales and limestones deposited many millions of years ago while the area was beneath shallow seas. These sediments have since changed to hard rock. After the area was uplifted above the sea at the end of the Cretaceous period, the bedrock surface underwent extensive alteration by erosion.

The present surficial features have been developed by several stages of advancement and regression of continental glaciers over the bedrock erosional surface. The last continental glaciation to completely cover the basin was known as the Kansan stage. When the ice receded, the area was covered by a relatively level drift plain and a deep soil developed on the upland surface.

Water and wind erosion have since dissected this plain until only remnants of the original surface remain.

Following this, a layer of wind-blown silt called loess was deposited over most of Iowa. The loess probably had its origin in the floodplain of the Missouri River, although loess derived from floodplains adjacent to interior rivers and streams is present.

At about the same time as the loess deposition, a final stage of glaciation called the Wisconsin covered the northern half of the basin. The glacier advanced to about the present location of Des Moines and is known as the Des Moines Lobe. When it retreated it left behind a drift plain similar to that left after the Kansan.

Figure A-2
AVERAGE TEMPERATURE BY MONTHS FOR IOWA
(Standard Period, 1941-70)

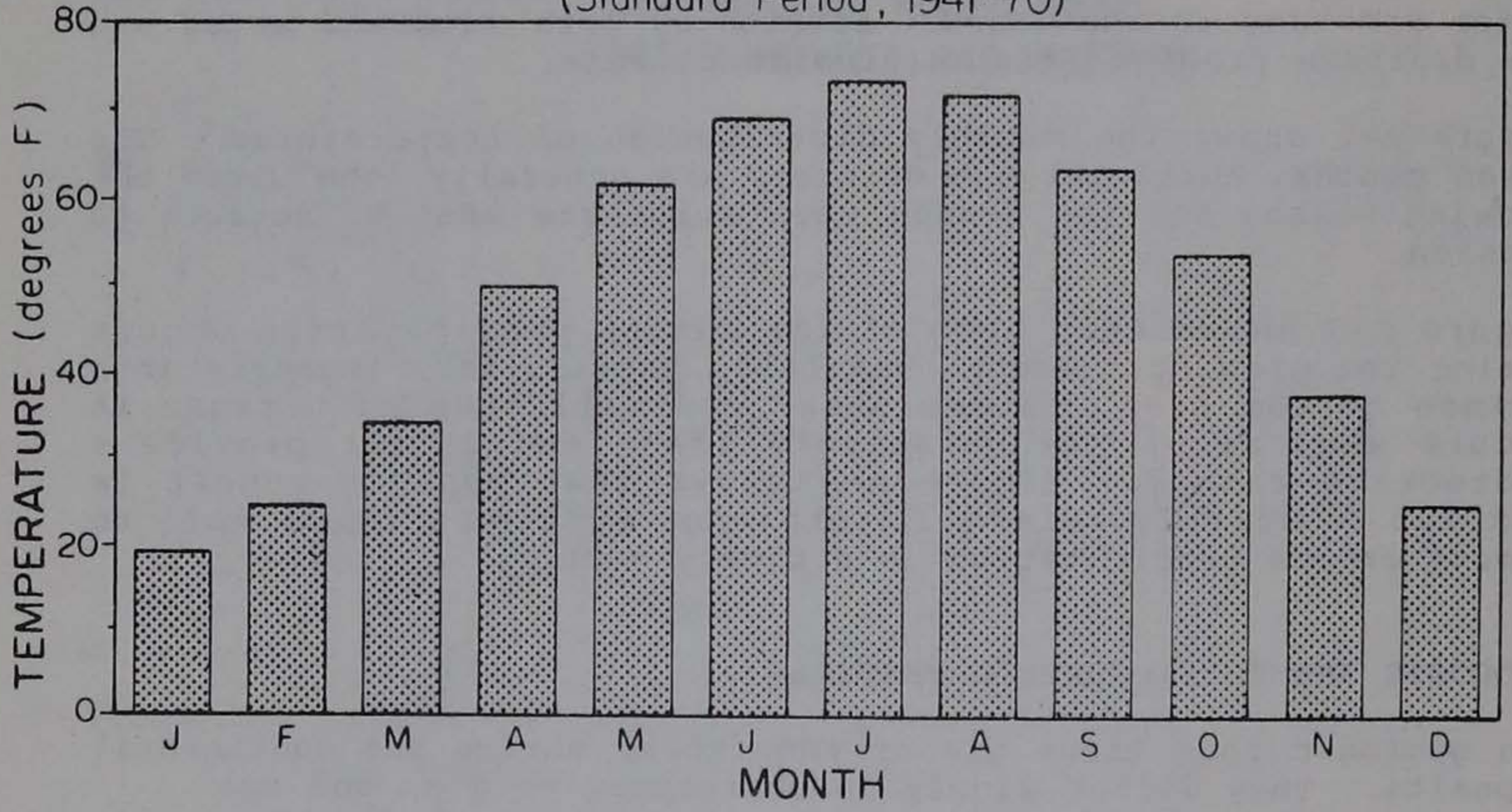


Figure A-3
PRECIPITATION DISTRIBUTION BY MONTHS FOR IOWA
(Standard Period, 1941-70)

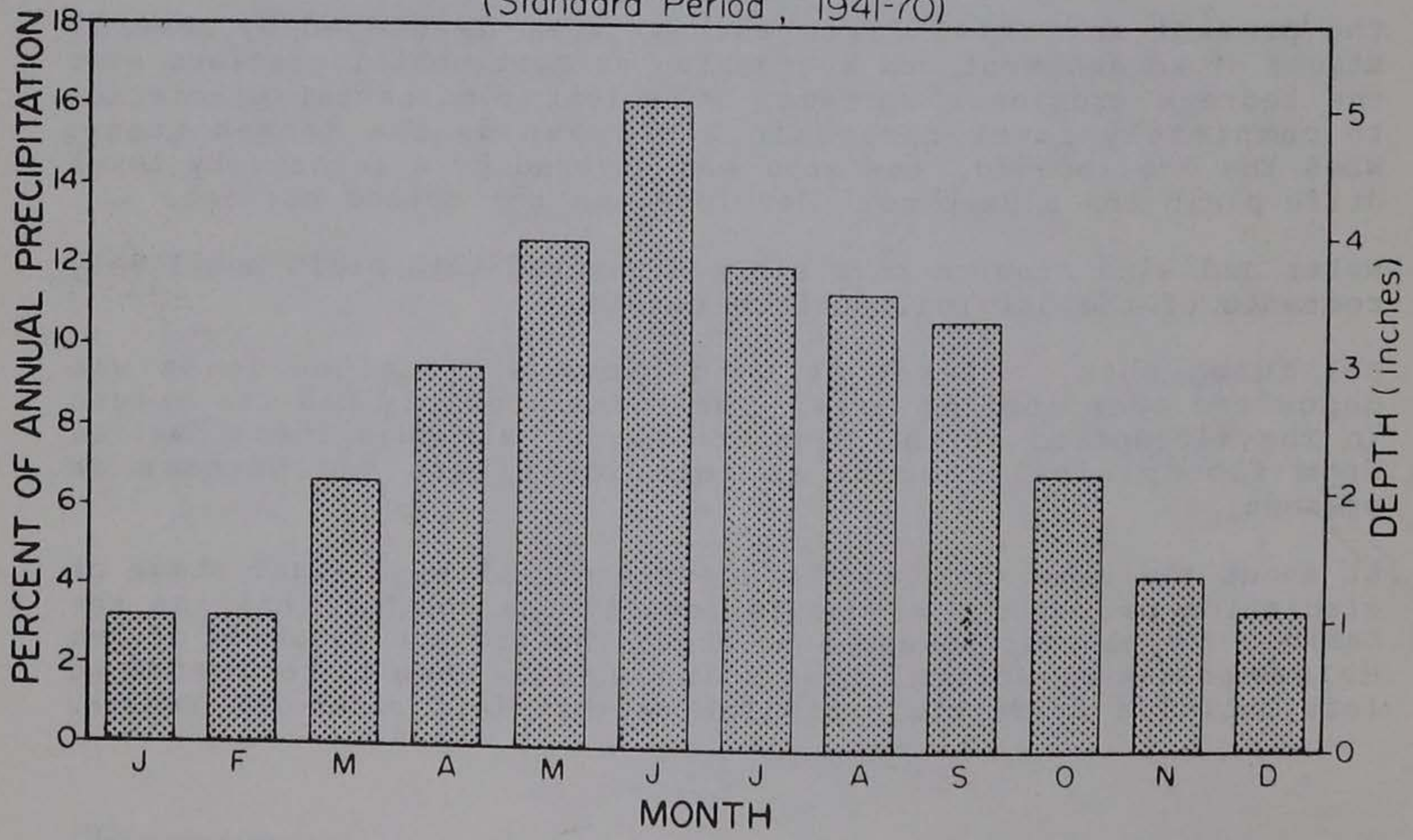
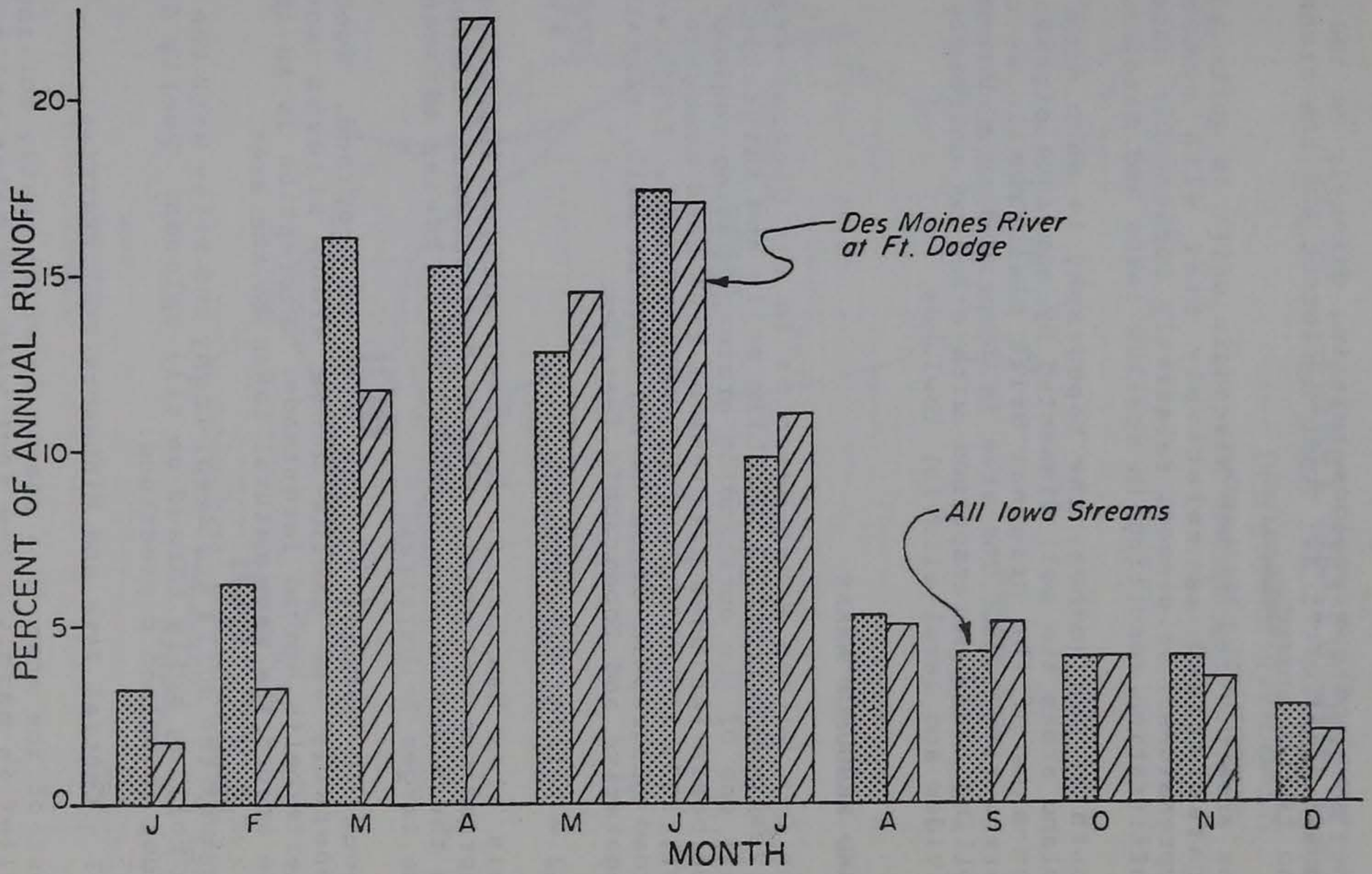


Figure A-4
MONTHLY DISTRIBUTION OF RUNOFF
(Standard Period , 1941-70)



The land surface of Des Moines Lobe however, has undergone little modification since the retreat of the ice sheet.

