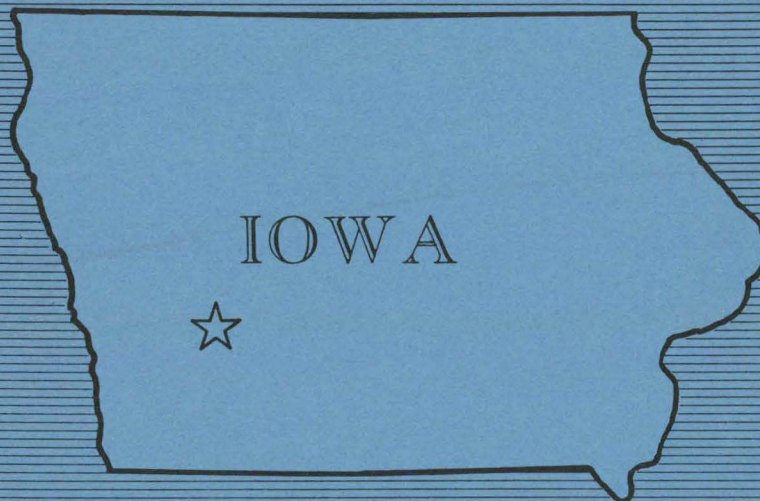


**WORK PLAN**  
**FOR WATERSHED PROTECTION AND FLOOD PREVENTION**

**TROUBLESOME CREEK  
WATERSHED**

**Audubon, Cass, and Guthrie Counties  
Iowa**



U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

HD  
1773  
.A3  
1972





WATERSHED WORK PLAN

WATERSHED WORK PLAN

TROUBLESOME CREEK WATERSHED

Audubon, Cass and Guthrie Counties, Iowa

(83,100 ac. or 129.8 sq. mi.)

Physical Data  
Topography  
Climate  
Biological Data  
Wild and Wildlife Resources Data

WATERSHED PROBLEMS

Water Quality  
Sediment Damage  
Channel Damage

Prepared Under the Authority of the Watershed  
Protection and Flood Prevention Act (Public Law  
566, 83d Congress, 68 Stat. 666) as amended.

Problems  
Sediment  
Channel

PREPARED BY

- Prepared by: Audubon County Soil Conservation District
- Cass County Soil Conservation District
- Guthrie County Soil Conservation District
- Audubon County Board of Supervisors
- Cass County Board of Supervisors
- Guthrie County Board of Supervisors
- Audubon County Conservation Board
- Guthrie County Conservation Board
- State Conservation Commission

WITH ASSISTANCE BY

- U. S. Department of Agriculture, Soil Conservation Service
- U. S. Department of Agriculture, Forest Service

August 1972

APPROVED BY

State Conservation Commission



WATERSHED WORK PLAN AGREEMENT

between the

AUDUBON COUNTY SOIL CONSERVATION DISTRICT  
CASS COUNTY SOIL CONSERVATION DISTRICT  
GUTHRIE COUNTY SOIL CONSERVATION DISTRICT  
AUDUBON COUNTY BOARD OF SUPERVISORS  
CASS COUNTY BOARD OF SUPERVISORS  
GUTHRIE COUNTY BOARD OF SUPERVISORS  
AUDUBON COUNTY CONSERVATION BOARD  
GUTHRIE COUNTY CONSERVATION BOARD  
STATE CONSERVATION COMMISSION

in the State of Iowa

(hereinafter referred to as the Sponsoring Local Organizations)

and the

SOIL CONSERVATION SERVICE  
United States Department of Agriculture  
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Troublesome Creek Watershed, State of Iowa, under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress, 68 Stat. 666) as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Troublesome Creek Watershed, State of Iowa, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in twelve years.



It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. Except as hereinafter provided, the Sponsoring Local Organizations will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost \$534,050). The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Land Rights Cost</u> (Dollars)
Multi-Purpose Str. & Basic Recreational Facilities			
Payment to Landowners for:			
About 323 acres - D-47	50	50	123,560
About 415 acres - D-62	50	50	183,060
Cost of Road Modification			
Structure D-47	50	50	15,000
Structure D-62	50	50	12,000
Legal fees, survey costs, flowage easements and other			
Structure D-47	100	0	3,370
Structure D-62	100	0	9,960
All other structural measures	100	0	181,500
Wildlife Mitigation measures	100	0	5,600

The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.



2. The Sponsoring Local Organizations will provide relocation assistance advisory services, make the relocation payments to displaced persons and otherwise comply the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organizations and the Service as follows:

	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment costs</u> (dollars)
Relocation Payments	26.8	73.2	37,100

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Multi-Purpose Str.			
D-47	11.0	89.0	119,840
D-62	7.8	92.2	134,400
Basic Recreational Fac.			
D-47	50	50	122,120
D-62	50	50	60,700
3 Cooperative Str.			
80-1, 81 & 84	50	50	63,400 <sup>1/</sup>
All other str. measures	0	100	2,010,920
Wildlife Mitigation measures	0	100	15,600

<sup>1/</sup> Non-Project costs for road purposes are included in this value



5. The distribution of estimated costs for engineering services to be borne by the Sponsoring Local Organizations and the Service are as follows:

For structures 80-1, 81 and 84 the engineering services will be based on a division of work. This will be accomplished by assigning engineering services to be performed by the County in equal value to the engineering services performed by the Service. This specific assignment of responsibilities is set forth in detail in the work plan.

For all other structural measures, the percentages of the costs for engineering services to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Cost</u> (dollars)
Multi-Purpose Str.			
D-47	0	100	23,970
D-62	0	100	26,880
Basic Recreational Fac.			
D-47	50	50	24,420
D-62	50	50	12,140
All other structural measures	0	100	402,180

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$34,420 and \$364,440 respectively
7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the Watershed.
10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.



11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.



AUDUBON COUNTY SOIL CONSERVATION DISTRICT  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Audubon County Soil Conservation District adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
(Secretary, Local Organization)

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

CASS COUNTY SOIL CONSERVATION DISTRICT  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Cass County Soil Conservation District adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
(Secretary, Local Organization)

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_



GUTHRIE COUNTY SOIL CONSERVATION DISTRICT  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the Guthrie County Soil Conservation District adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
(Secretary, Local Organization)

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

AUDUBON COUNTY BOARD OF SUPERVISORS  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Audubon County Board of Supervisors, governing body of Audubon County, adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
County Auditor

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_



CASS COUNTY BOARD OF SUPERVISORS  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Cass County Board of Supervisors, governing body of Cass County, adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
County Auditor

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

GUTHRIE COUNTY BOARD OF SUPERVISORS  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Guthrie County Board of Supervisors, governing body of Guthrie County, adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
County Auditor

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_



AUDUBON COUNTY CONSERVATION BOARD  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Audubon County Conservation Board adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
Secretary

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

GUTHRIE COUNTY CONSERVATION BOARD  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the Guthrie County Conservation Board adopted at a meeting held on \_\_\_\_\_ 19\_\_\_\_.

\_\_\_\_\_  
Secretary

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_



STATE CONSERVATION COMMISSION  
Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the State Conservation Commission, adopted at a meeting held on \_\_\_\_\_ 19\_\_.

\_\_\_\_\_  
Director for Commission

Address \_\_\_\_\_

Zip Code

Date \_\_\_\_\_

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

SOIL CONSERVATION SERVICE  
United States Department of Agriculture

By \_\_\_\_\_

Administrator

Date \_\_\_\_\_



## WATERSHED WORK PLAN

### TRoublesome Creek Watershed Audubon, Cass and Guthrie Counties, Iowa

August 1972

#### SUMMARY OF PLAN

##### Participating Organizations

The Work Plan for Troublesome Creek Watershed, Audubon, Cass, and Guthrie Counties, Iowa, was prepared by the Audubon, Cass, and Guthrie County Soil Conservation Districts, hereinafter referred to as the Districts; and the Audubon, Cass, and Guthrie County Boards of Supervisors, hereinafter referred to as the Counties, the Audubon and Guthrie County Conservation Boards, and the State Conservation Commission as joint local sponsoring organizations. Technical assistance was provided by the United States Department of Agriculture, Soil Conservation Service, hereinafter referred to as the Service. The U. S. Forest Service assisted in developing the land treatment phase of the work plan.

##### Description of the Watershed

The Troublesome Creek Watershed is located in the west central part of Iowa. Troublesome Creek flows in a southwesterly direction and outlets into the East Nishnabotna River northwest of the town of Atlantic. There are 83,100 acres or 129.8 square miles within the total drainage area. It is approximately 27 miles long and seven miles wide. The town of Atlantic is located in the watershed.

##### Watershed Problems

Floodwater damage to crops and pasture is a problem on the bottomlands along Troublesome Creek. Excess runoff causes frequent flooding of this area. The average annual agricultural floodwater damages are estimated to be \$61,990. On the average 1,461 acres of the 6,053-acre flood plain are flooded annually.

Gully erosion is a major problem in the upland areas of the watershed and damages land in two principal ways. It destroys land by creating a void where the gully is formed. This voided area then lowers or depreciates the utility of the land adjacent to it by dissection of fields making portions inaccessible. This causes cropland to depreciate to pasture or idle areas. It is estimated that 7,450 acres of land will be damaged during the next 50 years. The average annual gully erosion damage is estimated to be \$187,550 (Table 5).



Local Sponsoring Organizations in two counties have expressed concern over the lack of adequate water-based recreational opportunities. Fishing, boating, swimming, and picnicking areas within reasonable driving distance are of most concern.

#### Planned Works of Improvement

The project for the protection and development of the watershed will be installed during a 12-year project installation period at a total cost of \$4,771,810 (Table 1). The Public Law 566 share is \$3,492,200 and the other or local share is \$1,279,610.

Land treatment measures for erosion control will be installed on most of the cropland areas where sheet erosion is a problem. The land treatment measures to be installed are level and parallel terraces, contouring, grassed waterways, woodland improvement, wildlife habitat development, and conservation cropping systems. The installation cost of these measures is estimated to be \$810,590 of which \$75,930 is for accelerated technical assistance to be provided from P.L. 566 funds (Table 1). The remaining \$734,660 will be borne by the landowners, State funds, and Federal funds provided under authorities other than P.L. 566. Land treatment measures will be maintained by the landowners and/or operators of the farms on which these measures are to be installed in accordance with cooperative agreements entered into with the Districts.