The two landform regions relating directly to the Wisconsin and Kansan drift areas are quite different and the transition between the two is abrupt.

The area covered by the Wisconsin drift is quite youthful and is characterized as relatively flat with numerous shallow depressions. In places, relatively impermeable materials inhibit infiltration resulting in shallow lakes and marshes.

South of Des Moines, the topography is much more mature. The upland areas are well dissected by numerous streams so that only remnants of the original drift plain remain as comparatively narrow ridgetops. The area is described as moderately to steeply rolling hills interspersed with areas of uniformly level upland divides and level alluvial lowlands.

LAND RESOURCE AREAS

The Des Moines River Basin is in the Central Feed grains and Livestock Region. 1/ Fertile soils and favorable climate make this one of the outstanding grain-producing regions of the world. The basin includes portions of five Land Resource Areas (LRA's) 102, 103, 107, 108, and 109 (Figure A-5). LRA's are defined as broad geographic areas having similar soil, climatic, geologic, vegetative and topographic features.

102 - Rolling Till Prairie

This area has nearly level to rolling topography with many depressions and poorly defined drainageways. Steeper slopes are on the sides of drainageways and in breaks adjacent to some of the larger tributaires.

About 70 percent of the area is cropland. Wooded sections generally are narrow bands along streams and rivers or shelterbelts around farmsteads. Recreation is an important land use around the many natural lakes in the area.

Most of the soils are deep, loamy and silty with the nearly level to rolling soils formed on till uplands. Poorly drained soils occur in upland depressions.

103 - Central Iowa and Minnesota Till Prairies.

Most of the area is a nearly level to gently rolling till plain. Relief is mainly a few feet with the major valleys 100 to 200 feet below the adjoining uplands.

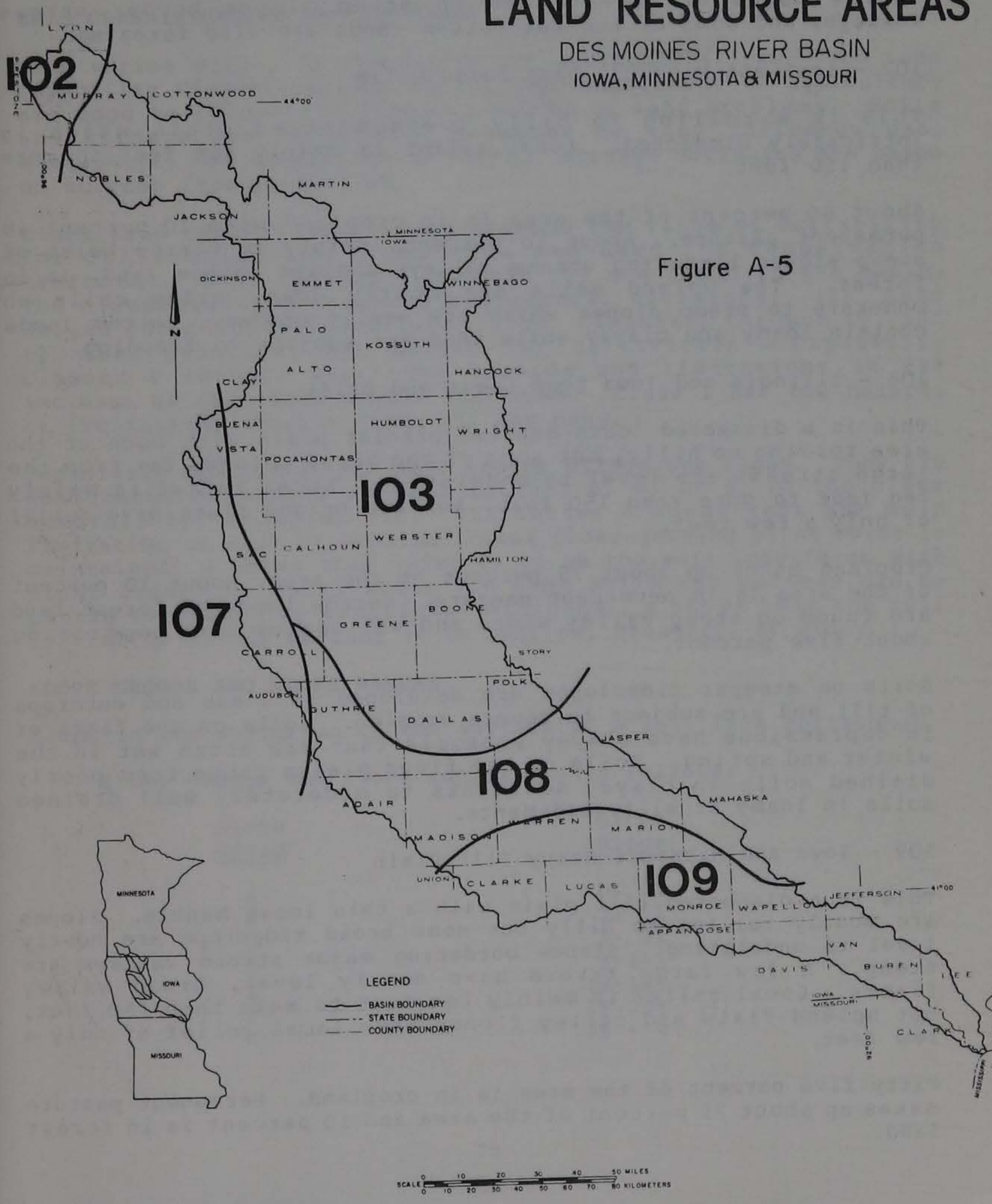
1/ Agriculture Handbook 296, Land Resource Regions and Major Land Resource Areas of the United States, SCS, USDA, 1981.

LAND RESOURCE AREAS

DES MOINES RIVER BASIN

IOWA, MINNESOTA & MISSOURI

Figure A-5



SOURCE
FAMILY OF MAPS, SCS DRWG. NO. S.P. 36,523 (9-78) AND
INFORMATION FROM SCS FIELD PERSONNEL
LAMBERT CONFORMAL CONIC PROJECTION
USDA SCS LINCOLN NEB. 1980

6 20 80
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About 75 percent of the area is in cropland. When used for row crop production, sloping soils need erosion control measures, while nearly level soils require artificial drainage. Permanent pasture accounts for between 10 and 15 percent of the area. Narrow bands of forest land on steep slopes border stream valleys, and some of the wet bottom lands are also forested.

107 - Iowa and Missouri Deep Loess Hills

This is a rolling to hilly loess-mantled plain which is intricately dissected. Local relief is mainly ten feet to more than 150 feet.

About 60 percent of the area is in cropland with 20 percent in permanent pasture. About 10 percent, mainly in narrow belts of steep slopes bordering stream valleys and wet bottom land, is in forest. The upland soils are mostly deep, silty soils on moderate to steep slopes which are easily eroded. Bottom lands contain loamy and clayey soils that are subject to flooding.

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 75 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 bottom land 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.

109 - Iowa and Missouri Heavy Till Plain

This is a dissected till plain with a thin loess mantle. Slopes are mostly rolling to hilly but some broad ridgetops are nearly level to undulating. Slopes bordering major stream valleys are steep. A few large rivers have nearly level, broad valley floors. Local relief is mainly ten feet to more than 150 feet, but upland flats and valley floors have local relief of only a few feet.

Fifty-five percent of the area is in cropland. Permanent pasture makes up about 25 percent of the area and 10 percent is in forest land.

Upland soils are loamy and have pronounced slopes that are subject to severe erosion. Bottom land soils are loamy and clayey and subject to flooding.

SOIL CLASSIFICATION AND SUBCLASS

Land varies widely in capability for agricultural use. The Land Capability Classifications of the U.S. Department of Agriculture are used to illustrate type and degree of land problems. Soils and climate are considered together as they influence use, management, and production on farms. Acreage estimates are based on current interpretations.

Eight land capability classes express the range of suitability for cultivation and other uses and need for conservation treatment. Only Classes I through VII are found in the basin. The classification contains two general divisions: (1) Land suited for cultivation - Capability Classes I through IV, and (2) land generally not suited for cultivation - Capability Classes V through VII. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations whereas Class VII has many.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, or s, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony.

SLOPE GROUPS AND SLOPE RANGES

Slope is the deviation of the surface of a soil from horizontal.

Slope groups and slope ranges are as follows:

Slope Group	Slope Range
A	0- 2%
B	2- 5%
C	5- 9%
D	9-14%
E	14-18%
F	18-25%
G	25 + %

Erosion Phases

Erosion Phase 1 includes those soils only slightly eroded, with topsoil depths over seven inches and no mixing of topsoil and subsoil in the tilled layer. Erosion Phase 2 includes those moderatly eroded soils that have between three and seven inches of remaining topsoil and have some subsoil mixed in the tilled layer. Erosion Phase 3 is severely eroded and has less than three inches of remaining topsoil and the tilled layer is predominantly subsoil material.

TOLERABLE SOIL LOSS LEVEL

This is the amount of soil that can be lost in tons per acre per year and still maintain a high level of productivity over a long period of time.

LAND USE

Cropland is the dominant land use, 6.9 million acres, about 75 percent of the total (Table A-2). Major crop enterprises are corn, soybeans, hay and oats. Land use by state is also shown in Table A-2. Land use by subbasin is shown in Table A-3.

TABLE A-2

LAND USE - STATES

Des Moines River Basin

Land Use	Iowa	Minnesota	Missouri	Total	Percentage
			- - - - - Acres- - - - -		
Cropland	6,103,230	782,890	20,780	6,906,900	75
Pasture	930,450	79,760	8,670	1,018,880	11
Forest	344,480	4,140	7,080	355,700	4
Other	275,770	40,560	530	316,860	3
Urban, Roads and Railroads	432,300	43,020	1,260	476,580	5
Federal	55,720	1,910	0	57,630	1
Water	94,880	32,420	3,280	130,580	1
Total	8,236,830	984,700	41,600	9,263,130	100

TABLE A-3

LAND USE - SUBBASIN

Des Moines River Basin

Land Use	SUBBASIN								
	Des Moines						Raccoon		
	Upper West	West	East	Upper	Middle	Lower	North	South	Boone
	Acres								
Cropland	633,750	582,410	731,060	860,730	923,970	780,180	1,336,470	548,040	510,290
Pasture	72,310	27,880	32,180	63,210	296,780	330,640	88,750	88,630	18,500
Forest	2,060	4,770	4,760	41,120	103,850	140,710	23,960	29,640	4,830
Other	33,270	26,190	28,390	27,990	77,500	47,700	39,400	22,750	13,670
Urban, Roads & Railroads	29,210	28,740	33,550	73,140	105,100	58,050	86,310	34,830	27,650
Federal	1,910	0	450	18,390	36,450	430	0	0	0
Water	26,910	11,620	10,170	14,470	20,660	19,010	15,520	7,140	5,080
Total	799,420	681,610	840,560	1,099,050	1,564,310	1,376,720	1,590,410	731,030	580,020

TABLE A-4 (Cont'd)

FOREST LAND BY COUNTY

Des Moines River Basin

County	Commercial 1/ Forest	Non-Commercial Forest	Total
	- - - - - - - - - - - Acres- - - - - - - - - - -		
Minnesota			
Cottonwood	413	16	429
Jackson	1,252	119	1,371
Lyon	110	22	132
Martin	886	49	935
Murray	820	224	1,044
Nobles	226	-	226
Pipestone	8	-	8
Minnesota Sub-total	3,715	430	4,145
Missouri			
Clark	7,022	53	7,075
Basin Total	323,493	32,204	355,697

1/ Commercial forestland is that capable of producing crops of industrial wood.

Based on data provided by the USDA Forest Service, North Central Forest Experiment Station (MO - 1972; IA - 1974; MN - 1977). Forested acreages for those counties only partially within the basin were estimated by multiplying the forest acreage by the percent of the county within the basin.

The remainder of this analysis will deal with the Iowa portion of the basin which comprises 97 percent of the forest land.

Net annual growing stock growth and removals 1/ exceed growth by 25 percent. Most of this excess occurs in the white oak and red oak groups.

1/ Removals are made up of three categories: removals for products, logging residues, and other removals. Other removals include trees removed during cultural operations, such as timber stand improvement; during land clearing for power line and transportation corridors; and as a result of land use conversions.

The basin's wood industry establishments are primary processors -- they purchase timber or logs and produce lumber and other wood products. There is essentially no secondary processing such as the manufacture of furniture. There are 19 sawmills which produce a total of eight to eight and one-half million board feet of lumber annually. 2/

TABLE A-5

NET ANNUAL GROWING STOCK GROWTH AND REMOVALS
BY SPECIES GROUPS - 1973 - IOWA

Des Moines River Basin

Species Group	Growth	Removals
	- - - - 1000 Cubic Feet- - - - - -	
White Oaks	1,742	2,659
Red Oaks	1,171	2,145
Hickory	988	875
Soft Maple	1,452	907
Cottonwood	1,189	827
Elm	341	1,224
Black Walnut	237	136
Others	2,155	2,011
All Species	8,593	10,784

There are seven major species groupings important to the local timber economy; white oaks, red oaks, hickory, soft maple, cottonwood, elm and black walnut. Hard maple, ash, aspen, basswood, black cherry, hackberry, willow, birch, eastern and red cedar and other softwood are minor components of timber production and are combined in the "others" category (Table A-6).

2/ Directory of Sawmills, Veneer Mills, and Pulp Mills in Iowa. 1979 Cooperative Extension Service, Iowa State University.

TABLE A-6

ROUNDWOOD PRODUCTION BY SPECIES GROUP
AND PRODUCT - 1972 - IOWA

Des Moines River Basin

Species Group	Sawlogs	Veneer Logs	Pulpwood	Other Products	All Products
	- - - - - -	-1,000 Cubic Feet-	- - - - - - - - - -		
White Oaks	702	3	1,841	29	291
Red Oaks	840	78	1,854	1/	299
Hickory	114	204	305	12	89
Soft Maple	1,794	6	838	84	450
Cottonwood	3,114	18	851	-	589
Elm	822	72	90	1,367	1,523
Black Walnut	474	276	-	-	125
Others	522	3	1,181	1,214	1,394
All Species	8,382	660	6,960	2,706	4,760

1/ Less than .5

TABLE A-7

ROUNDWOOD PRODUCTION BY PRODUCT
1972 - IOWA

Des Moines River Basin

Product	1000 Cu.Ft.
Saw logs	1,397
Veneer logs	110
Cooperage logs	27
Pulpwood	550
Posts	54
Fuelwood	2,568
Other	54
All Products	4,760

Over 50 percent of the timber harvested is for fuelwood. Sawlogs are the second largest product with approximately 30 percent (Table A-7).

Total annual removals exceed growth by 25 percent. If the timber economy in the basin is to remain stable, removals must be brought down to or below annual growth or else the shortage will have to be imported.

WILDLIFE RESOURCES

Wildlife habitat quality is quantified using a Habitat Suitability Index (HSI). This index evaluates habitat conditions for wildlife species normally occurring in the area. It is directed towards upland and forest land habitats and their associated wildlife species. Wetland habitats are less precisely evaluated by the HSI.

The HSI does not evaluate annual species populations. However, it is based on the assumption that habitat quality governs how many individuals of a species can exist in a given area. Therefore, it is generally true that the greater the HSI, the greater the populations of resident wildlife species.

Pheasant population information from two intensive study areas is shown on Figure A-6. The Winnebago Pheasant Study Area is located at the extreme northeast edge of the basin. It would be representative of the north Iowa wildlife habitat quality region. The Union-Adair Pheasant Study Area is located just southwest of the basin and represents the south Iowa wildlife habitat quality region. These long-term studies show how pheasant populations have declined. The basin HSI values from 1940 to 1980 (Figures 8 and 9) indicate population declines could be expected.

Wildlife species commonly found in the basin are listed on Table A-8. The list is not meant to include all species which occur there. It includes species which are of special interest for recreational uses such as hunting, birdwatching, and trapping. The waterfowl listed are usually present only during spring and fall migration, although some species nest in the remaining wetlands in northern Iowa and Minnesota, and on state waterfowl management units near the major reservoirs. Other species may also be present only during certain times of the year.

TABLE A-8

WILDLIFE SPECIES OF SPECIAL INTEREST

Des Moines River Basin

White-tailed deer	Pintail
Eastern cottontail rabbit	Green-winged teal
Fox squirrel	Blue-winged teal
Gray squirrel	American Wigeon
Red fox	Wood duck
Raccoon	Redhead
Mink	Canvasback
Beaver	Cardinal
Muskrat	American robin
Coyote	Northern oriole
Gray partridge	Common flicker
Ring-necked pheasant	Mourning dove
Bobwhite quail	American goldfinch
Turkey	Eastern bluebird
Canada goose	Great blue heron
Snow goose	Great horned owl
White-fronted goose	Red-tailed hawk
Mallard	Bald eagle
Gadwall	American kestrel

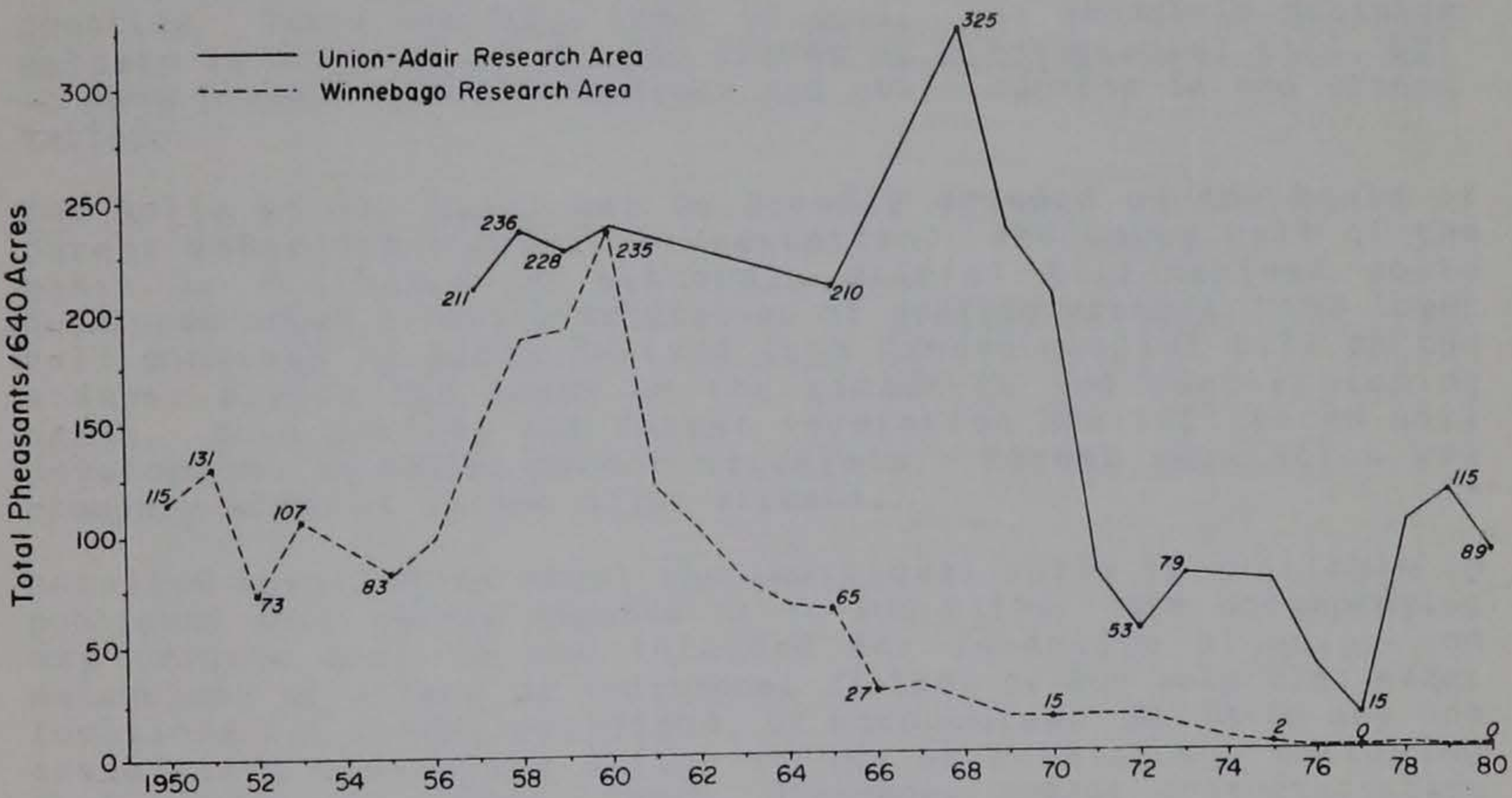

Figure A-6 Total pheasants observed per section during direct winter counts on the Winnebago Research Area (1950-1980) and the Union-Adair Research Area (1957-1980)

Source: Iowa Conservation Commission

APPENDIX B

SOILS

The Des Moines River Basin covers an area that extends from the southwest corner of Minnesota to the southeast corner of Iowa and the northeast corner of Missouri. It includes all or parts of 47 counties. There are many types of soil. The dendritic drainage pattern is controlled in most places by thick glacial till, but in some 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 upper half of the basin is dominated by Wisconsin glacial till-derived soils developed under a native vegetation of prairie grasses. The lower half consists of soils derived from Kansan glacial till on the steeper slopes and loess on the ridgetops and gently sloping areas. Both prairie and forest vegetation has influenced soil development in these parent materials. Forest vegetation was commonly adjacent to the major streams.

Detailed information about the individual soils is available in published soil survey reports or in SCS files. The accompanying map (Figure B-2) 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 fourteen areas and the major soils in each soil association are briefly discussed in the text that follows.

1. Nearly level and gently sloping (0-5%) prairie-derived soils developed in Wisconsin till. Webster, Okoboji, Canisteo, Clarion, Nicollet, and Harps soils.

The soils in this association formed under grass vegetation and occupy about 37 percent of the basin. Relief varies from short irregular slopes on the higher areas to slight depressions in low areas. Surface drainage is not well-developed and runoff water commonly accumulates in some of the lowest areas.

Webster soils are poorly drained and occur in slight depressions, nearly level areas, and narrow drainageways. They typically occupy lower elevations than the Clarion and Nicollet soils. Tile drainage is needed in most areas of Webster soils.

The Okoboji soils are very poorly drained soils and commonly occur in depressions. Surface drainage as well as tile drainage is needed on these soils.

The Canisteo soils are poorly drained and have a high content of lime in all horizons. They occupy similar landscape positions as the Webster soils. Tile drainage is also needed in most areas of Canisteo soils.

The Clarion soils are well drained and occur predominantly on convex slopes. Erosion control practices are recommended on the more sloping Clarion soils.

The Nicollet soils are somewhat poorly drained and occur on slightly convex areas between the higher well drained Clarion soils and the lower poorly drained Webster or Canisteo soils. Depth to high lime parent materials usually ranges between 2.5 and 4.5 feet in both the Clarion and Nicollet soils. Tile drainage is needed in some areas of Nicollet soils.

The Harps soils are poorly drained and have a very high content of lime. They commonly occur as narrow bands adjacent to the Webster and Okoboji soils at slightly higher elevations.

Most of the soils in this association are used for corn and soybeans. The production of crops is good to excellent in most areas. The management need is to control runoff and wind erosion on many of these soils. Conservation tillage, some terraces, contouring, and grassed waterways are needed.

2. Nearly level to strongly sloping (0-14%) prairie-derived soils developed in Wisconsin till. Clarion, Canisteo, Nicollet, Webster, and Storden soils.

The soils in this association formed under grass vegetation and occupy about 19.8 percent of the basin. Relief varies from short irregular slopes on the higher areas to slight depressions in low areas. Surface drainage is not well-developed and runoff water commonly accumulates in some of the lowest areas.

The Clarion soils are well drained and occur predominantly on convex slopes. Erosion control practices are recommended on the more sloping Clarion soils.

The Canisteo soils are poorly drained and have a high content of lime. They occupy similar landscape positions as the Webster soils. Tile drainage is also needed in most areas of Canisteo soils.

The Nicollet soils are somewhat poorly drained and occur on slightly convex areas between the higher well drained Clarion soils and the lower poorly drained Webster or Canisteo soils. Depth to high lime parent materials usually ranges between 2.5 and 4.5 feet in both the Clarion and Nicollet soils. Tile drainage is needed on some areas of Nicollet soils.

Webster soils are poorly drained and occur in slight depressions, nearly level areas, and narrow drainageways. They typically occupy lower elevations than the Clarion and Nicollet soils. Tile drainage is needed in most areas of Webster soils.

The Storden soils are well drained and occur on the steeper convex slopes. These soils have a high content of lime inherent in their parent materials. These soils erode very easily when used for row crops.

Most of the soils in this association are used for corn and soybeans. The production of crops is good in most areas. The management need is to control runoff and wind erosion on many of these soils. Conservation tillage, some terraces, contouring, and grassed waterways are needed.

3. Nearly level and gently sloping (0-5%) prairie-derived soils developed in alluvium. Wadena, Talcot, Flagler, and Saude soils.

The soils in this association formed under grass vegetation and occupy about 2.7 percent of the basin. They occur mostly on stream benches and are underlain with sand and/or gravel.

The Wadena soils are well drained and have calcareous sand and gravel at 32 to 40 inches. These soils occur on both stream benches and glacial outwash areas.

The Talcot soils are poorly drained, calcareous soils formed on stream benches. They are underlain with calcareous sand and gravel at 32 to 40 inches.

The Flagler soils are somewhat excessively drained and occur on stream benches and uplands. They are underlain with sand and gravel at 24 to 36 inches.