The project includes two multiple purpose structures for flood prevention and recreation with recreational facilities, two floodwater retarding structures, and 135 grade stabilization structures. These structures plus a total of 100 acres of wildlife habitat mitigation plantings will be installed during the 12-year project installation period. The estimated installation costs of these structures are \$3,961,220 (Table 1). Of this amount, P.L. 566 funds will bear \$3,416,270 and other or local funds \$544,950.

Relocation payments of \$37,100 involving five families are included in this project.

Non-project costs of \$43,370 for including roadways in structures located on roads will be borne by Audubon County. These costs are shown in parentheses in Table 2 but are not included in total project costs in Table 1 or in annual costs shown in Table 4.

The structural measures, except those located on roads will be operated and maintained by the Districts and the Counties in which located, using tax revenues available from a county-wide tax on agricultural land. The Audubon County Conservation Board, the Audubon District, and Audubon County will provide maintenance for structure D-47 and the public recreational development. The Guthrie County Conservation Board, the Guthrie District and Guthrie County will provide maintenance for structure D-62 and the public recreational development. The estimated average annual operation, maintenance, and replacement cost is \$21,810 (Table 4).



### Project Benefits

The benefits of the project have important effects on the inhabitants and agricultural land in the watershed. Of the 575 farms in the watershed, benefits from gully erosion will accrue to 350 farms. Floodwater damage reduction benefits to crops and pasture will accrue to 80 farms; these latter farms will also realize benefits from land enhancement.

Water will be stored in the sediment pools of 76 grade stabilization structures. Many of these pools will be stocked with fish by landowners or local groups. Wildlife plantings for food and cover will be made at some of these sites. The pools will provide recreation to local residents in the form of fishing, picnicking, boating, swimming, and hunting. Monetary values of these benefits were not estimated.

The average annual primary and secondary benefits accruing to the structural measures are as follows:

Gully erosion damage reduction	\$151,920
Other agricultural damages	9,140
Non-agricultural damages	17,550
Floodwater damage reduction	29,210
Other agricultural damages	7,960
Changed Land Use	5,910
More intensive use of land	38,070
Indirect damage reduction	23,830
Secondary benefits	18,890
Recreation benefits	73,500
Total	\$375,980

The average annual benefits of the structural measures are \$375,980; the average annual costs for the structural measures are \$255,720 and the benefit-cost ratio is 1.5 to 1.0 (Table 6).

### General

There are 575 farms located entirely or partially within the watershed. To date, owners of 324 farms, 53,483 acres, or 56 percent of the watershed, are cooperating with the Districts installing land treatment measures. Conservation plans have been developed on 223 farms, 38,868 acres, or 39 percent of the watershed. Local landowners and operators have installed land treatment measures valued at \$549,660 (Table 1A).



## DESCRIPTION OF THE WATERSHED

### Physical Data

Location and Size: The watershed is located in the loess soil region in west-central Iowa in Audubon, Cass, and Guthrie Counties. Troublesome Creek, which heads in Guthrie County, flows in a southwesterly direction and enters the East Nishnabotna River just north of Atlantic. The watershed is 83,100 acres in size; of this, 40,600 acres are in Audubon County, 27,800 acres in Cass County, and 14,700 acres in Guthrie County. The drainage area is long and narrow being 27 miles long and seven miles across at its widest point.

Soils: The soils in the watershed are derived from the Wisconsin loessial deposits and the Kansan glacial drift. The watershed is located in an area of soils transition with the major portion in the Marshall soil association area. In general the hilltops are capped with Marshall loess except in the eastern and northeastern portion where the cap is thinner, less rolling Sharpsburg loess. The more severely eroded sloping side hills on the west side of the watershed, the area sloping toward the Nishnabotna River, are generally designated as the Shelby soils. The upland drainageway soils are generally a dark colored alluvial-colluvial complex. The major bottomland soils along the Troublesome Creek floodplain are Nodaway, Kennebec and Colo-Zook with the same type of bottomland soils on the Nishnabotna River floodplain. These soils all have excellent production potentials. Flooding is a problem.

The Marshall soils are dark colored. The surface 30 inches contains about 9 percent sand, 58 percent silt and 33 percent clay. This texture continues about the same to 56 inches and from there on the texture becomes more silty and less clay. These soils are well drained and very productive. The principal management problems are fertility maintenance and erosion prevention. The prevention of sheet and gully erosion are major problems.

The Sharpsburg soils are dark colored. The surface 17 inches contains about three percent sand, 64 percent silt and about 33 percent clay. These soils are moderately well drained and very productive. The principal management problems are fertility maintenance and erosion prevention.

The Shelby soils are till with some dark colored surface soil. The surface 11 inches contains about two percent gravel, 37 percent sand, 30 percent silt and about 31 percent clay. From 11 inches to about 52 inches is found about four percent gravel, 30 percent sand, 30 percent silt and about 36 percent clay. These soils are moderately to very slowly permeable and are subject to severe sheet and gully erosion. Control of erosion and maintenance of fertility are the major soil management problems.



The upland drainageway soils are predominantly Judson. They are similar to but somewhat heavier textured than adjacent soils. The average soil texture to a depth of 54 inches is eight percent sand, 65 percent silt and 27 percent clay. They are very productive but are subject to severe gully erosion.

The bottomland soils along Troublesome Creek as well as on the Nishnabotna River are dark colored, with an average soil texture in the upper 18 to 45 inches of about 9 percent sand, 56 percent silt and 35 percent clay. They are moderately permeable and imperfectly drained. These soils are excellent producers. Flooding is the major problem.

Topography: The topography of the watershed is classed as mature. It is characterized by open terrain, narrow ridges, steep slopes, and narrow valleys on the west side of the watershed, next to the Nishnabotna River. The remainder of Troublesome Creek watershed is characterized by open terrain, low ridges, gentle slopes, and fairly wide shallow valleys. The uplands in the eastern part of the watershed are gently rolling to rolling (2-14 percent slopes). The natural drainage system is well developed. The main drainage of the watershed is southwesterly. The main valley has a slope of about five feet per mile.

Climate: The climate of the watershed is of the extreme mid-continental type. The spring season may fluctuate from extremely wet to fairly dry. Hot winds and periods of prolonged high temperatures are common in the summer months. Precipitation in the area averages 31 inches and snowfall averages 28 inches annually. The average frost-free growing season is about 160 days. Temperature range has been from -38 to +117 degrees.

#### Economic Data

The major farm enterprise in the watershed is the production of cattle and hogs or livestock farming. According to the 1964 U. S. Census of Agriculture, 70 percent of the farms in the counties involved are livestock farms and this is estimated to be representative of the watershed area. Other types of farming are divided among cash grain and dairy farms. The principal crops are corn, soybeans, oats and hay.

There are 575 farms located entirely or partially within the watershed. Approximately 61 percent of the farms are owner-operated. The average size farm is 153 acres. The average value of land and buildings per farm is \$51,549 or \$243 per acre for Audubon County. The estimated current market price of cropland is \$400 per acre on the upland and \$500 per acre on the bottomland in this watershed.

The cities of Council Bluffs, Iowa, and Omaha, Nebraska, located about 50 miles southwest of the watershed, serve as a marketing and distribution center for the area. These two cities have a number of manufacturing plants and Omaha has a large stockyard and several meat processing plants. The town of Atlantic (pop. 7,300) located in the southwest corner of the watershed, has some manufacturing plants and also provides opportunity



for off-farm employment for residents of the watershed. The Agricultural Census of 1964 indicates that about 30 percent of the farms in the three counties involved in the watershed, had off-farm employment. Of this number, 42 percent of them had 100 or more days of off-farm employment.

The number of people living on farms in Audubon County has decreased from 5,752 in 1959 to 5,294 in 1964.

The following table indicates trends in the size of farms. It is noted that family type farms are being maintained in the watershed.

Farm Size	Audubon County <u>1/</u>				Watershed	
	1959		1964		1964	
Acres	No.	%	No.	%	No.	%
Under 10	44	3	47	3	8	1
10-49	93	6	81	6	46	8
50-99	161	11	152	11	63	11
100-219	753	50	557	42	254	44
220-499	419	28	463	34	193	34
500-999	32	2	40	3	11	2
1000+	3	-	8	1	-	-
<b>TOTAL</b>	<b>1,505</b>	<b>100%</b>	<b>1,348</b>	<b>100%</b>	<b>575</b>	<b>100%</b>

1/ Statistical data used is for Audubon County as the major portion of the watershed is located in this county.

Adequate transportation facilities are available to the watershed, Interstate Highway 80 and Iowa Highway 44 traverse the watershed east and west. U. S. Highway 71 passes through the western edge and serves the town of Atlantic. One natural gas pipeline crosses the watershed.

The Audubon County Soil Conservation District was organized March 23, 1942, Cass County Soil Conservation District was organized August 25, 1942, and the Guthrie County Soil Conservation District was organized December 18, 1945. To date, 64 percent, or 53,483 acres of the watershed is under cooperative agreements with the Districts and are installing land treatment measures with assistance from the Soil Conservation Service. Conservation plans have been developed on 47 percent or 38,868 acres of the watershed. Land-owners and operators within the watershed have applied land treatment measures valued at \$549,660 (Table 1A).

Present forest stands occupying the watershed are 68 percent oak-hickory type and 32 percent bottomland hardwood types.



Available markets for walnut saw logs, walnut veneer logs and white oak stave bolts are good. The markets for other local forest products are poor, but improving as indicated by recent market sales.

The Audubon County Park Board owns and manages 60 acres of forest land within the watershed boundaries. The remaining forest land is all private ownership.

Forest fire protection is being provided by local fire departments and the Iowa Conservation Commission, Forestry Section, in cooperation with the U. S. Forest Service through the Clarke-McNary Cooperative Fire Control Program. There are no records of any fires during the past 5 years. The established state-wide fire loss index goal of 0.10 percent is being met. No increase in fire occurrence is expected as a result of the watershed project.

Other available Federal-State forestry programs include Cooperative Forest Management, Cooperative Forestation and Cooperative Insect and Disease Control. Given protection, care and management, the forest areas are expected to increase their contributions to the economy of the watershed.

Productive soils extend throughout the watershed. The bottomland soils are used intensively for row crops. The upland area is used in an average rotation of two years of row crops, one years of oats and one year of meadow. Some of the grassland area will be improved through pasture renovation. Adequate cover will be maintained through controlled grazing.