The Saude soils are well drained and occur on stream benches and uplands. They are underlain with sand and gravel at 24 to 36 inches.

Most of the soils in this area are used for corn and soybeans except for some of the more droughty areas. These soils are generally low in fertility, have low water-holding capacity, and are subject to erosion by wind. The management need is to control wind erosion and conserve soil moisture. This can be accomplished by using conservation tillage.

4. Nearly level to very steep (0-40%) prairie-derived and some forest- and mixed prairie-forest-derived soils developed in Wisconsin till. Includes some bottomlands and terraces. Storden, Clarion, Hayden, and Lester soils.

The soils in this association formed under various kinds of vegetation and occupy about 4.6 percent of the basin. The very steep upland soils have numerous ravines and gullies cut into them. The contrast in relief between the valley slopes and the narrow drainageways is a distinctive feature of this association.

The Storden soils are well drained and occur on the steeper convex slopes. These soils formed under a native vegetation of grasses. These soils have a high content of lime inherent in their parent materials. These soils erode very easily when used for row crops.

The Clarion soils are well drained and occur predominantly on convex slopes. These soils formed under a native vegetation of grasses. Erosion control practices are recommended on the more sloping Clarion soils.

The Hayden soils are well drained and occur on upland sideslopes that are generally near major streams. These soils formed under a native vegetation of forest. These soils erode very easily when used for row crops.

The Lester soils are well drained and occur on convex upland knolls and ridgetops. These soils formed under a native vegetation of both grasses and trees. These soils erode easily when used for row crops.

The soils in this association are used mostly for corn, soybeans, and hay. In a few areas, the soils are in permanent pasture or wooded pasture. The main concern of management is control of water erosion on the sloping soils.

5. Gently sloping to moderately steep (2-18%) prairie-derived soils developed in loess and outcrops of pre-Wisconsin till. Marshall, Monona, Shelby, and Adair soils.

The soils in this association formed under grass vegetation and occupy about 1.8 percent of the basin. They occur on gently sloping to moderately sloping ridgetops and moderately sloping to moderately steep sideslopes. Numerous small streams dissect this association.

The Marshall and Monona soils are well drained and occur on convex ridgetops and sideslopes. They formed in deep deposits of Wisconsin loess. A relatively high proportion of these soils are used for cultivated crops. These soils erode easily on sloping sites and the surface soil may be partly or completely removed by erosion. Terraces and conservation tillage are recommended erosion control practices.

The Shelby soils are well to moderately well drained and occur on strongly sloping to moderately steep sideslopes. They formed in Kansan glacial till which has been exposed by geologic erosion.

Some of these soils are used for cultivated crops but most are used for hay and pasture. When used for cultivated crops, conservation tillage is commony recommended for erosion control.

Adair soils are moderately well or somewhat poorly drained and occur on moderately and strongly sloping ridgetops and sideslopes. When used for cultivated crops, conservation tillage is recommended for erosion control. In many places, erosion has removed all or most of the surface soil exposing a unique reddish-brown subsoil of clay loam or clay texture.

Most farms are of the general type where some livestock is kept. Corn, soybeans, small grains, and hay are the main crops grown in this association. Controlling sheet and gully erosion is the major management need. Conservation tillage, terracing, contouring, and grassed waterways can be used to control this erosion. Maintaining fertility is also important.

6. Nearly level to moderatly sloping (0-9%) prairie-derived soils developed in loess or pre-Wisconsin till. Sharpsburg, Macksburg, Winterset, and Clarinda soils.

The soils in this association formed under grass vegetation and occupy about 1.3 percent of the basin. They occur on broad upland flats and adjacent convex sideslopes and heads of drainageways. These soils are used mostly for cultivated crops and hay.

The Sharpsburg soils are well to moderately well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess. On sloping sites, the surface soil may be partly or completely removed by erosion. Terraces and conservation tillage are recommended erosion control practices.

The Macksburg soils are somewhat poorly drained and occur near the edge of broad flats and on gently sloping ridgetops. They formed in deep Wisconsin loess and are very productive soils used mostly for corn and soybeans. Tile drainage is needed in some areas of Macksburg soils.

The Winterset soils are poorly drained and occur on the broad upland flats. They formed in deep Wisconsin loess and are among the most productive soils in this association. They are used for corn and soybean production but tile drainage is generally needed for best yields.

The Clarinda soils are poorly drained and occur on sideslopes and heads of drains below the loess-derived soils. They formed in highly weathered glacial till and are difficult to manage because of their clay textured subsoils and low inherent fertility. These soils are very easily eroded and erosion causes very serious degradation of the soils.

A large portion of this association is used for corn and soybean production. In most years, very good yields are harvested from the loess-derived soils, especially on less sloping areas. The more sloping parts of the area are used for hay and pasture. The management need for this association is to control runoff. Conservation tillage, terracing, contouring, and grassed waterways are needed. Tile in waterways is needed in most areas for drainage.

7. Nearly level and gently sloping (0-5%) prairie-derived soils developed in alluvium. Colo, Zook and Nodaway soils. Soils on some adjacent upland slopes include Sparta, Dickinson, Chelsea, and Waukee soils.

The major soils in this association formed under grass vegetation and occupy 3.8 percent of the basin. They occur on the floodplains of the Des Moines River and its tributaries.

The Colo and Zook soils are poorly drained and formed in dark colored alluvium 3 to 4 feet thick. Where these soils are protected from flooding and adequately drained, they are used for corn and soybeans.

The Nodaway soils are moderately well drained and occupy bottomlands near the major stream channels. They formed in recent silty alluvium, and where protected from flooding they are used for production of corn and soybeans.

The minor soils on the adjacent upland slopes formed mostly from sandy parent material deposited by wind from local sources. Most of these soils are droughty and are subject to wind and water erosion. Permanent vegetative cover is very beneficial for these soils.

The soils of this association are very productive for crops where drainage has been established and protection from flooding is provided. Where these soils are unimproved, they are used for pasture and in some cases wildlife habitat. The management need is to control wetness and flooding. Artificial drainage such as tiling, surface drains, and grading are essential for production of crops. Multipurpose dams, diking, and grade stabilization structures are needed in some places to protect against flooding.

8. Gently sloping to moderately steep (2-18%) prairie-derived soils developed in till and Wisconsin aged loess. Shelby, Adair, and Sharpsburg soils.

The soils in this association formed under grass vegetation and occupy about 7.2 percent of the basin. These soils occur on lower ridgetops and sideslopes of the uplands.

The Shelby soils are well to moderately well drained and occur on strongly sloping to moderately steep sideslopes. They formed in Kansan glacial till which has been exposed by geologic erosion. Some of these soils are used for cultivated crops but most are used for hay and pasture. When used for cultivated crops, conservation tillage is commonly recommended for erosion control.

Adair soils are moderately well or somewhat poorly drained and occur on moderately and strongly sloping ridgetops and sideslopes. When used for cultivated crops, conservation tillage is recommended for erosion control. In many places, erosion has removed all or most of the surface soils exposing a unique reddish-brown clay textured subsoil.

The Sharpsburg soils are well to moderately well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess. On sloping sites, the surface soil may be partly or complelely removed by erosion. Terraces and conservation tillage are recommended erosion control practices.

The more sloping areas are used mostly for hay and pasture. Where these soils are used for cultivated crops, there is a need to control runoff with conservation tillage, terracing, contouring, and grassed waterways.

9. Gently sloping to moderately steep (2-18%) prairie and forest-derived soils developed in pre-Wisconsin till and loess. Adair, Shelby, Lindley, Haig, and Grundy soils.

The soils in this association formed under grass or deciduous forest vegetation and occupy about 7.3 percent of the basin. The loess-derived soils occur on the less sloping ridgetops and sideslopes, and the glacial-derived soils are on the lower ridgetops and steeper sideslopes.

Adair soils are moderately well or somewhat poorly drained and occur on moderately and strongly sloping ridgetops and sideslopes. When used for cultivated crops, conservation tillage is recommended for erosion control. In many places, erosion has removed all or most of the surface soil exposing a unique reddish-brown clay textured subsoil.

The Shelby soils are well to moderately well drained and occur on strongly sloping to moderately steep sideslopes. They formed in Kansan glacial till which has been exposed by geologic erosion. Some of these soils are used for cultivatd crops but most are used for hay and pasture. When used for cultivated crops, conservation tillage is commonly recommended for erosion control.

The Lindley soils are well to moderately well drained and occur on the steeper slopes in the association. Most of these soils are used for pasture or remain in forest cover. These soils have low natural fertility and when cultivated, these sloping soils erode easily.

The Haig soils are poorly drained and occur on the broad upland flats. They formed in Wisconsin loess and are among the most productive soils in this association. They are used for corn and soybean production. Open surface drains are beneficial but tile drains are generally not effective.

The Grundy soils are moderately well to somewhat poorly drained and occur on sideslopes and ridgetops adjacent to broad upland flats. They formed in Wisconsin loess and are very productive soils. They are used mostly for corn and soybean production. They developed under a native vegetation of prairie grasses.

The loess-derived soils on the lesser slopes are very productive and are used mostly for corn, soybeans, and hay. The management needs of these soils are to control runoff, which can be done with conservation tillage, terracing, contouring, and grassed waterways. The glacial till-derived soils have low natural fertility and are used mostly for hay and pasture. The management needs of these soils are proper fertilization and establishing improved hay and pasture plantings.

10. Gently sloping to steep (2-25%) forest-derived soils developed in pre-Wisconsin till and loess. Lindley and Weller soils.

The soils in this association formed under deciduous forest vegetation and occupy about 8 percent of the basin. The loess-derived soils occur on the less sloping ridgetops and sideslopes and the glacial-derived soils are on the lower ridgetops and steeper sideslopes.

The Lindley soils are well to moderately well drained and occur on the steeper slopes in the association. Most of these soils are used for pasture or remain in forest cover. These soils have low natural fertility, and when cultivated these sloping soils erode easily.

The Weller soils are moderately well drained and occur on convex ridgetops. In some places, these loess-derived soils are used for corn or soybeans, but more commonly they are used for hay or pasture. The inherent fertility of these soils is low, and when used for cultivated crops they erode easily.

The management needs of the loess-derived soils used for cultivated crops are proper fertilization and use of conservation practices such as conservation tillage, terracing, contouring, and grassed waterways.

The management needs of the glacial-derived soils used for pasture or hay are proper fertilization and establishing improved hay and pasture plantings.

11. Gently sloping to very steep (2-30%) forest-derived soils developed in pre-Wisconsin till and loess. Lindley, Keswick, and Clinton soils.

The soils in this association formed under deciduous forest vegetation and occupy about 2.3 percent of the basin. The loess-derived soils occur on the less sloping ridgetops and sideslopes and the glacial-derived soils are on the lower ridgetops and steeper sideslopes.

The Lindley soils are well to moderately well drained and occur on the steeper slopes in the association. Most of these soils are used for pasture or remain in forest cover. These soils have low natural fertility and when cultivated these sloping soils erode easily.

The Keswick soils are moderately well to somewhat poorly drained and occur on lower ridgetops and sideslopes in uplands. In many places, these soils are used for hay or pasture. Other areas remain in forest. They are very low in natural fertility. In some cultivated areas, erosion has removed the surface layer exposing a reddish-brown clay textured subsoil.

The Clinton soils are moderately well drained and occur on convex ridgetops. In some places, these loess-derived soils are used for corn or soybeans but more commonly they are used for hay or pasture. The inherent fertility of these soils is low and when used for cultivated crops, they erode easily.

The management needs of the loess-derived soils used for cultivated crops are proper fertilization and use of conservation practices such as conservation tillage, terracing, contouring, and grassed waterways.

The management needs of the glacial-derived soils used for pasture or hay are proper fertilization and establishing improved hay and pasture plantings.

12. Nearly level to sloping (0-14%) prairie and forest-derived soils developed in loess and pre-Wisconsin till. Otley, Mahaska, Taintor, Ladoga, Clinton, and Adair soils.

The soils in this association formed under grass and/or forest vegetation and occupy about 1.4 percent of the basin. They occur on broad upland flats and adjacent convex sideslopes and heads of drainageways. These soils are used mostly for cultivated crops and hay.

The Otley soils are well to moderately well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess. On sloping sites, the surface soil may be partly or completely removed by erosion. Terraces and conservation tillage are recommended erosion control practices.

The Mahaska soils are somewhat poorly drained and occur near the edge of broad flats and on gently sloping ridgetops. They formed in deep Wisconsin loess and are very productive soils used mostly for corn and soybeans. Tile drainage is needed in some areas of Mahaska soils.

The Taintor soils are poorly drained and occur on broad upland flats. They formed in deep Wisconsin loess and are among the most productive soils in this association. They are used for corn and soybean production, but tile drainage is generally needed for best yields.

The Ladoga soils are moderately well drained and occur on convex ridgetops and sideslopes. These soils formed in deep Wisconsin loess under a mixed native vegetation of grass and trees. In many places, they are used for corn, soybeans, or hay.

The Clinton soils are moderately well drained and occur on convex ridgetops. In some places, these loess-derived soils are used for corn or soybeans but more commonly they are used for hay or pasture. The inherent fertility of these soils is low and when used for cultivated crops they erode easily.

The Adair soils are moderately well or somewhat poorly drained and occur on moderately and strongly sloping ridgetops and sideslopes. When used for cultivated crops, conservation tillage is recommended for erosion control. In many places, erosion has removed all or most of the surface soil exposing a unique reddish-brown clay loam or clay textured subsoil.

A large portion of this association is used for corn and soybean production. In most years, very good yields are harvested from the loess-derived soils, especially on less sloping areas. The more sloping parts of the area are used for hay and pasture. The management need for this association is to control runoff. Conservation tillage, terracing, contouring, and grassed waterways are needed. Tile in waterways is needed in most areas for drainage.

13. Gently to strongly sloping (2-14%) prairie and forest-derived soils developed in loess and pre-Wisconsin till. Grundy, Pershing, Weller, Keswick, and Lindley soils.

The soils in this association formed under grass and/or deciduous forest vegetation and occupy about 1.5 percent of the basin. The loess-derived soils occur on the less sloping ridgetops and sideslopes and the glacial-derived soils are on the lower ridgetops and steeper sideslopes.

The Grundy soils are moderately well to somewhat poorly drained and occur on sideslopes and ridgetops adjacent to upland flats. They formed in Wisconsin loess and are very productive soils. They are used mostly for corn and soybeans. They developed under a native vegetation of prairie grasses.

The Pershing soils are moderately well to somewhat poorly drained and occur on convex ridgetops and sideslopes. These soils formed in loess under a native vegetation of both grass and trees. They are commonly used for corn, soybeans, and hay.

The Weller soils are moderately well drained and occur on convex ridgetops. In some places these loess-derived soils are used for corn or soybeans, but more commonly they are used for hay or pasture. The inherent fertility of these soils is low and when used for cultivated crops they erode easily.

The Keswick soils are moderately well to somewhat poorly drained and occur on lower ridgetops and sideslopes in uplands. In many places, these soils are used for hay or pasture. Other areas remain in forest. They are very low in natural fertility. In some cultivated areas, erosion has removed the surface layer exposing a reddish clayey subsoil.

The Lindley soils are well to moderately well drained and occur on the steeper slopes in the association. Most of these soils are used for pasture or remain in forest cover. These soils have low natural fertility, and when cultivated these sloping soils erode easily.

The management needs of the loess-derived soils used for cultivated crops are proper fertilization and use of conservation practices such as conservation tillage, terracing, contouring, and grassed waterways.

The management needs of the glacial-derived soils used for pasture or hay are proper fertilization and establishing improved hay and pasture plantings.

14. Gently to moderately steep (2-18%) prairie and forest-derived soils developed in loess and pre-Wisconsin till. Otley, Clinton, Tama, Downs, Fayette, and Lindley soils.

The soils in this association formed under grass and/or deciduous forest vegetation and occupy about 1.2 percent of the basin. The loess-derived soils occur on the less sloping ridgetops and sideslopes and the glacial-derived soils are on the lower ridgetops and steeper sideslopes.

The Otley soils are well to moderately well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess. On sloping sites, the surface soil may be partly or completely removed by erosion. Terraces and conservation tillage are recommended erosion control practices.

The Clinton soils are moderately well drained and occur on convex ridgetops. In some places, these loess-derived soils are used for corn or soybeans but more commonly they are used for hay or pasture. The inherent fertility of these soils is low and when used for cultivated crops they erode easily.

The Tama and Downs soils are well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess and are very productive soils used mostly for corn and soybeans. When used for cultivated crops on sloping sites, the surface soil may be partly or completely removed by erosion.

The Fayette soils are well drained and occur on convex sideslopes and ridgetops. They formed in deep Wisconsin loess and are fairly productive soils used mostly for corn, soybeans, and hay. When used for cultivated crops on sloping sites, the surface soil may be partly or completely removed by erosion.

The Lindley soils are well to moderately well drained and occur on the steeper slopes in the association. Most of these soils are used for pasture or remain in forest cover. These soils have low natural fertility, and when cultivated these sloping soils erode easily.

The management needs of the loess-derived soils used for cultivated crops are proper fertilization and use of conservation practices such as conservation tillage, terracing, contouring, and grassed waterways.

The management needs of the glacial-derived soils used for pasture or hay are proper fertilization and establishing improved hay and pasture plantings.

APPENDIX C

REPRESENTATIVE FARMS

The representative farm study is an evaluation of how the increasing cost of erosion over a 25-year period impacts income. It is an evaluation of the costs resulting from reduced productivity, increased fertilizer and increased fuel costs. A goal of this study is to estimate the economic effect that current levels of soil erosion, if continued, will have on the projected income of representative farms in the Des Moines River Basin in the next 25 years. The representative farm can also be used to calculate and display the historic and projected future income lost because of soil resource depletion.

A representative farm was selected for each of 14 soil association groups in the Des Moines River Basin. The actual 160-acre tracts selected to be representative have a typical mix of soil mapping units, land use, and current conservation practices.

It is important to be able to visualize the relationship and proportion of steep erosive soils with other soils on the landscape. Representative farms graphically display the mix of soil mapping units and the relationship of land use for each of the 14 soil association groups.

Data in the report compares the cost of controlling excessive erosion. The data is a comparison of the total annual costs for a 25-year period for the cropland in each of the representative farms. A copy of the special report can be obtained from the Soil Conservation Service, Des Moines, Iowa.

APPENDIX D

SOIL DEPLETION

WHY THE STUDY WAS MADE

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 Des Moines River Basin by the year 2020.

SUMMARY

The annual cost of soil resource depletion in the Iowa portion of the basin will increase $12.3 million from 1976 to 2020, an increase of $280,000 annually. The soil resource depletion up to 1976 is estimated at $26.5 million annually. The present plus projected increased annual depletion will total $38.8 million at the end of the evaluation period.

While the ability to produce continues to increase because of increasing technology, it has declined significantly from its original potential because of soil resource depletion. The soil resource depletion loss (12.3 million) from 1976 to 2020 is estimated to increase $10 million in yield loss, $1.9 million in increased fertilizer costs, and $0.4 million in increased fuel costs.

The following procedure demonstrates a method for using the depletion concept. For further details on the depletion study see the Soil Depletion Report, Des Moines River Basin Study. A copy of the report can be obtained from the Soil Conservation Service, Des Moines, Iowa.

A DEPLETION EVALUATION PROCEDURE

General

This procedure is for estimating the impact of continued excess erosion on the productivity of agricultural soils that are tilled. It is intended as a tool for conservation planners to demonstrate the costs of not controlling erosion.

The costs of depletion are related to the present and projected future topsoil depth as it relates to yields, fuel required for tillage, and the change in fertilizer requirements.

Topsoil Depth

The first step in evaluating the impact of future erosion is to determine the present depth of topsoil. Table D-3 presents the average topsoil depth of various soils by slope group for the slightly eroded phase. Blanks are shown where the data is not applicable. For example, some soils occur only in some slope groups and not in others, i.e., bottomland soils are not mapped with steep slopes. For planning, the actual topsoil depth in the field should be used. The definition of slight, moderate, and severe erosion is in the depletion report.

Fuel

Fuel requirements for tillage for an average farming operation using combinations of tillage systems is estimated at 6.0 gallons per acre per year in the example. The actual fuel use for a specific operator should be used where available. The percentage increase for some indicator soils is shown in Table D-3. If the soil being used in planning is not listed, select a similar soil from the table and use the increases shown.

Changes in Corn Yields

The incremental changes in yield associated with a change in erosion phase shown in Table D-4 were taken from the Iowa Conservation-9 Form where available. Where data was not available, estimates of incremental yield changes were made by using the increments that were available and the judgement of experienced technicians.

Fertilizer

Soil depletion reduces the amount of crop nutrients in the root zone which in turn decreases the amount of nutrients available to plants. Soils vary in their response to fertilizer inputs as erosion occurs. The data in Table D-1 indicates the additional fertilizer inputs needed to keep management at recommended levels.

TABLE D-1

ADDITIONAL FERTILIZER REQUIREMENTS

Des Moines River Basin

	Erosion Phase Change	
	Slight to Moderate	Moderate to Severe
	- - - - - -Pounds- - - - - - - -	
Nitrogen, N	10	30
Phosphate, P_2O_5		
Prairie Soils	3	3
Mixed Prairie & Timber Soils	1	2
Timber Soils	0	0
Potash, K_2O	5	10

Prices

Prices used are shown in Table D-2. These values were used for computing the economic cost of depletion shown in the tables.

TABLE D-2

UNIT PRICES FOR COMPUTATIONS

Des Moines River Basin

Item	Price/Unit
Corn	$2.58 / bu.
Nitrogen	0.14 / lb.
Phosphate	0.26 / lb.
Potash	0.13 / lb.
Diesel Fuel	1.15 / gal.

For a specific management situation, different prices could be used. The prices in Table D-2 are presented as examples.

Table D-5 is a summary of the average cost of depletion by slope group and change in erosion phase. It includes the cost of reduced yields, increased fertilizer and additional fuel. The unit costs shown in Table D-2 were used to develop Table D-5.

TABLE D-3

TOPSOIL DEPTH AND FUEL INCREASES
BY
SOIL SERIES

Des Moines River Basin

Soil Name	Map No.	Typical Top Soil Depth For Slightly Eroded Units by Slope Group				Additional Fuel Required by Erosion Phase Change	
		B	C	D	E	Slight to Moderate	Moderate to Severe
		-Inches-				Percent	
Shelby	24	14	12	11	10	16.7	14.3
Storden	62	9	8	8	--	9.1	0.0
Lindley	65	--	8	8	8	16.7	14.3
Clearfield	69	--	14	12	--	23.1	12.5
Ladoga	76	10	10	8	--	16.7	14.3
Pershing	131	10	9	8	--	36.4	20.0
Weller	132	10	8	8	--	36.4	20.0
Clarion	138	14	12	11	10	9.1	0.0
Downs	162	9	9	8	--	10.0	9.1
Hayden	168	9	9	8	--	8.3	0.0
Gara	179	--	9	8	--	16.7	14.3
Adair	192	--	12	11	10	25.0	26.7
Lester	236	9	9	8	--	8.3	0.0
Gosport	313	--	--	--	--	23.1	18.8
Grundy	364	14	12	--	--	25.0	20.0
Sharpsburg	370	14	11	11	10	7.7	14.3
Keswick	425	--	9	8	--	25.0	26.7
Lamoni	822	--	12	11	10	23.1	18.8

TABLE D-4

YIELD DECREASES & SOIL DENSITY
BY
SOIL SERIES

Des Moines River Basin

Name	Map No.	Decrease in Corn Yield for Erosion Phase Changes by Slope Groups 1/								Density
		B-B2	B2-B3	C-C2	C2-C3	D-D2	D2-D3	E-E2	E2-E3	
		- - - - - - - - - - - - - - - - -Bushels- - - - - - - - - - - - - - - - -								Tons/Ac. In.
Shelby	24	3	8	3	8	3	8	3	8	171
Storden	62	3	5	3	5	3	5	--	--	158
Lindley	65	--	--	8	10	8	10	8	10	147
Clearfield	69	--	--	3	9	3	10	--	--	152
Ladoga	76	3	9	3	9	3	9	--	--	147
Pershing	131	4	7	5	9	5	9	--	--	152
Weller	132	5	9	5	9	4	8	--	--	158
Clarion	138	3	4	3	4	3	4	3	4	158
Downs	162	3	8	3	8	3	8	--	--	142
Hayden	168	3	4	3	4	3	4	--	--	171
Gara	179	--	--	3	9	3	9	3	9	171
Adair	192	--	--	8	10	8	10	8	10	163
Lester	236	3	4	3	4	3	4	--	--	152
Gosport	313	--	--	--	12	--	14	--	15	158
Grundy	364	4	7	5	9	--	--	--	--	158
Sharpsburg	370	3	6	3	6	3	6	3	6	147
Keswick	425	--	--	8	11	8	11	8	12	167
Lamoni	822	--	--	5	10	5	10	5	11	161

1/ For Shelby soils a 3 under the B-B2 Column shows that on a B slope a yield decrease of 3 bushels per acre per year can be expected as the soil depletes from Erosion Phase 1 to Erosion Phase 2.