Approximately one percent (832 acres) of the watershed is in forest cover. It has been determined that the present hydrologic condition of the forest land is fair.

The following table lists the present and planned land use in the watershed:

Land Use	<u>Without Project</u>		<u>With Project</u>	
	%	(Acres)	%	(Acres)
Cropland	78	64,860	77	63,847
Pasture	14	11,611	13	11,100
Forest Land	1	832	1	772
Other	5	3,997 <sup>1/</sup>	7	5,581 <sup>2/</sup>
Urban	2	1,800	2	1,800
<b>Total</b>	<b>100%</b>	<b>83,100</b>	<b>100%</b>	<b>83,100</b>

<sup>1/</sup> Includes 40 acres of water.

<sup>2/</sup> Includes 740 acres of water.



### Fish and Wildlife Resource Data

The fishery of Troublesome Creek Watershed is of minor importance. The stream has only token flow. Carp, bullheads, catfish, and sunfish travel upstream from the East Nishnabotna River during high stream flow; however, this fishery is too transient to be of much value.

About 78 percent of the watershed is cropped and intensively farmed, with suitable permanent wildlife habitat lacking over much of the area. Some of the lands adjoining Troublesome Creek and many of the associated watercourses are wildlife habitat. These areas can not be farmed due to flooding or eroded conditions. Such areas are dominated by annual forbs, shrubs, herbaceous perennials, and trees (maple, box elder, American elm, and cottonwood). Widely interspersed in the watershed are many wooded tracts on hillsides and in ravines which provide suitable deer, squirrel, quail, songbird, and furbearer habitat. Some tracts are grazed considerably; others only occasionally; and some not at all, which markedly influences the numbers of associated wildlife.

The many fence rows on farms, odd corners and areas, wind breaks around farmsteads, grassed waterways, seeded back slopes of the steep back slope terraces additionally serve as food and cover areas.

Some quail and song birds are present, and there are good populations of pheasants, skunks, raccoon, coyote, red fox and cottontail rabbits. Mink, beaver and muskrat are found in nearly all riparian and aquatic habitat. Very little habitat for waterfowl resting, production, or wintering is present.

### WATERSHED PROBLEMS

A major portion of the cropland is in row crops. Sheet erosion is prevalent in the uplands where corrective conservation treatments have not been applied. Needed land treatment measures such as terracing, grassed waterways and contouring are being applied. Some areas will need to receive added emphasis in order to provide for the necessary percentage of land being properly treated above the structural measures to be installed. It is expected that the necessary land treatment measures will be installed during the twelve year installation period.

#### Floodwater Damage

A 100-year frequency flood is estimated to inundate 6,053 acres; a 50-year frequency flood is estimated to inundate 5,711 acres; a 25-year frequency flood 4,938 acres; a five-year frequency flood 2,440 acres; and a one-year frequency flood 121 acres.

The average annual area flooded is 1,461 acres and the average annual floodwater damage to crops and pasture is \$61,990 (Table 5).

Approximately 90 percent of the bottomlands are used for cropland. Some areas are not farmed as intensively as possible due to problems from flooding. Many farmers designate floodwater problem areas as land to be out of production in order to comply with regulations for programs of other agencies.



It is estimated that 53 percent of the floods occur in April, May and June. These floods cause a reduction in crop yields and an increase in the number of tillage operations. Occasionally crops are lost, causing farmers to replant the original crop or a catch crop.

About 45 percent of the floods occur during the summer and fall seasons of the year. Floods during this time often completely destroy the entire crop. This causes an economic hardship upon farmers on the flood plain.

Only two percent of the floods occur during the winter months. Storms at this time of the year cause only minor damage to crops and pasture.

The effect of flooding has been felt throughout the entire watershed.

Spring and summer floods have a detrimental effect on the wildlife habitat located in uncultivated areas on the lands adjoining Troublesome Creek and associated watercourses. Game bird nestings are disturbed or destroyed, reducing the propagation of these species.

#### Sediment Damage

Sediment damage to crops, pasture, and waterways occurs at many small areas in the watershed. Many of these locations will be benefited by project measures.

#### Erosion Damage

Gully Erosion: Gully erosion damage to land is the major problem in the watershed. It occurs as land voiding and associated depreciation of the productive capacity of other areas in a farm unit, especially those areas adjacent to the voided gully area. The laterals which advance from the main gullies establish a pattern which makes it necessary to abandon field cropping on most of the areas in between, permitting the use of the land only as pasture or idle areas. These areas cannot be profitably farmed in corn and grain crops because of their relatively small size, the cost of maintaining crossings, or the extra travel involved. The gullies range in width from 10 to 150 feet and in depth from 4 to 25 feet. If permitted to continue at its present rate, much valuable cropland will be destroyed and the general economy of the local community will deteriorate. It is estimated that about 7,450 acres will be damaged during the 50 year evaluation period if the project is not installed.

Gully erosion damage to farm fences also occurs. The sloughing and caving of the gully banks cause cross and parallel fences to be frequently damaged. Gully erosion also damages farm field crossings by undermining the supports and approaches.



Gully erosion damage occurs in minor areas of the watershed where structural measures are not planned. These damages were found to be too low to justify structural measures, but will be partially controlled by land treatment measures. Only damages that will be affected by structural measures have been evaluated monetarily.

The total damage from gully erosion is \$187,550 each year.

Sheet Erosion: Excessive sheet erosion has occurred on many of the sloping cropland areas of the watershed. Land treatment measures installed in recent years have corrected this problem on portions of the cropland area. Some steep cropland has been converted to permanent pasture. Continuation of sheet erosion on the untreated erosive areas would cause a gradual decline in the productivity of those areas by further removal of the fertile topsoil.

At present 43,206 acres of watershed land are considered to be adequately treated. The remaining 39,894 acres need treatment. The planned land treatment measures will reduce damages from sheet erosion on the treated areas.

#### Indirect Damages

Field studies indicated that indirect damages occur in the watershed and consist of increased cost of normal field operations, rerouting traffic, farm equipment breakage, interruption in pasturage resulting from fence damage, breaking out of livestock, etc.

The indirect damages are estimated to be \$27,200 annually (Table 5).

#### Problems Relating to Water Management

Recreation: The Local Sponsoring Organizations are concerned with the lack of adequate water-based recreational opportunities within the local community. Rural and urban residents alike have expressed an interest in acquiring a local recreational area and have proposed such developments at the sites of structures D-47 and D-62.

It is felt that with the inclusion of the two recreational developments in this project the people living within the watershed and surrounding area will have adequate recreation facilities available to them within a reasonable driving distance.

No interest has been shown in developing water storage for irrigation purposes. No municipal or industrial water needs exist in the area. Water supplies for farm needs are supplied by wells.



### PROJECTS OF OTHER AGENCIES

The U. S. Army Corps of Engineers is studying a proposal to provide the City of Atlantic local protection against floods of maximum record from the East Nishnabotna River and Troublesome Creek. The proposal includes a system of 14,000 feet of levees along the left banks of these two streams. The structural measures included in this project will have negligible effect on these levees.

Site D-47 will provide water based recreation to the roadside park and timber area in Audubon County. This will satisfy the need for the type of facility which local people have been trying to accomplish.

No other Federal or State agencies have any other existing or proposed program for water resource development that will affect or be affected by the works of improvement included in this work plan.

### PROJECT FORMULATION

Meetings were held with local people to discuss existing problems and to formulate objectives for a flood prevention program. Livestock production and grain farming are the major agricultural enterprises in the watershed. Damages are occurring from gully erosion in the uplands and from excess water on the bottomlands.

Opportunities to include storage of water for other purposes was discussed. Two County Conservation Boards expressed an interest in storing additional water for recreation. After reviewing all considerations and the responsibilities that each sponsor would need to assume in completing the project, it was decided to include additional water for recreation at two sites.

Local sponsors were informed of the importance of carrying out a land treatment program. Fair progress has been made and they are willing to assume the responsibilities of getting additional land treatment measures applied.

The objectives for the project are as follows:

1. Establish necessary land treatment measures needed above structural measures and in other areas of the watershed that are in need of this type of protection.
2. Attain at least a 50 percent reduction in average annual flood damages to insure sustained crop production on the flood plain. Stabilization sites will benefit two or more landowners.
3. Provide water-based public recreational opportunities for residents of the local and surrounding communities.



### Structural Measures

Grade Stabilization Structures: There are 135 grade stabilization structures planned to stabilize the major upland watercourses in the watershed where control is not possible with land treatment measures alone. Seventy-six of the grade stabilization structures are detention type structures. The design data for these are shown on Table 3. These structures consist of compacted earthfill dams and principal spillways of corrugated metal pipe with suitable outlets.

The principal spillway crest elevations for these structures were determined by the grade control needed to stop gully growth. The average normal pool for these is five acres with a range from 1.6 to 12.5 acres. Seventy-two of these are designed with principal spillways of corrugated metal pipe 24 or less inches in diameter with hood inlets. Sketch SS-12 illustrates the hood inlet and the propped outlet. Nineteen of these corrugated metal pipes (24-1, 25-3, 38-1, 38-6, 42-2, 44-1, 45, 47-3, 48-3, 50-4, 53-6, 80-2, 84-2, 84-3, 85-3, 85-5, 85-7, 85-8, 86-2) have corrugated metal chute outlets which permit the structure to function properly when the downstream conditions are variable and changes in outlet elevation may occur. Structure 86-2 has a shallow concrete box around the corrugated metal hood inlet as shown in sketch SS-13. Structures 16-1, 36-4 and 80-2 have standard vertical corrugated metal pipe riser inlets.

Structure 36-4 will be constructed with a 30-inch corrugated pipe with straight drop inlet and propped outlet. Structures 84-1, 85-1, and 86-1 have been classified as "b" structures under SCS criteria because of isolated farm buildings downstream. These three structures will be constructed with 30-inch diameter reinforced concrete pipe principal spillways. The inlets will be standard SCS rectangular concrete drop inlets with trash racks. The outlets of these three structures will be propped with reinforced concrete or concrete piling.