TABLE D-5

TOTAL DEPLETION COSTS
BY
SOIL SERIES

Des Moines River Basin

Name	Map No.	Per Acre - Cost of Depletion by Slope Group and Change in Erosion Phase B-B2	B2-B3	C-C2	C2-C3	D-D2	D2-D3	E-E2	E2-E3
		-Dollars-							
Shelby	24	11.72	27.91	11.72	27.91	11.72	27.91	11.72	27.91
Storden	62	11.20	19.18	11.20	19.18	11.20	19.18	---	---
Lindley	65	---	---	23.84	32.29	23.84	32.29	23.84	32.29
Clearfield	69	---	---	12.16	30.36	12.16	32.94	---	---
Ladoga	76	11.20	30.23	11.20	30.23	11.20	30.23	---	---
Pershing	131	15.14	25.46	17.72	30.62	17.72	30.62	---	---
Weller	132	17.46	30.10	17.46	30.10	14.88	27.52	---	---
Clarion	138	11.20	16.60	11.20	16.60	11.20	16.60	11.20	16.60
Downs	162	10.74	27.29	10.74	27.29	10.74	27.29	---	---
Hayden	168	10.36	15.82	10.36	15.82	10.36	15.82	---	---
Gara	179	---	---	11.20	30.23	11.20	30.23	11.20	30.23
Adair	192	---	---	25.20	33.92	25.20	33.92	25.20	33.92
Lester	236	10.62	16.34	10.62	16.34	10.62	16.34	---	---
Gosport	313	---	---	---	37.75	---	42.92	---	45.50
Grundy	364	14.88	25.72	17.46	30.88	---	---	---	---
Sharpsburg	370	11.10	22.75	11.10	22.75	11.10	22.75	11.10	22.75
Keswick	425	---	---	24.42	35.72	24.42	35.72	24.42	38.30
Lamoni	822	---	---	17.32	33.38	17.32	33.38	17.32	33.38

Example Calculation

The example illustrates the depletion procedure on an Adair soil as it changes from moderately eroded to severely eroded. On a moderately eroded mapping unit the topsoil depth varies from 7 inches to 3 inches in depth. After 4 inches of erosion the entire mapping unit would be depleted to the severely eroded phase.

(4 inches) (163 tons/Ac.In.) = 652 tons to change erosion phase. If the present erosion rate is 30 Tons/Ac/Yr, then the years needed to completely deplete the mapping unit is 652÷ 30 = 22 years.

COST OF DEPLETION, See Tables D-2 and D-4

Yield Change 10 bu.X $2.58/bu. = $25.80

ADDITIONAL NUTRIENTS - A Prairie Soil, See Tables D-1 and D-2

Nitrogen 30 lbs X $0.14/lb. = $4.20

Phosphate 3 lbs X $0.26/lb. = 0.78

Potassium 10 lbs X $0.13/lb. = 1.30

FUEL - See Table D-3

Additional gallons (6) (0.267) X $1.15/gal. = 1.84

Annual cost of depletion at the end of depletion period = $33.92

The annual increase in the cost of depletion = $33.92÷ 22 = $1.54. The first year cost is $1.54, second year $1.54 + $1.54 or $3.08, third year $3.08 + 1.54 or $4.62, etc.

APPENDIX E

WATER IMPOUNDMENT OPPORTUNITIES

One of the sponsoring organizations' objectives in the Des Moines River Basin was an inventory of potential water storage sites. Local interests cited a need for impoundments for water storage for multiple uses including municipal and regional water supplies, recreation, and flood control.

The SCS was requested to inventory sites that would provide lakes with a minimum surface area of 50 acres and with drainage areas of less than 25 square miles. The Corps of Engineers has prepared an inventory of dam sites with drainage ares in excess of twenty-five square miles. The inventory of 266 potential water impoundment locations (Figure E-1) is included in a special reference report entitled Water Impoundment Opportunities. This report is available from the U.S. Soil Conservation Service in Des Moines, Iowa.

Tables in the reference report list sites by counties with location by section, township and range. Also shown are drainage area, estimated sediment storage needed for a fifty year period, maximum multi-purpose pool surface areas that can be developed.

USGS (United State Geological Survey) topographic maps are available for the area. Location maps and stage-storage curves were developed for each site. The area south of Des Moines has potential for many small sites. Very few sites were inventoried north of Des Moines. No foundation investigations were made for inventoried dam sites. Seepage losses can be extremely high in the northern portion of the basin. Prior to selection of any site for detailed development, intensive on-site geologic, biological, and archeological investigations should be made.

APPENDIX F

PUBLIC PARTICIPATION AND INFORMATION

Two series of public meetings were conducted: the first shortly after the beginning and the second near the end of the study. In the first instance the purpose was to present general information and to solicit direction. At the second series, findings and alternatives were presented.

FIRST SERIES

The first series of public meetings was conducted at Ottumwa, Perry, and Humboldt in Iowa and at Windom, Minnesota. These locations permitted relatively convenient access to the meetings for all residents of the basin. Records of meeting attendance show the number of government and nongovernment employees attending (Table F-1).

TABLE F-1

INITIAL MEETING ATTENDANCE

Des Moines River Basin

Category of Participants	Number Attending by Location				
	Ottumwa	Perry	Humboldt	Windom	Total
	2/22/78	2/23/78	2/21/78	3/9/78	
Public	34	20	37	9	100
Federal Employees	10	11	11	10	42
Gov't non-Federal	9	8	4	1	22
Total	53	39	52	20	164

Meeting Agenda

1. Welcome and Introductions
2. Soil Conservation Committee Work Reviewed
3. River Basin Studies in general and Des Moines River Basin Study in Particular
4. Discussion of Typical Soil and Water Problems - Solutions
5. Local Participation, Questions - Answers
6. Response Sheet

Response Sheet Data

The public was asked to complete response sheets at each of the four regional meetings. These prepared forms gave each respondent opportunity to relate perceived soil and water resource problems in his home area. Questions sought causes for certain resource problems and anticipated results from corrective actions. District conservationists carried response sheets to individuals who wished to participate in problem identification but could not attend so that public opinion from a broader base would be available. A total of 269 response sheet booklets were received. Thirty-two (32) responses - seventeen (17) from Soil Conservation Service field employees and fifteen (15) from a high school agriculture class - were reviewed but data from these were not included in the summarization which follows in Figure F-1. As shown in Table F-2 the occupational and organizational interests include many who are concerned with natural resources.

Response sheet data was summarized by region to indicate the variation in problems across the study area. For example wet cropland soils are a widespread problem in the Humboldt region in northern Iowa but of minor concern in the Ottumwa region in southern Iowa. In addition to direct objective questions the response sheet gave opportunity for subjective comments. A good response was obtained from respondents. Highlights of the comments follow. They are sorted by area of concern.

Erosion and Sedimentation

1. Sense of responsibility for care of resources is lacking.
2. Production pressure to maximize profits is the way of life for most.
3. Farmers do not think they are losing "that much" soil.
4. Conservation has a low return to cost ratio on short term basis.
5. Problem due to apathy and lack of economic incentives.
6. Insufficient and misinformation from state college.
7. Fence row to fence row U.S. farm policy to blame.
8. If there were adequate cost sharing, there would not be enough technical assistance available.
9. Should not have so much intertilled crops.
10. Greed, selfishness, not concerned about future generations.
11. Government does too much cost sharing so that we expect it to do everything for us.
12. More conservation tillage needed.
13. Eighty percent of erosion and pollution problems can be solved by residue and contouring.

Streambank Erosion and Flooding

1. There will be bank erosion anywhere a motor boat is used.
2. Twice the comment was made that some streambank erosion was good for maintaining a channel (probably the thought here applied principally to streams in which vegetation or sedimentation occurs).
3. A large number of streams were cited for these problems.

Wet Cropland Soils

1. Comments from Ottumwa region were derogatory toward drainage. Noted were adverse effects upon wildlife, forests, floods, erosion, and surplus crops. One said drainage lowers productivity which was not explained.
2. In the other three regions improved drainage is desired.

FIGURE F-1
PROBLEM SELECTION

Des Moines River Basin

Rank	Land and/or Water Resource Problem -- Number or Times Selected as One of the Four Most Important by Region and Total
1	Sheet and Rill Erosion oooooooooooooppppppppppppppppppphhhhhhhhhhhwww 96
2	Wind Erosion oooooppppppppppppppppphhhhhhhhhhhhhhhhhwwwwww 91
3	Improper Land Use ooooooooooooppppppppppppppppphhhhhwwww 80
4	Lack of Fish and Wildlife Habitat ooooooooppppppppppphhhhhhhhhhhwwww 67
5	Gully Erosion oooooooooooooppppppppppppphhhhww 66
6	Sedimentation oooooooppppppppppphhhhhwwwwww 58
7	Wet Cropland ooopppppppphhhhhhhhhhhwwwww 51
8	Flooding ooooooopppppppphhhhhwwww 45
9	Low Forage Production on Pastureland ooooooooppppppppphhw 41
10	Streambank Erosion oooooooooopppppppphhww 39
11	Low Quality of Ground Water oooopppppppphhhww 32
12	Low Quality of Surface Water ooooopppphhhhhww 30
13	Inadequate Water Supply oooppppphhw 22
14	Inadequate Outdoor Recreation oopphhhhhw 22
15	Depreciation of and Lack of Woodland ooooooppph 20
16	Lack of Wood Products Market oppw 7

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Legend - Regional Areas
o Ottumwa, IA
p Perry, IA
h Humboldt, IA
w Windom, MN
Each letter symbol represents two selections

TABLE F-2

VOCATIONAL OR AVOCATIONAL INTEREST OF RESPONDENTS

Des Moines River Basin

Organization or Occupation	Region				
	Ottumwa	Perry	Humboldt	Windom	Total
	- - - - - - - - - Number - - - - - - - - -				
Farmer	42	60	41	22	165
County Supervisor (Iowa) County Commissioner (Minn.)	4	-	2	2	8
Lawyer	-	1	-	-	1
Ag Business 1/	2	5	4	2	13
State Conservation Department	5	5	3	1	14
Rural Water Association	-	1	-	-	1
County Conservationist 2/	3	6	9	-	18
Engineer	3	-	1	-	4
League of Women Voters	-	-	1	-	1
City Official	2	1	-	-	3
Izaak Walton League	-	-	2	-	2
University Women	-	-	1	-	1
Realtor	1	-	-	-	1
Extension	1	2	2	-	5
Total	63	81	66	27	237

1/ Includes contractors, bankers, salesmen, life insurance agents, clerks, carpenters, and laborers.

2/ Includes Conservation Board, Natural Resources Council, Agricultural Stabilization and Conservation Service, and Soil Conservation District Commissioners (Iowa) or Supervisor (Minnesota).

3. Reasons for inadequate drainage in addition to those suggested in the questionnaire were:
   a. Elderly landowners.
   b. Pumps will be needed (high costs).
   c. No cost share.
   d. Cost distribution - "People too cheap to spend their own money, all want someone else to foot the bill".
4. Drainage should proceed only as economic conditions allow landowners to do so without government cost share.
5. When the demand for agricultural products reaches more profitable levels owners will improve and drain the land.
6. Need complete watershed plan and interstate cooperation.
7. The regions where wet cropland soils are a major problem reported improved drainage would increase soybean yields from 5 to 8 bushels per acre and corn 13 to 16 bushels per acre.

Lack of Outdoor Recreation

1. Need bike trails and traffic regulations for safety.
2. Need county owned recreation areas.
3. Need archery, skeet, and trap.

Lack of Fish and Wildlife Habitat

1. Not enough area for the hunters.
2. Deer endanger motorcyclist and motorist.
3. Agricultural practices cause loss of habitat.
4. Problems: Woodland conversion to other uses, drainage, monocrop systems, pesticides, outdated noxious weed laws, hunting laws not enforced, poor water quality, poor timber management, winter kill, drought, low water, game preserve areas opened, siltation of waterways, economics of corn and soybeans rule farming.
5. Manage fish in farm ponds.

Inadequate Water Supply

1. Quality problems especially during low flow or ice.
2. Coal mine areas contribute sulphur to water.
3. Rural water systems are needed and are best answer to individual's quality problems.
4. Need deeper wells, sediment and other pollutants are problems, need to reduce drainage into groundwater.
5. One suggested farmers use less fertilizer and chemicals.
6. Need more information on underground water supply.
7. One from Windom said underground water has high iron and sulphate content.
8. At Humboldt, there was concern about irrigation and rural water system pumping from Black Hawk Lake, feared shallow wells of the area will be damaged.
9. Recycle water, use waste water for irrigation.

Depreciation of and Lack of Woodland

1. Farmstead windbreaks need improving.
2. Lack of shelterbelts is a serious problem.
3. Need to preserve the woodlands now in existence.
4. Need more trees for wind erosion control.
5. Some want field windbreaks.
6. Should be no subsidy or tax incentives for land clearing.
7. Long term investment in woodland is not attractive.
8. There is an in-grained attitude to clear land.
9. FmHA pressure on borrowers to "improve land" results in land clearing.
10. Inadequate replanting program.
11. Need tax incentive for woods that are properly managed.
12. There is a place for pastured woodland.
13. Need zoning.

Improper Land Use

1. Land for airport and four-laned highway was a concern.
2. Cropping systems too intensive for the level of conservation practices.
3. Need regulations to prevent or control urban sprawl.
4. Wrong to use prime land for urban and industrial uses.
5. Too much land used for "inner state" roads.
6. Too much or improper fall plowing.
7. Develop a land ethic through education,"soil and water conservation is not high enough priority in most landowner management plans".