The earth fills for all these structures except one will be designed with three-to-one side slopes, 12 foot top width for those under 25 feet in height, 14-foot top width for those over 25 feet in height, foundation trench drainage systems and, 8 to 12 foot wide upstream berms at or near the crest of the inlets for wave action protection. Structure 80-1 will be similar in design but will have a 32-foot top width or whatever width is required by county road specifications at time of construction. This structure will be a part of the county road system and it is anticipated that the county will bridge the emergency spillway after construction of the structure. All these detention type grade stabilization structures will be provided with vegetated emergency spillways to convey the runoff from storms of greater magnitude than the design storm without causing over-topping of the dam. Sketches SS-2A and SS-13 of drop inlet earth dams show illustrations of this type of emergency spillways.



Fifty-nine of the 135 grade stabilization structures are full flow type structures. Data as to the drainage area, grade control in feet, volume of concrete and type of structure can be found on Table 3B.

Thirty-four of these are reinforced concrete box inlets to be installed on existing county or state road culverts to provide 4 to 10 feet of grade control. It does not reduce the capacity of the culvert for flow of water, but reduces the gradient of the upstream watercourse. Features of this structure are shown in sketch SS-11. Four are reinforced concrete chutes with box inlets and propped outlets that will provide grade control for 12 to 18 feet each. Sketch SS-5 illustrates the chute spillway. There are two types of drop spillways planned, ten straight drop spillways as shown in sketch SS-1 and eight box-inlet drop spillways as shown in sketch SS-4. These drop spillways will provide 5 to 9 feet of grade control each.

The principal spillway of structure 78-2 is monolithic concrete with a box inlet on twin culverts and chute with a SAF outlet. The SAF outlet utilized concrete blocks to dissipate the energy of the water as it leaves the chute. Structure 78-2 will also be provided with a vegetated emergency spillway. The other two full flow structures (81 and 84) will be located on county roads and will replace existing bridges. The design consists of a standard State Highway designed monolithic concrete road culvert with chute outlet and energy dissipator. These structures will provide 10 to 14 feet of gully control upstream. Nearly all of these 59 full flow grade control structures will be designed to provide an outlet for tiled waterways. Thirteen of these will have waterways constructed upstream as part of this project and the cost of these are included as part of the structure cost. The design will include a tile line on each side of the waterway for drainage. Structures that have planned waterways included on their cost are 7-1, 8-1, 15-1, 23-2, 53-8, 57-2, 62-3, 62-5, 62-6, 66-1, 66-2, 68 and 75-1. The length of these waterways range from 100 feet to 2,400 feet and total approximately 17,000 feet.

Floodwater Retarding Structures: There are four floodwater detention structures with two of these having recreation as an added purpose. The two single-purpose structures D-38 and D-53, and one multiple-purpose structure D-47 are designed with principal spillways of 30-inch reinforced concrete pipe with propped outlets. Multiple-purpose structure D-62 will have a 36-inch reinforced concrete pipe with propped outlet. Structures D-47 and D-62 will be provided with gated 24-inch concrete drawdown pipe for water management and maintenance. These two structures (D-47 and D-62) and the single purpose structure D-53 will be provided with 12-foot wide upstream berms and rock riprap for wave erosion protection. The smaller single purpose structure D-38 will be provided with a 12 foot berm. All four of these structures will be provided with vegetated emergency spillways with the principal spillways designed to store run-offs from anticipated 50-year storms. These principal spillways will have standard rectangular open top risers equipped with trash racks and propped outlets as shown on sketch SS-2A and are designed with 14-foot top widths, three-to-one side slopes and trench drains. Multiple-purpose structures D-47 and D-62 will have a blind well or sand point well system to relieve



hydraulic pressures. A core trench for D-62 will be eight feet deep across the floodplain with 10-foot bottom width and two-to-one side slopes.

Storage capacity for sediment is provided in the design of all these detention structures to assure that the storage for temporary detention and the recreational water will be available throughout their 50-year expected life. The design of structure D-47 provides for 266 acre-feet of water for recreation to be stored above the 264 acre-feet of storage needed for the anticipated 50-year sediment production from the upstream drainage area. The normal pool for this structure is 70.5 acres. The acres of land for the water resource improvement at this site is estimated to be 213 acres. Structure D-62 provides 315 acre-feet of water for recreation to be stored above the 335 acre-feet of storage needed for the anticipated 50-year sediment production. The normal pool for this structure is 108 acres. The acres of land for the water resource improvement at this site is estimated to be 278 acres. The crest of the concrete riser on the two floodwater retarding structures (D-38 and D-53) will be set at the top of the storage provided for the 50-year sediment accumulation.

Relocation Payments: The installation of structural measures in this project will result in the relocation of three farm families. These payments are included for structure sites D-38, D-47, D-53 and D-62.

Relocation payments are included for eight farming operations. Sixteen people are residing on these farms at the present time. Two of these farms will discontinue their farming operations. The other six farms will continue farming but one of these will need to replace the farmstead.

#### Mitigation Measures

A reconnaissance study and report by the Bureau of Sport Fisheries and Wildlife indicated that a minimum of 100 acres of wildlife habitat will be replaced as mitigation measures. This loss of habitat is estimated to result from the installation of project measures.

Mitigation of habitat losses are provided through easements by the State Conservation Commission under their Farm Game Habitat program. Plantings will be one to five acre plots on private lands, in odd corners or near impoundments. Fencing will be provided, if needed, to exclude livestock. These plantings will serve principally for pheasant nesting and winter cover, however many species of wildlife will benefit.

#### Basic Recreational Facilities

Recreational facilities will be installed at two different sites in the watershed to meet estimated public demand for water based recreation. A variety of facilities are planned at each site in order to satisfy the anticipated need. Water and toilet facilities are included at each site to meet the requirements of the State Health Department. The facilities to be installed are shown in Table 2B.



Approximately five acres of the reservoir pool area of site D-62 is isolated from the remaining area by a county road and is considered as not essential for recreation. Flowage easements will be obtained for this area and a swinging water gate will be installed at the road to prevent public access to the recreational development.

The Public Recreational Developments (Figures 2 and 3) show the general plans for the recreational facilities and the approximate taking lines for land purchase for the two sites.

The facilities will occupy an estimated 110 acres at site D-47 and 137 acres at site D-62.

The location of the structures and the recreational developments are shown on the project map. Tables 2, 2A and 3 set forth further data and details pertaining to costs, construction quantities, and design features of the structural measures.

#### EXPLANATION OF INSTALLATION COSTS

The project installation costs, as used in this work plan, include all costs to P.L. 566 and other funds, in cash or its equivalent, for installing all works of improvement for the project purposes of watershed protection, flood prevention, and for non-agricultural water management, which includes the public recreational development.

The cost of installing land treatment measures includes all P.L. 566 and other costs for applying those measures and for technical assistance for their planning, layout and installation. The costs also include costs to the farmers, cost sharing from going agricultural programs, and technical assistance from the State Cooperative Forest Management, P.L. 46 and P.L. 566 funds. The estimated cost of installing the land treatment measures is \$810,590. This is divided into \$75,930 from P.L. 566 funds and \$734,660 from other funds (Table 1).

Costs of the forest land treatment measures are based on current costs of supervision, labor, equipment and materials necessary to accomplish specific measures.

Costs of technical assistance for the installation of the forest land treatment measures are based on actual expenditures and accomplishments of the Iowa Conservation Commission, Forestry Section. An analysis of costs against accomplishments was made for each measure to determine unit costs for technical assistance.

The cost of installing structural measures includes all P.L. 566 and other costs.

These costs are for construction, engineering services, land rights, mitigation measures and project administration. The total estimated costs of all structural measures are \$3,961,220. Of this amount \$3,416,270 will be provided from P.L. 566 funds and \$544,950 from other funds.



Construction cost includes a contingency cost added to the engineers cost estimate to provide for unforeseeable cost increases during construction. Based upon experience to date in similar watershed work, the contingency cost was estimated to be 12 percent of the engineer's estimate.

The construction costs of the mitigation measures will be assumed by P.L. 566 funds. These measures are the result of the many grade stabilization structures included in this project.

The total construction costs are estimated to be \$2,495,280 (Table 1). Of this amount, \$2,380,210 will be provided from P.L. 566 funds and \$115,070 from other or local funds.

Engineering services includes the direct cost of engineers and other technicians for surveys, investigations, design, and preparation of plans and specifications of structural measures. Engineering services costs for the structural measures including basic recreational facilities are estimated to be \$495,930 (Table 1). P.L. 566 funds will bear \$477,650 and other or local funds \$18,280 (Table 1).

Land rights costs include all costs and expenditures made in acquiring land or easements, or the value of such lands if donated. These values are estimated by the sponsors with concurrence of the Service.

The project administration costs are P.L. 566 and other administrative costs associated with the installation of structural measures including the cost of contract administration, review of engineering plans prepared by others, government representatives, construction surveys, and necessary inspection service during construction to insure that structural measures are installed in accordance with the plans and specifications. Relocation assistance advisory services are included as project administration cost. The total estimated project administration costs are \$398,860 and are assigned \$364,440 to P.L. 566 funds and \$34,420 to local funds (Table 1).

The total estimated costs of relocation payments for this watershed are \$37,100. Paragraph 2, in the work plan agreement lists the percentages that each agency will assume of these payments. The Service will assume the first \$25,000 of each relocation for these costs which occur prior to July 1, 1972. After this time they will be cost-shared by the percentages listed in the work plan agreement.

The "Use of Facilities Method" for cost allocation as set forth in the Economics Guide For Watershed Protection and Flood Prevention, was used to determine the costs to be assigned to flood prevention and recreation for the multiple purpose structures. For structure D-47 a storage capacity of 266 acre-feet of water is provided for recreation compared with 944 acre-feet of storage for flood prevention, giving an allocation of 22 percent for recreation and 78 percent for flood prevention. For structure D-62 a storage capacity of 315 acre-feet of water is provided for recreation compared with 1,710 acre-feet of storage for flood prevention, giving an allocation of 15.6 percent for recreation and 84.4 percent for flood prevention. Therefore, the construction and engineering services costs



have been allocated to flood prevention and recreation in this ratio, for these two structures. The costs of all land rights, except flowage easements has been allocated to recreation for these two structures. Costs of flowage easements have been allocated to flood prevention and will be paid from local funds.