Other Problems

1. Need better interstate cooperation where watersheds cross state lines.
2. Need know-how and resources for lake restoration, particularly prairie lakes.
3. Non-farm groups attempting to control agriculture.
4. Terrible weed problem.
5. Lack of coordination among agencies.
6. Siltation in lakes -cost of new lakes is so high and it is expensive to dredge existing lakes.
7. Flooding caused by Red Rock Dam is a problem.
8. Silt buildup at hydro-dam in Ottumwa.
9. Feedlot runoff.
10. Stream straightening.
11. Sewage disposal at river cabins and trailer courts.

Incidental Comments and Suggestions

1. Economic incentives seem necessary to implement new programs.
2. Government programs have to vary across areas.
3. Should prevent state and Corps of Engineers from renting land to others to use for crops.
4. Need highercost share rates, no limits, more money appropriated.
5. Government creates some of our problems, such as eat less meat. Overspending contributes to inflation, farm programs always penalize farmers in a crop rotation.
6. Should develop Des Moines River for barge traffic up to Ottumwa.
7. Allow investment credit in place of cost sharing.
8. Coordinate this study with other studies.
9. Need to recognize values of marshes, meandering streams and woody areas; such values cannot be overlooked or belittled when any alteration of the environment is contemplated.
10. Take 30-50 acres of most 160-acre farms and keep in grass.
11. Need a voice promoting meat products to the American people and beef production especially helps erosion control.
12. Major cost of conservation should be borne by the federal government as the benefits will be for all.

SECOND SERIES

The second series of public meetings were at Humboldt, Adel, and Ottumwa, Iowa. Again these locations allowed relatively easy access to all in the Des Moines River Basin. These meetings were held on three consecutive evenings, October 4, 5, and 6, 1982. Total attendance was 69 of which 34 were state and federal agency personnel.

Meeting Agenda

1. Welcome and Introductions
2. Introductory Remarks
3. Cropland Erosion
4. Pastureland Erosion
5. Forest Land Erosion
6. Loss of Forest Land
7. Gully Erosion
8. Change in Agricultural Land Resource Base
9. Wet Cropland
10. Loss of Wildlife Habitat
11. Closing Comments

Presentation included a review of problems identified in the basin, a summary of surveys and inventories, and alternatives investigated. A discussion period allowed people to express their views.

Information Program

The sponsors and advisors for this basin study met in Des Moines on August 19, 1982. A review of the study and findings was presented. Comments were useful in refining plans for other meetings and for improving the impending publications. Attendance was: 7 - Soil Conservation Service, 2 - Extension Service, 11 - State Agencies, and 2 - Other U.S. Agencies.

Prior to the second series of public meetings an information meeting in Des Moines on September 22, 1982, was conducted by the river basin staff to relate study findings to district conservationists, area conservationists, county extension directors, and area crop specialists. This was used to give a preview of the public meeting presentation to the conservationists and to inform the Extension Service of the Des Moines River Basin study and findings. Comments and suggestions stemming from this presentation were useful in final preparation for the three regional public meetings. Attendance was: 32 - Soil Conservation Service and 5 - Extension Service.

APPENDIX G

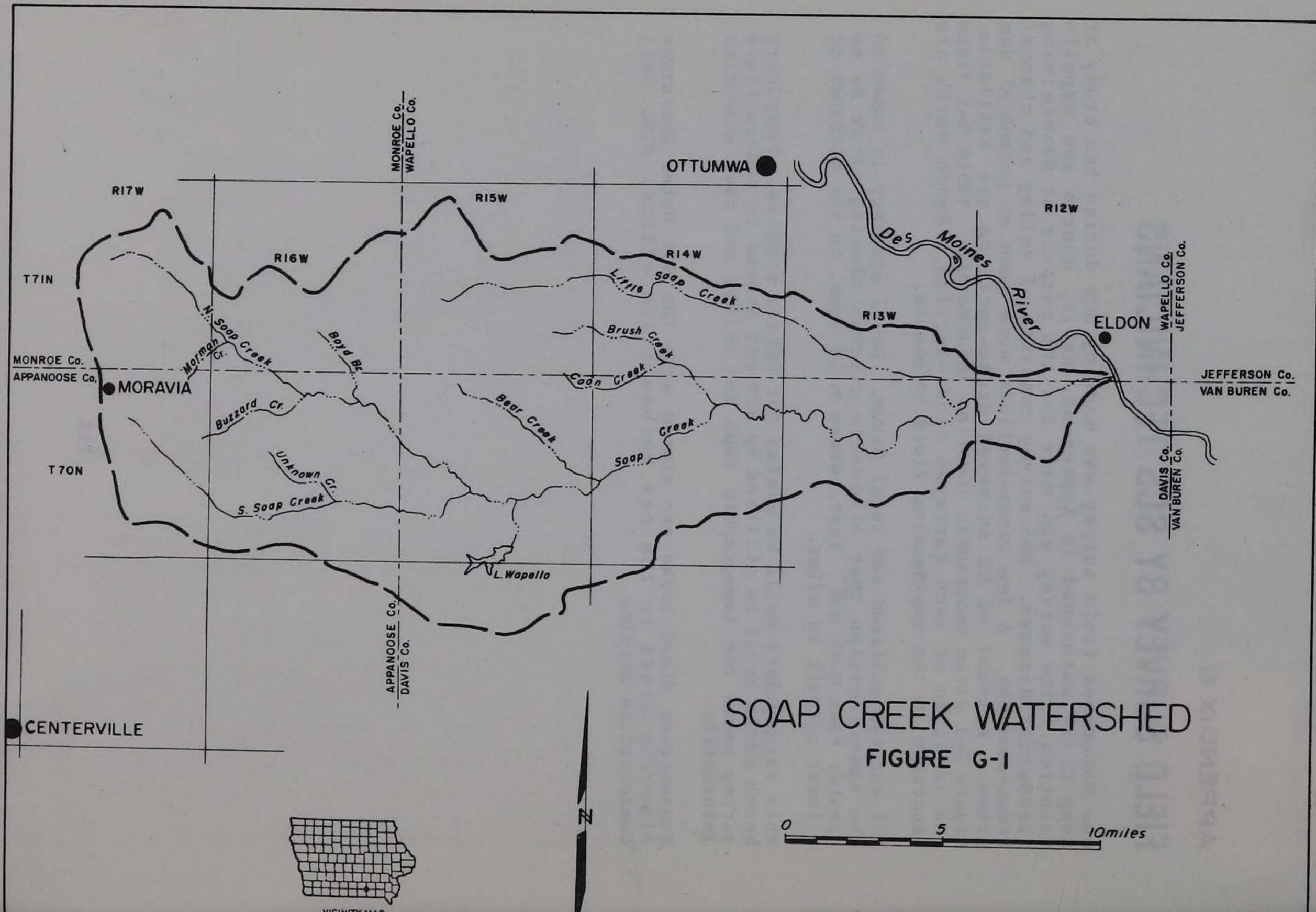
FIELD SURVEY BY SCS TECHNICIANS

One Watershed field survey was made by SCS during the study of Soap Creek Watershed in Appanoose, Davis, Monroe and Wapello Counties. The survey was made for the purpose of determining floodwater damages. The survey consists of valley and channel cross-sections. A few cross-sections were made at potential dam sites. A total of 52 surveyed cross-sections are available. Figure G-1 gives geographic location information. Table G-1 lists the location of each surveyed cross-section. Bench marks are described in the engineering field notebooks.

All surveys utilized sea level datum. Level accuracy is based on the specification that allowable circuit closing error be no greater that 0.07 $\sqrt{M}$ feet, where M is equal to the distance of a level circuit in miles.

This survey data could be useful for future studies. Temporary bench marks could be utilized by SCS and others to reduce field survey costs for topographic maps and bridge and road elevation information.

Engineering field books are stored with the SCS Water Resources Planning Staff in the Des Moines state office, U.S. Soil Conservation Service.



SOAP CREEK WATERSHED

FIGURE G-1

TABLE G-1

SOAP CREEK WATERSHED SURVEYS
Appanoose, Davis, Monroe and Wapello Counties, Iowa

Des Moines River Basin

Field Book Identification	Stream Name	Location			
		Township	Range	Section	1/4 Sec.
S-A	Soap Creek	70-N	13-W	8	NW
S-B	" "	70-N	13-W	15	NW
S-1	" "	70-N	15-W	27	NW
S-2	" "	70-N	14-W	19	NE
S-3	" "	70-N	14-W	2	SW
S-4	" "	70-N	12-W	6	SW
S-5	" "	70-N	12-W	4	NE
LS-A	Little Soap Creek	71-N	14-W	16	SW
LS-B	" " "	71-N	15-W	22	NW
LS-C	" " "	71-N	15-W	20	SE
LS-1	" " "	71-N	14-W	18	SW
LS-2	" " "	71-N	13-W	33	NW
LS-3	" " "	71-N	13-W	35	SE
90-1	" " "	71-N	14-W	24	SW
90-2	" " "	71-N	15-W	23	NE
90-83	" " "	71-N	15-W	20	SW
90-84	" " "	71-N	15-W	19	SE
90-85	" " "	71-N	15-W	19	NE
90-105	" " "	71-N	15-W	16	NW
NS-A	North Soap Creek	71-N	17-W	25	NE
NS-1	" " "	70-N	16-W	3	SE
NS-2	" " "	70-N	16-W	12	NW
NS-3	" " "	70-N	15-W	20	NW
68-1	" " "	71-N	16-W	31	SE
68-9	" " "	71-N	17-W	23	NE
68-48	" " "	71-N	17-W	15	NE
SS-A	South Soap Creek	70-N	17-W	14	SW
SS-1	" " "	70-N	16-W	27	NW
SS-2	" " "	70-N	15-W	30	NE
4-30	" " "	70-N	17-W	24	SE
4-32	" " "	70-N	17-W	36	SE
4-67	" " "	70-N	17-W	14	NW

TABLE G-1 (cont'd)

SOAP CREEK WATERSHED SURVEYS
Appanoose, Davis, Monroe and Wapello Counties, Iowa

Des Moines River Basin

Field Book Identification	Stream Name	Location			
		Township	Range	Section	1/4 Sec.
BR-A	Bear Creek	70-N	15-W	13	SW
BR-B	" "	70-N	15-W	11	SW
BR-C	" "	70-N	15-W	10	NW
26-43	" "	70-N	15-W	4	NE
BY-A	Boyd Branch	71-N	16-W	34	NE
4-29	" "	70-N	16-W	2	NE
68-3	" "	71-N	16-W	28	NE
BS-A	Brush Creek	71-N	14-W	34	SW
BS-B	" "	71-N	14-W	30	SE
BS-C	" "	71-N	15-W	25	NE
BS-D	" "	71-N	15-W	26	SE
90-3	" "	71-N	14-W	32	NE
BU-A	Buzzard Creek	70-N	16-W	8	NE
4-26	" "	70-N	16-W	9	NE
CN-A	Coon Creek	70-N	14-W	5	NW
CN-B	" "	70-N	15-W	1	NE
90-4	" "	71-N	14-W	32	SE
MO-B	Mormon Creek	71-N	17-W	36	NE
UK-A	Unknown Creek	70-N	16-W	21	SE
4-1	" "	70-N	16-W	22	SE

APPENDIX H

ENVIRONMENTAL CORRIDORS

Some stream corridors are more esthetically pleasing than others. Some corridor segments have been drastically altered, others are in native condition. All corridors cannot provide recreational resources of identical quality or quantity. With this concept in mind, a joint effort was undertaken to evaluate environmental corridors. Foresters and biologists of the Iowa Conservation Commission, SCS district conservationists, and county conservation board personnel rated twenty categories of physical, biological, and human use characteristics for each stream draining 10 square miles or more within their county. The rating system used is explained in the Environmental Corridor Reference Report.

The segments of corridor which have a higher rating present a better opportunity for multiple use planning. The resources available for quality recreation, wildlife habitat, and esthetic appeal are more desirable in those segments of the corridors. They are often the only remnants of natural areas in the basin.

Recommendations for establishment, preservation, enhancement, or management of certain segments of corridors can be made. The land use planners, sponsors, and local people of the area must make the decisions concerning any land acquisition or other protective measures. Strategies for corridor preservation are discussed in the Environmental Corridor Report. The report is available from the Soil Conservation Service, Des Moines, Iowa.

Figure H-1 shows the location of environmental corridors in the Iowa portion of the basin.

APPENDIX I

DRAINAGE REPORT

This report was prepared by the Soil Conservation Service and the Economic Research Service at the request of the sponsors of the Des Moines River Basin. Material in the report relates potential for increasing productivity of cropland through improving subsurface and surface drainage in Land Resource Area 103.

Basic data was drawn from soil survey reports, interviews with engineers and soil conservationists well acquainted with the study area, inventories of legal drainage districts' plans of record, and a cooperative study of drainage with Iowa State University.