The estimated cost and cost sharing of structure D-47 and recreational facilities is as follows:

	Estimated Cost		
	P.L. 566	Other	Total
<b>Structure</b>			
Construction	\$106,660	\$ 13,180	\$119,840
Engineering	23,970	-	23,970
<b>Recreation Facilities</b>			
Construction	61,060	61,060	122,120
Engineering	12,210	12,210	24,420
<b>Land Rights</b>			
Payments made to landowners			
Water Res. 213 Ac.	40,770	40,770	81,540
Payments made to landowners			
Rec. Fac. 110 Ac.	21,010	21,010	42,020
Bridge Modification	7,500	7,500	15,000
Flowage Easements	-	900	900
Land Surveys, Title searches, etc.	-	2,470	2,470
<b>Total</b>	<b>\$273,180</b>	<b>\$159,100</b>	<b>\$432,280</b>

The estimated costs and cost sharing of structure D-62 and recreational facilities is as follows:

	Estimated Cost		
	P.L. 566	Other	Total
<b>Structure</b>			
Construction	\$123,920	\$ 10,480	\$134,400
Engineering	26,880	-	26,880
<b>Recreation Facilities</b>			
Construction	30,350	30,350	60,700
Engineering	6,070	6,070	12,140
<b>Land Rights</b>			
Payments made to landowners			
Water Res. 278 Ac.	61,330	61,330	122,660
Payments made to landowners			
Rec. Fac. 137 Ac.	30,200	30,200	60,400
Bridge Modification	6,000	6,000	12,000
Flowage Easements	-	6,300	6,300
Land Surveys, Title Searches, etc.	-	3,600	3,600
<b>Total</b>	<b>\$284,750</b>	<b>\$154,390</b>	<b>\$439,140</b>



The installation and engineering costs of all other structural measures have been allocated to flood prevention since they serve only that purpose. Construction costs allocated to flood prevention will be provided from P.L. 566 funds.

Land rights costs of all other structural measures have an estimated value of \$187,100 and will be provided from local funds. Of this amount, \$5,600 is for land rights of mitigation measures.

Project administration costs have not been allocated, but have been assigned to P.L. 566 funds and local funds in the estimated amounts that the Service and sponsors will each incur in the installation of the project.

A summary of the cost allocations and cost sharing is shown on Table 2A.

Non-project costs are all additional costs resulting from changes of or additions to project works of improvement for non-project purposes such as altering a structure to permit its use as a roadway. These costs must be borne by the local organizations. For structures 80-1, 81 and 84 the purposes of the use as a road crossing (non-project cost) and for stabilizing a gully (flood prevention cost) were considered to be of equal importance; therefore the Service and the County will share equally in the construction costs and in a division of engineering services responsibility for these structures.

The cost of installing the wildlife habitat mitigating measures on 100 acres of land and fencing where needed will be borne by P.L. 566 funds. The State Conservation Commission will obtain the easements for these plantings. The total cost of the mitigation measures included in the project are estimated to be \$21,200 (Table 2).

The total installation cost of all structural measures, which includes the mitigation measures, and the recreational developments is \$3,961,220 (Table 1). Of this amount \$3,416,270 will be provided from P.L. 566 funds. Local funds will provide \$544,950.

An estimated schedule of Federal and non-Federal obligations, by fiscal years, for land treatment and structural measures is tabulated as follows:



Fiscal Year	Structural Measures		Land Treatment		TOTAL
	P.L. 566	Local	P.L. 566	Local	
1	\$ 75,000	\$ 25,000	\$ 6,500	\$ 60,000	\$ 166,500
2	270,000	50,000	6,500	60,000	386,500
3	270,000	100,000	7,000	75,000	452,000
4	275,000	100,000	10,000	100,000	485,000
5	300,000	75,000	12,000	110,000	497,000
6	350,000	40,000	15,000	120,000	525,000
7	500,000	40,000	7,000	75,000	622,000
8	400,000	30,000	4,000	35,000	469,000
9	400,000	30,000	2,000	25,000	457,000
10	275,000	30,000	2,000	25,000	332,000
11	175,000	12,510	2,000	25,000	214,510
12	126,270	12,440	1,930	24,660	165,300
Total	\$3,416,270	\$544,950	\$75,930	\$734,660	\$4,771,810

#### EFFECTS OF WORKS OF IMPROVEMENT

##### Effects of Land Treatment Measures

Land treatment measures included in the project will effectively reduce sheet erosion on lands in the watershed. The present rate of 7.6 tons per acre per year averaged for the entire upland area, will be reduced to 5.0 tons per acre per year. This is a 35 percent reduction in sheet erosion and in that source of sediment to downstream structures.

With the planned land treatment measures installed, 55,401 acres or 67 percent of the land in the watershed will be adequately treated from sheet erosion and the accompanying damage. Some of the remaining 27,699 acres or 33 percent of the land will be partially protected by conservation measures.

The forest land treatment measures will improve the hydrologic condition on 540 acres of forest land. This will reduce surface runoff and result in a reduction in sediment yield. In addition, proper management, protection from grazing by domestic livestock and continued fire protection will increase the productivity of the forest land on the watershed. Additional wildlife plantings will be established adjacent to impoundments and in odd areas to provide wildlife habitat lost to the impoundments.

##### Effects of Structural Measures

Benefits from the project have far-reaching effects on the inhabitants, land and facilities in the watershed. Of the 575 farms in the watershed, benefits from gully erosion damage will accrue to 7,450 acres on 350 farms. It is estimated that 1,500 acres of land treatment measures can be



applied when stable outlets are provided through the installation of the structural measures included in this project. According to computer data, the floodplain consists of 6,093 acres. It is estimated that 80 farms will receive benefits from reduction in damages from floodwater.

This gives a total of 15,003 acres and 430 farms that will receive benefits from this project.

A total of about 28,563 acres (35 percent of the watershed) will have the runoff and flood producing potential substantially reduced when project measures are installed.

Floodwater damage to cropland and pasture in the evaluated area will be reduced 54 percent. The average annual area flooded will be reduced from 1,461 to 797 acres.

With the project installed, farmers will convert bottomland pasture and idle areas to cropland and follow a higher level of management, such as use of fertilizer, more timely operations, etc. The use of this bottomland for cropping will permit less intensive cropping on the more erodible upland areas. Reduction of flooding will permit changed land use on 195 acres and 4,000 acres of bottomland will be put to more intensive use as a result of the project.

Benefits will be realized at 30 bridge sites through reduced future costs of replacement in the watershed. The resulting reduced peak flows will permit installation of smaller and less costly culverts when the present bridges are in need of replacement.

Benefits will be realized by a reduction of road damages at 99 locations within the watershed.

Computations were made on the amount of sediment that would be delivered to the Nishnabotna River. This was done for present and with project conditions. It was estimated that 165,018 tons of sediment would be stored each year by the planned structural and land treatment measures included in this project.

Structures D-47 and D-62 are designed as multiple purpose structures for flood prevention and recreation.

The installation of the recreational development at structures D-47 and D-62 will provide residents of the surrounding area with the opportunity to participate in various recreational activities. These consist of fishing, swimming, boating, camping, picnicking, hunting, etc. These added opportunities should have a measurable effect on the economic activity of many local citizens and will satisfy the present and future recreation needs of the people.



With a trend toward shorter work weeks and a growing population such recreational facilities will receive intensive use. The estimated length of the recreational season is 100 days. Facilities at site D-47 are designed for a capacity of 500 people per day and facilities at site D-62 are designed for a capacity of 750 people per day. It is expected that the facilities will be used at 10 percent of their capacity on week days and at 125 percent of their capacity on week-ends.

The number of visitor days have been estimated to 22,000 annually at site D-47 and 27,000 annually at site D-62. The average value per visitor day is \$1.50 at each location.

The State Health Department stated that the present runoff water is of adequate quality for recreational use and anticipate no future problems. They also said the sanitary facilities in the recreational developments are adequate.

The sediment storage pools in 76 of the structures will provide water storage and will have recreational use for a portion of the life of the project. The pools vary in size from 1.6 to 12.5 acres and are suitable for a year-long fishery. Farmers have indicated that they will secure fish for stocking, mostly bass and bluegill and some catfish. Many of the ponds will be fenced by farmers and wildlife food and cover plantings established near the ponds and in odd corners. These ponds and surrounding areas will provide farm families and others with recreational opportunities such as fishing, swimming, boating, picnicking, and hunting.

The Sponsoring Local Organizations are aware that incidental recreational use may require attention and consideration for installing sanitary facilities. If the use becomes so concentrated that toilet facilities are required for protection of health, they will either provide such facilities or restrict the use of the water pool areas. Drinking water will not be available at any of the sites.

Secondary benefits will accrue within the immediate zone of influence of the project. They include (1) the transporting, processing, and marketing of goods and services that produce the primary benefits and (2) the supplying of additional materials and services required to make possible the increased net returns which result from the installation of the project. These benefits accrue primarily to processors and merchants providing services to farmers.

#### Effects on Fish and Wildlife Resources

The project has potential to be both beneficial and detrimental to wildlife habitat. Certain game species, such as waterfowl, will enjoy a long-term increase in habitat while other species, such as deer, will lose some habitat. For example, some wooded terrestrial wildlife habitat of value to upland game and deer will be destroyed in the permanent pools of detention structures. These species will suffer a temporary setback during the period in which replacement of cover is being established. Structural measures will be seeded and each site will be checked to see that a stand is established.



The planting of 100 acres of wildlife areas will adequately compensate for the losses of cover destroyed by the structural measures. Additional areas of cover will develop naturally around the proposed structures in the project.

The proposed project will have a marked beneficial effect on certain fish and wildlife resources, both real and potential, throughout much of the watershed. The stocking of fish in some of the impoundments will improve the watershed fishery resource.

The 65 acres of wildlife habitat plantings planned on farms with conservation plans will further enhance wildlife populations. The 540 acres of planned woodland improvements will likewise benefit wildlife.

The numerous grade stabilization structures will create small aquatic niches useful to resident game. The larger detention structures will create a lake area, previously unknown in the watershed. These water impounding structures will attract shorebirds, waterfowl and fur bearers not now found in the area. Thus, in total consideration, a better ecological diversity, stability and productivity is indicated.

#### PROJECT BENEFITS

The annual evaluated gully erosion damage to agricultural land of \$159,520 will be reduced to \$7,600 for a benefit of \$151,920. Other agricultural damages of \$9,600 will be reduced to \$460 for a benefit of \$9,140. Non-agricultural damages of \$18,430 will be reduced to \$880 for a benefit of \$17,550 (Table 5).

The average annual evaluated floodwater damages to crop and pasture of \$53,640 will be reduced to \$24,430 for a benefit of \$29,210. Other agricultural damages from floodwater are \$8,350 and will be reduced to \$390 for a benefit of \$7,960 (Table 5).