Excess water is a problem on agricultural land when it interferes with farm operations and plant growth. Results are reduced crop yields, lower crop quality, and increased production costs. The problem stems from high water tables, excess precipitation, snow melt, and seepage.

Many open channel outlets and tile mains were designed and constructed between 1906 and 1925. Frequently, these drains have very inadequate capacity due to design deficiencies, deterioration, or changes in the area drained. Improvements are being installed at a rate that is barely greater than the rate of deterioration.

Obstacles to more rapid installation of drainage improvements were found to be institutional, social, and financial.

The report shows production and financial impacts of bringing drainage status up to standard criteria. Suggestions are presented for a program emphasis to accelerate drainage improvement.

Benefit-Cost comparisons are made with costs calculated at three rates of interest. Financial returns exceed costs at even very high rates of interest.

A copy of the special report can be obtained from the Soil Conservation Service, Des Moines, Iowa.

APPENDIX J

SUMMARY OF RESERVOIR SEDIMENTATION STUDY

The watershed erosion and resulting sedimentation of three lakes was studied as part of the Des Moines River Basin Study. The lakes are Don Williams Lake, Springbrook Lake, and Lake Wapello (Figure J-1). The primary objectives of the study were: estimate the erosion for the small watershed areas above each lake; determine the loss of reservoir storage caused by sedimentation; estimate the sediment delivery ratios for each of the areas; and compare them with generalized data for the three land resource areas involved.

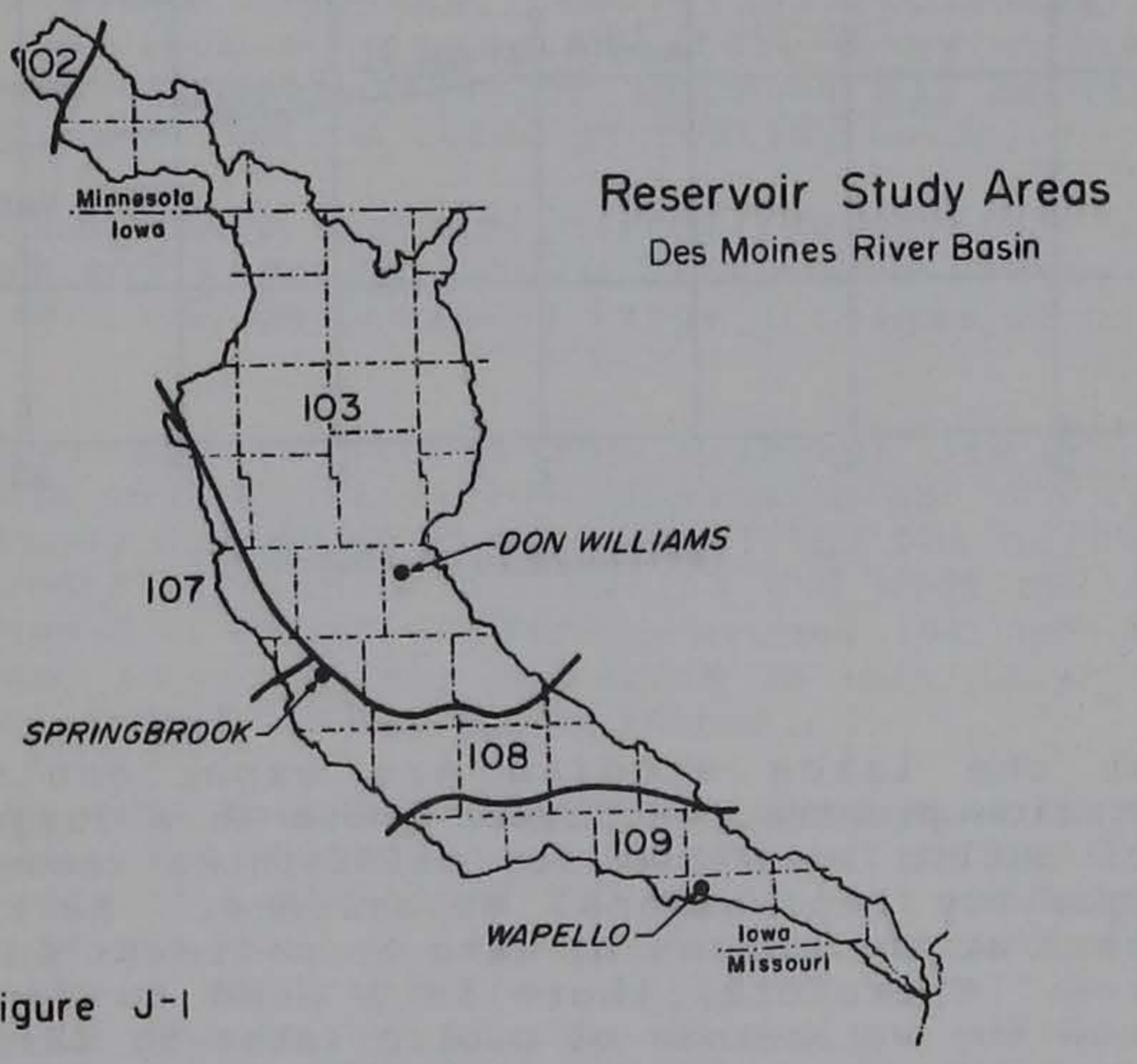
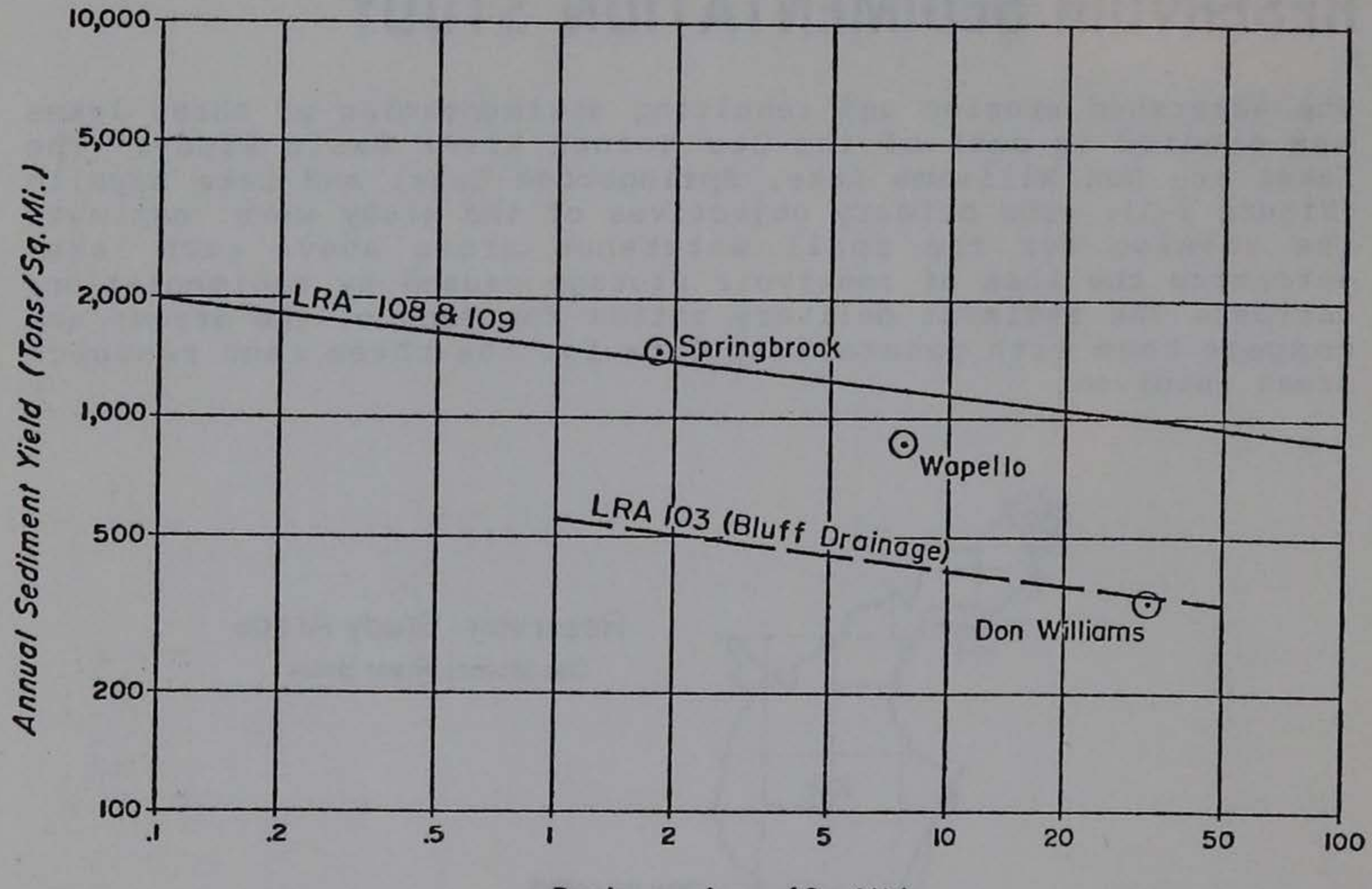


Figure J-1

Sediment yields calculated from these surveys are about the same as those determined during the Upper Mississippi River Comprehensive Basin Study. When the sediment yield for the three lakes is plotted on the sediment yield curves developed during the Upper Mississippi Study (Figure J-2), Springbrook and Don Williams fall very close to the generalized curves. Wapello was a little below its expected yield, however, the sediment caught in the traps was not determined.

Figure J-2

Observed Sediment Yields



None of the lakes studied are experiencing a critical sedimentation problem. However, there is a large commitment in terms of public investment to maintaining reservoir capacities for a quality recreational experience. Recreation quality diminishes at an increasing rate as sediment encroaches on the pool area. Therefore, there is a need to control excessive erosion in the watersheds of public lakes to maintain both their capacities and recreational quality for future use.

Sediment delivery ratios, which averages about 15 percent for the three lakes, can be used as a guide in estimating the effectiveness of additional land treatment measures in reducing sedimentation. For example, a reduction in erosion of 1,000 tons per year would not reduce sedimentation by an equal amount. Since the delivery ratio average is 15 percent, sedimentation would be reduced 150 tons or 15 percent, annually.

For more information on the Reservoir Sedimentation Study see the special reference report entitled Reservoir Sedimentation. This report is available from the U.S. Soil Conservation Service in Des Moines, Iowa.

APPENDIX K

NARROW ROW SOYBEAN STUDY

Intensive agricultural practices have reduced the quality of wildlife habitat throughout the basin. Because wildlife usually provides no economic return to farmers, there is little incentive to maintain or improve habitat. Therefore, it is becoming increasingly important to develop agricultural crops, or methods of producing existing crops, which benefit both landowners and wildlife.

It has been documented in both Iowa and Illinois that pheasants will nest in wide-row soybeans. Narrow-row soybeans (those planted in rows narrower than 20 inches) take about half as long to canopy as wide-row soybeans. Additionally, those in rows narrower than 18 inches are not disturbed by cultivation. Because of these factors, narrow-row soybeans may be attractive to pheasants and other upland birds as nesting cover.

Farmers are planting more acres of narrow-row soybeans annually. Yield advantages and improved herbicides are allowing a rapid change. This trend may be creating large acreages of potential nesting cover.

In order to determine if narrow-row soybeans are acceptable nesting cover, the Iowa Conservation Commission and SCS conducted a cooperative study during 1980 as part of the Des Moines River Basin Study. Several fields of narrow-row and wide-row soybeans in Clarke and Madison Counties were searched for nests. Each field was searched in early July and again in late July. Soybean row widths ranged from 7 inches to 30 inches.

No pheasant nests were found, and only low densities of songbird nests (Table K-1). Estimated pheasant population densities in the study area were 16.4 pheasants/100 acres. It is likely that soybean growth was too slow in 1980 to provide attractive nesting cover. Area farmers reported that soybeans were two to four weeks behind normal due to dry weather in May and hail damage in early June. In addition, abundant alternate nesting cover was available in the area.

TABLE K-1

ESTABLISHED NEST DENSITIES IN NARROW-ROW AND WIDE-ROW SOYBEANS

Des Moines River Basin

	Nests/100 Acres	
Species	Narrow Row	Wide Row
	- - - - -Number- - - - - - - - - -	
Vesper sparrow	1.2	6.4
Dickcissel	2.0	6.4
Mourning dove	1.2	0.0

Narrow-row soybeans probably have their greatest potential as nesting cover for pheasants in an area having good pheasant numbers and limited quantities of traditional nesting cover. Multi-year studies planned to even out weather and population fluctuations are still needed to determine narrow-row soybean values for ground nesting birds.

Additional information concerning the study is available from the Soil Conservation Service, 693 Federal Building, Des Moines, Iowa 50309 and Iowa Conservation Commission, Chariton Research Station, RR #1, Box 209, Chariton, Iowa 50049.