Changed land use benefits that will accrue annually on protected bottomlands are \$5,910. Annual benefits from more intensive use of lands protected from flood damage are \$38,070 (Table 6).

Indirect damages of \$27,200 which accompany the direct damages will be reduced to \$3,370 giving a benefit of \$23,830 (Table 5).

Benefits accruing to the project from the two public recreational developments are estimated to have an annual value of \$73,500 (Table 6).

The average annual value of local secondary benefits are \$18,890 (Table 6). Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.



### COMPARISON OF BENEFITS AND COSTS

The annual installation costs of the structural measures including basic recreational facilities are \$233,910. The annual operation, maintenance and replacement costs are \$21,810. Of this amount, \$13,670 is for the operation, maintenance and replacement costs of the recreational facilities. The remaining \$8,140 is for the operation and maintenance of all other structural measures included in the project (Table 4).

The average annual primary flood prevention benefits from the structural measures, excluding local secondary benefits, are \$357,090; this compared with the average annual cost of \$255,720 gives a benefit-cost ratio of 1.4 to 1.0.

The average annual primary and local secondary flood prevention benefits from the structural measures in the project of \$375,980 compared with the average annual cost of \$255,720 gives a benefit-cost ratio of 1.5 to 1.0 (Table 6).

The project has been divided into three different evaluation units as shown on tables 4 and 6. Evaluation unit one includes all grade stabilization structures which drain into Troublesome Creek. Evaluation unit two includes all grade stabilization structures which drain into the East Nishnabotna River. Evaluation unit three includes the floodwater detention structures, multiple purpose structures and the recreational facilities.

### PROJECT INSTALLATION

The project measures will be installed during a twelve year project installation period. The Local Sponsoring Organizations and the Service will coordinate the installation of the structural measures in the project with the planning and application of land treatment measures on the individual farms.

#### Land Treatment Measures

The District governing bodies will schedule meetings to facilitate carrying out the planned program, set priorities of farmers to be assisted, make periodic checks on completed measures and maintenance needs, and otherwise assist to further the land treatment phase of the watershed project. Details of each individual landowner's portion of planned land treatment measures will be defined in the cooperator's conservation plan.

Land treatment measures will be installed by individual farmers or small groups of farmers working together. The current Rural Environmental Assistance Program will be utilized as may be available for those practices eligible for cost-sharing assistance.



The current land treatment program is being planned and applied by the landowners and District with technical assistance provided by the Service under the authority of Public Law 46. In order that the planned land treatment measures may be installed during the project installation period an acceleration of the present rate of application will be required. Additional technical assistance for this purpose will be made available by the Service from P.L. 566 funds.

The forest land treatment measures will be installed by the landowners with technical assistance provided by the Iowa Conservation Commission, Forestry Section, in cooperation with the U. S. Forest Service.

Additional land treatment measures will more completely protect the remaining watershed lands and it is expected that these needed additional measures will be installed by landowners in the years following the project installation period. It is expected that normal going program assistance will be available for this installation.

#### Structural Measures

The installation of structural measures will follow a sequence such that upstream works of stabilization and waterflow control will precede the installation of those that lie downstream. In this manner the sediment storage capacity and the temporary retarding pools at downstream sites can be designed and installed at least cost for flood prevention purpose. Project costs and evaluations of measures have proceeded on that basis in this work plan.

All structural measures will be installed by contract. Audubon County will award and administer contracts for road structures 80-1, 81, and 84-1. The Audubon County Conservation Board will contract for multiple-purpose structure D-47 and the basic recreational facilities. Guthrie County Conservation Board will contract for multiple-purpose structure D-62 and the basic recreational facilities. The Service is requested and agrees to award and administer contracts for all remaining structural measures.

Engineering services for the basic recreational facilities will be contracted for by Audubon County at structure D-47 and by Guthrie County at structure D-62. An Agreement for Engineering Services will be executed by the Service and County in which facilities are located, setting forth work to be accomplished, estimated costs, and payments and/or reimbursements by each party to meet the cost sharing requirements, etc.

The designs for structures 80-1, 81 and 84, will incorporate features for both a road crossing purpose, which is considered a non-project purpose, and for the project purpose of flood prevention.



For these structures, the Service will make or pay for the needed site surveys for structure design; the necessary site investigations of foundation and borrow areas; the soil mechanics laboratory work; the preparation of preliminary designs and specifications for the earth fill and the accompanying foundation drainage; development of flood routings of storage type structures and the associated hydraulic designs; and the establishment of elevations for the inlets and outlets of the principal spillways of the structures.

The County will make or pay for the needed surveys for establishment of vertical approach curves and associated ends of fill as limit of fill quantities to be included in the project and used in the preparation of detailed structure designs. The County will prepare all detailed structure designs and contract specifications.

Iowa Highway Commission Standard Plans and Specifications will generally be followed in designs except that agreed-to needed modifications and/or additions will be incorporated so as to meet the design requirements of the Service.

Provisions of the contract shall meet SCS requirements. The technical specifications shall be prepared in a manner that will result in the same quality work as is required under the SCS Standard Specifications. The construction plans and specifications shall embody the basic standards and criteria established by the Service.

The County will stake out the works of improvement to be installed and perform inspection service.

Inspection services shall meet SCS inspection standards and all materials and testing shall be conducted and documented to satisfactorily support payment for the work. A government representative designated by the Service will personally check on the inspection services to assure that the work meets all requirements.

Engineering services for all other structural measures will be provided or contracted for by the Service.

Project administration will be provided by the Service and by the Local Sponsoring Organizations, each as required for the satisfactory completion of the work.

The Audubon County Board of Supervisors will be the sponsor that will provide personally or by first class mail, notice of displacement and necessary forms to each displaced person or farm involved by structures in Audubon County. The Guthrie County Board of Supervisors will be the sponsor that assumes these duties for structures in Guthrie County. They will assist in filing applications and will review and process grievances in connection with displacements and see that payments are made.



The Service will assist the local sponsors in all phases listed in the above paragraph.

Relocation assistance advisory services will be provided by the Audubon and Guthrie County Boards of Supervisors. No Federal funds are provided for these services. This includes the following:

- (1) Determine need of displaced persons for relocation assistance.
- (2) Provide current information on the availability, prices and rentals, of decent, safe and sanitary sale and rental housing.
- (3) Assure that within a reasonable period of time prior to replacement, replacement dwellings will be available.
- (4) Assist a displaced person in obtaining and becoming established in a suitable replacement location.
- (5) Supply information concerning housing programs, disaster loan programs and other Federal or State programs, offering assistance to displaced persons.
- (6) Provide other advisory services in order to minimize hardships of displaced persons in adjusting to relocation.
- (7) Advise displaced persons to notify the displacing agency before moving.
- (8) Provide brochure, outlining benefits to which they are entitled, to persons from whom land will be acquired.

All persons displaced by the project will receive a 90 day notice before they must move. The sponsors have determined that decent, safe and sanitary replacement housing will be available when needed.

The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights as the State law may require for installation and operation of the works of improvement.

Each District will acquire land rights for structural measures located therein other than for mitigation measures, road structures and the multiple purpose structures.

Audubon County will obtain the land rights for structures 80-1, 81 and 84 which are located on county roads.

The Audubon County Conservation Board will obtain land rights for structure D-47 and the recreational facilities. The Guthrie County Conservation Board will obtain land rights for structure D-62 and the recreational facilities. Should the Districts or the County Conservation Boards not be able to acquire such land rights for structural measures, the Counties have power of eminent domain and will use this authority to acquire those land rights as need be.



For the wildlife mitigation measures, the State Conservation Commission will acquire land rights by 15 year term easements such as are used in its farm game habitat program. These easements are renewable and will be renewed if the State Conservation Commission feels more time is needed to accomplish the purpose for which they were established.

After the required land rights in a construction unit have been acquired and certification made for the adequacy of land treatments, a Project Agreement for Construction of Structural Measures will be executed for each contract unit of work prior to issuance of invitation to bid.

Mitigation measures will be installed in the same amount as habitat destroyed by the structural measures included in a contract.

The agreement will be executed by the Service, Audubon County and Audubon District for structures 80-1, 81, 84 and multiple purpose structure D-47. The agreement will be executed by the Service, Guthrie County and Guthrie District for multiple purpose structure D-62. For all other structural measures the agreements will be executed between the Service, District, and County in which the structure is located.

A Land Rights Agreement will be executed between the Service and Audubon County for structure D-47. For structure D-62 this agreement will be executed between the Service and Guthrie County. This agreement will set forth estimated costs, obligations and land to be acquired, responsibilities of each party, such as prior land appraisals, additional land appraisals, negotiations with landowners, acquisition of lands, and payments for reimbursement to effectuate the agreed upon cost sharing.

A Project Agreement for the basic facilities will be executed between the Service and Audubon County at site D-47 and between Guthrie County and the Service at site D-62. It will set forth facilities to be installed, estimated costs, and obligations and responsibilities of each party for payments and/or reimbursements to meet cost sharing requirements, etc.

Eighty construction units have been established in order to provide maximum flexibility in establishing a sequence for installing the structural measures (Table 7). Land rights for all structural measures in any one construction unit will be obtained before a project agreement is executed for the installation of any of the structural measures within that construction unit.

The Service will develop plans for mitigating wildlife food and cover. These plans will be reviewed by the State Conservation Commission.



### FINANCING PROJECT INSTALLATION

Federal assistance for installing the works of improvement on the non-Federal land, as described in this work plan, will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666, as amended).

Individual landowners will assume the cost of installing land treatment measures with such cost-sharing assistance as may be available under the provisions of the Rural Environmental Assistance Program or any other going agricultural cost-sharing programs.

Land treatment measures to be installed on agricultural land, except forest land, will cost a total of \$793,590. Of this amount, the Service will provide \$68,630 for technical assistance and the remaining \$724,960 will be paid by the landowners with cost-sharing assistance from going programs (Table 1).

The total cost of installing forest land treatment measures is estimated to be \$17,000. Technical assistance to landowners for the installation of forestry measures will cost \$8,700 and will be provided under the P.L. 566 program (\$7,300) and the Iowa Conservation Commission, Forestry Section (\$1,400). The installation costs to forest landowners is \$8,300. It is expected that the Rural Environmental Assistance Program cost-sharing will be available to qualified landowners for installing their forest land treatment measures.

The Service will assume the entire construction cost of all structures except 80-1, 81, 84, D-47, D-62 and the recreational facilities. The Service will cost share with Audubon County on the construction costs of the cooperative road structures. The Service will cost share with the Audubon County Conservation Board on the construction cost of structure D-47 and the recreational facilities. They will cost share with the Guthrie County Conservation Board on the construction cost of structure D-62 and the recreational facilities.

All construction costs for mitigation measures will be assumed by the Service. Relocation payment costs will be paid from both P.L. 566 and local funds. Land rights for the mitigation measures and for the structural measures other than for structures 80-1, 81, 84, D-38, D-53, D-47, D-62 and recreational facilities are expected to be donated by the concerned landowner or otherwise obtained by the County and District in which they are located. Structures 80-1, 81 and 84 are located on road rights-of-way and land rights will be obtained by Audubon County. Land rights for structures D-38 and D-53 will be obtained by Audubon County from funds made available through the use of the one-quarter mill levy. The land rights needed for structure D-47 and the recreational facilities will be obtained by the Audubon County Conservation Board. The Guthrie County Conservation Board will obtain the necessary land rights for structure D-62 and the recreational facilities.



The State Conservation Commission will obtain the land rights for the mitigation measures. These easements are expected to be donated by interested landowners.

A quarter mill levy amounts to approximately \$9,000 in Audubon County and \$10,000 in Guthrie County. The County Conservation Boards of these two counties receive a portion of these funds for their use.

County road funds will be available for the non-project costs of structures 80-1, 81 and 84.

The Sponsoring Local Organizations have analyzed their financial needs in consideration of the scheduled installation of the works of improvement listed in this plan. They feel that the necessary funds will be available, when needed.

This work plan does not constitute a financial document to serve as a basis for the obligation of Federal funds. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

#### PROVISIONS FOR OPERATION AND MAINTENANCE

##### Land Treatment Measures

Land treatment measures will be maintained by the individual landowners and/or operators as prescribed in the conservation plans developed between the farmers and the Districts. Technical assistance will be made available through the Districts by the Service.

The forest land treatment measures will be maintained by the landowners with technical assistance furnished by the Iowa Conservation Commission, Forestry Section, in cooperation with the U. S. Forest Service under going Cooperative Forestry Programs.

##### Structural Measures

The structural measures including basic recreational facilities included in this project are planned and designed to serve project objectives. The total benefits to be derived from all measures cannot be realized unless the measures are operated and maintained in such a manner that they will serve the full purpose for which they were installed. The program for operation and maintenance consists of:

1. An agreed-to plan which will provide adequate and sound arrangements for proper operation, timely inspection, and prompt and appropriate performance of needed maintenance which will be in accordance to specifications of the Iowa Operation and Maintenance Handbook; financing the costs of operation and maintenance; and the maintaining of records reflecting the actions required and taken.



2. Carrying out of the provisions of the agreed-to plan in a manner consistent with the spirit, intent, and purpose of the plan and project.

In accordance with Iowa law, the three counties involved in this project will levy taxes as needed in each county on agricultural lands, not to exceed one-quarter mill per year. These funds will be used for operation, maintenance and replacement costs of the works of improvement. The revenue from this taxation is considered to be adequate to meet these estimated costs.

All structures located in Audubon County, except for road structures (80-1, 81 and 84) structure D-47 and the recreational facilities will be operated and maintained by the Audubon District and County. Structure D-47 and the recreational facilities will be operated and maintained by the Audubon County Conservation Board and Audubon District at an estimated cost of \$8,660 annually.

All structures located in Cass County will be operated and maintained by the Cass District and Cass County.

All structures in Guthrie County except D-62 and recreational facilities will be operated and maintained by Guthrie County and District. The Guthrie County Conservation Board and District will operate and maintain structure D-62 and recreational facilities at an estimated cost of \$5,900 annually.

The cooperative road structures and inlet risers on road culverts will be operated and maintained by the County and District in which they are located. County road maintenance funds will be used for this purpose in a manner similar to the maintenance of other road structures in the county.

The State Conservation Commission will provide operation and maintenance for the mitigation measures.

"Operation and Maintenance Agreements" setting forth all details in connection with responsibilities for operation and maintenance of structural measures including basic recreational facilities will be executed prior to the signing of project agreements for construction of the measures.

Inspection of the structural measures and recreational facilities will be made annually by the Local Sponsoring Organizations and the Service for three years after the structure is completed. After the third year, the annual inspections will be made by the local sponsors. Additional inspections will be carried out following a severe storm or any other unusual condition that might adversely affect the structural measures. These inspections will be made to determine maintenance needs and will include the following determinations:

1. Rodent damage to earth fills; may need refilling, rodent control, etc.



2. Condition of emergency spillways and earth fills including vegetative cover and its needed improvement; may need filling of rills, reseeding or sodding, prevention of grazing, etc.
3. Needs for removal and disposal of debris in the sediment and temporary pools.
4. Condition of the principal spillway; may need calking replacing concrete sections of pipe, adding riprap, etc.
5. Check condition of recreation facilities for repair and maintenance and see that work needing to be done is completed, such as making road repairs, repairs or replacements of picnic tables, shelters, water and sanitary facilities, etc.
6. The quality of water in the sediment pools of the smaller sites will periodically be considered by the sponsors for adequacy of meeting health standards for such contact sports as swimming, water skiing, etc. Primary concern in this regard will be given to barnyard drainage and the use of herbicides, insecticides, etc.

The Service will participate in operation and maintenance only to the extent of (1) furnishing technical assistance to aid in inspections and (2) furnishing technical design information necessary for operation and maintenance. When operation and maintenance is not being properly carried out, as found from inspections by the Service, the matter will be brought to the attention of the Local Sponsoring Organizations.



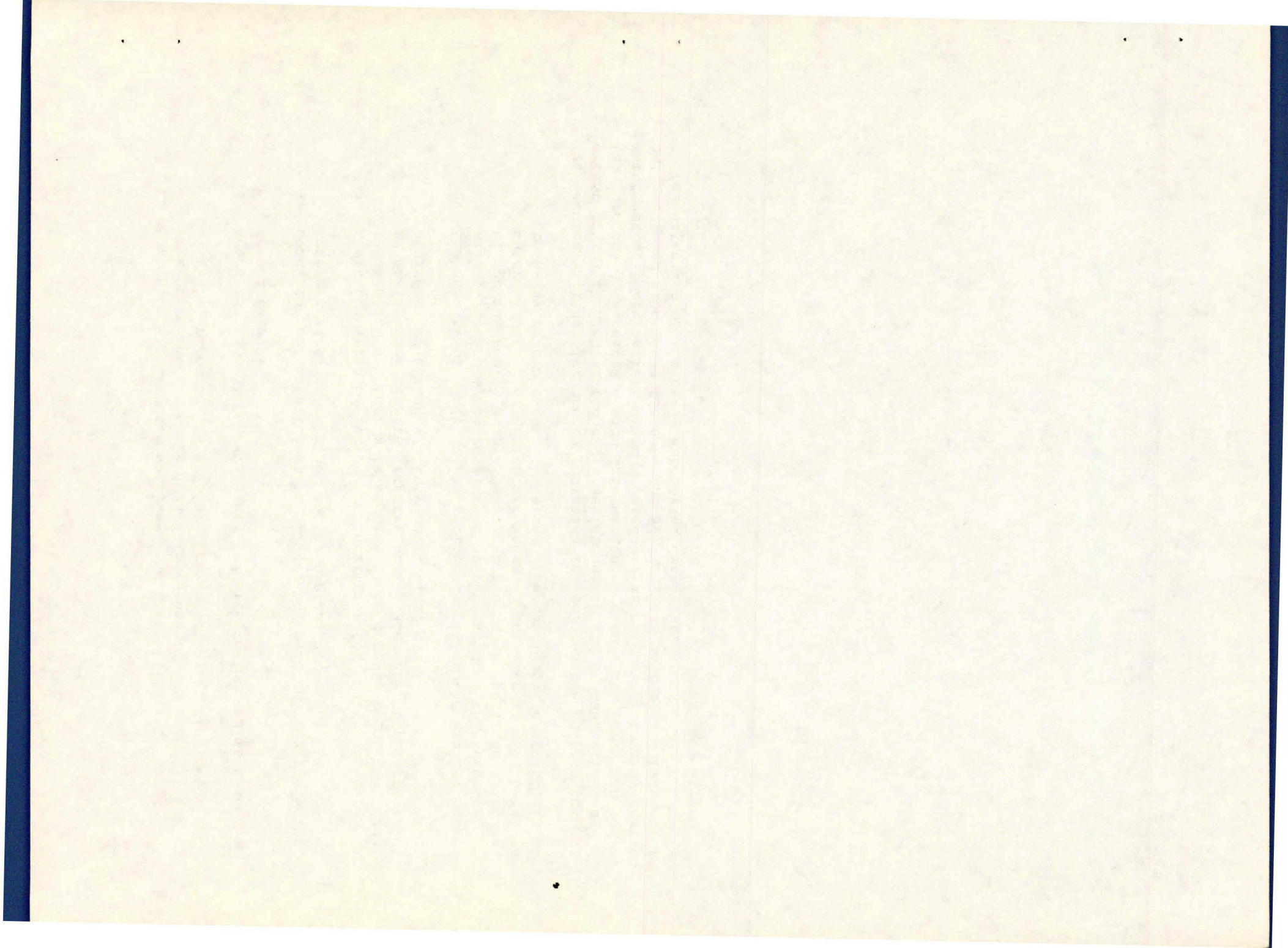




TABLE 1 - ESTIMATED INSTALLATION COST

Troublesome Creek Watershed, Iowa

Installation Cost Item	Unit	Number		Estimated Cost (Dollars) <sup>1/</sup>						TOTAL
		Non-Fed. Land	Total	P.L. 566 Funds			Other			
				Non-Fed. Land			Non-Fed. Land			
				SCS 3/	F. S. 3/	Total	SCS 3/	F. S. 3/	Total	
<b>LAND TREATMENT</b>										
Land Areas <sup>2/</sup>										
Cropland	Ac.	8,049	-	-	-	540,770	-	540,770	-	540,770
Pastureland	Ac.	2,683	-	-	-	125,650	-	125,650	-	125,650
Forest Land	Ac.	540	-	-	-	-	8,300	8,300	-	8,300
Technical Assistance			68,630	7,300	75,930	58,540	1,400	59,940		135,870
<b>TOTAL LAND TREATMENT</b>			68,630	7,300	75,930	724,960	9,700	734,660		810,590
<b>STRUCTURAL MEASURES</b>										
<b>Construction</b>										
Grade Stab. Structures	No.	135	1,849,980	-	1,849,980	-	-	-	-	1,849,980
Floodwater Retarding Struc.	No.	2	192,640	-	192,640	-	-	-	-	192,640
Multi-Purpose Struc. D-47	No.	1	106,660	-	106,660	13,180	-	13,180	-	119,840
Recreational Facilities	No.	1	61,060	-	61,060	61,060	-	61,060	-	122,120
Multi-Purpose Struc. D-62	No.	1	123,920	-	123,920	10,480	-	10,480	-	134,400
Recreational Facilities	No.	1	30,350	-	30,350	30,350	-	30,350	-	60,700
Mitigation Measures	Ac.	100	15,600	-	15,600	-	-	-	-	15,600
Subtotal - Construction			2,380,210	-	2,380,210	115,070	-	115,070		2,495,280
Engineering Services			477,650	-	477,650	18,280	-	18,280		495,930
Relocation Payments			27,160	-	27,160	9,940	-	9,940		37,100
<b>Project Administration</b>										
Construction Inspection			293,140	-	293,140	7,040	-	7,040		300,180
Other			71,300	-	71,300	26,450	-	26,450		97,750
Relocation Assist. Adv. Services						930	-	930		930
Subtotal - Administration			364,440	-	364,440	34,420	-	34,420		398,860
<b>Other Costs</b>										
Land Rights			166,810	-	166,810	367,240	-	367,240 <sup>4/</sup>		534,050
<b>TOTAL STRUCTURAL MEASURES</b>			3,416,270	-	3,416,270	544,950	-	544,950		3,961,220
<b>TOTAL PROJECT</b>			3,484,900	7,300	3,492,200	1,269,910	9,700	1,279,610		4,771,810

Footnotes 1 thru 4 on following page

Date: August 1972

Sheet 1 of 2



Troublesome Creek Watershed, Iowa

Footnotes - Table 1

- 1/ Price base - 1971
- 2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.
- 3/ Federal agency responsible for assisting in installation of works of improvement.
- 4/ Includes \$5,600 for land rights of mitigation measures.

Sheet 2 of 2



TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

## Troublesome Creek Watershed, Iowa

Measures	Unit	Applied to Date	
		Amount	Value <sup>1/</sup> (Dollars)
(1)	(2)	(3)	(4)
<u>Soil Conservation Service</u>			
<u>Land Treatment Measures</u>			
Contour Farming	Ac.	39,087	58,630
Grassed Waterways	Ac.	977	78,160
Terraces, Level	Mi.	246	98,940
Terraces, Gradient	Mi.	114	46,760
Terraces, Parallel	Mi.	5	2,890
Minimum Tillage	Ac.	2,405	4,810
Diversions	Mi.	8	4,000
Farm Ponds	No.	20	12,500
Pasture Planting	Ac.	650	20,150
Wildlife Habitat Development	Ac.	25	1,180
Grade Stabilization Structures	No.	26	49,920
Tile Drains	Mi.	120	146,880
Drainage Mains and Laterals	Mi.	10	14,120
Drainage Field Ditches	Mi.	9	4,320
Land Grading	Ac.	40	2,400
Conservation Plans Prepared	No.	223	-
Conservation Plans Revised	No.	15	-
District Cooperators	No.	324	-
<u>Forest Service</u>			
Grazing Control	Ac.	200	3,000
Fire Control	Ac.	832	1,000
TOTAL	xx	xx	549,660

<sup>1/</sup> Price Base: 1971

Date: August 1972



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L.566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Grade Stabilization Structures											
7-1	4,590	920			5,510			50		50	5,560
8-1	14,560	2,910			17,470			100		100	17,570
10-1	14,220	2,840			17,060			640		640	17,700
15-1	5,490	1,100			6,590			50		50	6,640
16-1	29,120	5,820			34,940		2,800		2,800	2,800	37,740
16-2	18,030	3,610			21,640		2,280		2,280	2,280	23,920
16-3	14,450	2,890			17,340		1,760		1,760	1,760	19,100
20-1	3,580	720			4,300			50		50	4,350
21	15,680	3,140			18,820		150		150	150	18,970
21-1	21,390	4,280			25,670		4,240		4,240	4,240	29,910
23-2	15,340	3,070			18,410		1,620		1,620	1,620	20,030
24-1	20,720	4,140			24,860		1,140		1,140	1,140	26,000
24-2	19,600	3,920			23,520		2,780		2,780	2,780	26,300
24-3	20,830	4,170			25,000		1,520		1,520	1,520	26,520
25	15,230	3,050			18,280		150		150	150	18,430
25-2	13,330	2,670			16,000		1,440		1,440	1,440	17,440
25-3	15,680	3,140			18,820		1,080		1,080	1,080	19,900
27-1	18,370	3,670			22,040		1,640		1,640	1,640	23,680
27-2	1,790	360			2,150		50		50	50	2,200
28	19,380	3,880			23,260		150		150	150	23,410
28-1	8,510	1,700			10,210		50		50	50	10,260
29-1	12,320	2,460			14,780		940		940	940	15,720
31-1	15,340	3,070			18,410		100		100	100	18,510
31-2	14,450	2,890			17,340		1,660		1,660	1,660	19,000



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L. 566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31-4	10,530	2,110			12,640			920		920	13,560
32-1	14,000	2,800			16,800			1,820		1,820	18,620
34-1	14,110	2,820			16,930			740		740	17,670
35-1	12,990	2,600			15,590			940		940	16,530
36-2	15,900	3,180			19,080			1,340		1,340	20,420
36-4	25,760	5,150			30,910			2,320		2,320	33,230
36-5	19,040	3,810			22,850			1,040		1,040	23,890
38-1	25,420	5,080			30,500			3,460		3,460	33,960
38-2	19,490	3,900			23,390			150		150	23,540
38-4	23,860	4,770			28,630			1,240		1,240	29,870
38-5	3,020	600			3,620			50		50	3,670
38-6	22,620	4,520			27,140			2,040		2,040	29,180
38-7	2,240	450			2,690			50		50	2,740
38-8	20,380	4,080			24,460			2,260		2,260	26,720
38-9	17,250	3,450			20,700			100		100	20,800
39-1	2,910	580			3,490			50		50	3,540
39-2	16,460	3,290			19,750			2,160		2,160	21,910
39-3	18,700	3,740			22,440			1,160		1,160	23,600
40-1	17,360	3,470			20,830			1,160		1,160	21,990
41-1	17,020	3,400			20,420			740		740	21,160
41-2	16,460	3,290			19,750			840		840	20,590
41-4	10,300	2,060			12,360			100		100	12,460
42-1	20,610	4,120			24,730			1,000		1,000	25,730
42-2	16,910	3,380			20,290			580		580	20,870
44-1	21,840	4,370			26,210			720		720	26,930
45	17,360	3,470			20,830			740		740	21,570
46	14,340	2,870			17,210			1,340		1,340	18,550



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L. 566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
47-3	15,900	3,180			19,080			340		340	19,420
47-4	15,010	3,000			18,010			320		320	18,330
47-5	7,500	1,500			9,000			100		100	9,100
47-6	4,030	810			4,840			50		50	4,890
48-3	20,610	4,120			24,730			2,080		2,080	26,810
48-4	2,910	580			3,490			50		50	3,540
48-5	17,020	3,400			20,420			340		340	20,760
49-1	16,350	3,270			19,620			440		440	20,060
49-2	2,910	580			3,490			50		50	3,540
49-3	19,710	3,940			23,650			1,160		1,160	24,810
49-4	2,800	560			3,360			50		50	3,410
49-5	14,450	2,890			17,340			840		840	18,180
49-8	3,920	780			4,700			50		50	4,750
50-1	16,800	3,360			20,160			720		720	20,880
50-2	24,080	4,820			28,900			1,360		1,360	30,260
50-3	3,020	600			3,620			50		50	3,670
50-4	17,020	3,400			20,420			420		420	20,840
51-1	2,130	430			2,560			50		50	2,610
53-1	13,890	2,780			16,670			220		220	16,890
53-2	7,170	1,430			8,600			100		100	8,700
53-5	14,340	2,870			17,210			520		520	17,730
53-6	11,090	2,220			13,310			440		440	13,750
53-7	15,340	3,070			18,410			360		360	18,770
53-8	11,760	2,350			14,110			100		100	14,210
53-9	1,570	310			1,880			50		50	1,930



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L. 566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
53-10	2,020	400			2,420			50		50	2,470
53-11	12,430	2,490			14,920			100		100	15,020
53-12	4,590	920			5,510			50		50	5,560
56-1	4,590	920			5,510			50		50	5,560
56-2	3,920	780			4,700			50		50	4,750
57-1	1,460	290			1,750			50		50	1,800
57-2	5,150	1,030			6,180			50		50	6,230
58-1	12,210	2,440			14,650			220		220	14,870
59-1	8,290	1,660			9,950			100		100	10,050
60-1	13,780	2,760			16,540			940		940	17,480
62-3	10,980	2,200			13,180			100		100	13,280
62-4	5,940	1,190			7,130			100		100	7,230
62-5	14,900	2,980			17,880			100		100	17,980
62-6	15,680	3,140			18,820			100		100	18,920
62-7	3,360	670			4,030			50		50	4,080
66-1	6,270	1,250			7,520			100		100	7,620
66-2	10,080	2,020			12,100			100		100	12,200
66-3	9,180	1,840			11,020			50		50	11,070
66-4	10,750	2,150			12,900			520		520	13,420
67-1	2,350	470			2,820			50		50	2,870
68	12,430	2,490			14,920			100		100	15,020
69-1	6,270	1,250			7,520			100		100	7,620
69-2	13,550	2,710			16,260			1,320		1,320	17,580
70-2	2,240	450			2,690			50		50	2,740
70-3	2,020	400			2,420			50		50	2,470



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L. 566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
75-1	13,780	2,760			16,540			100		100	16,640
75-2	12,320	2,460			14,780			620		620	15,400
76-2	2,130	430			2,560			50		50	2,610
78-1	2,910	580			3,490			50		50	3,540
78-2	29,230	5,850			35,080			200		200	35,280
78-3	18,370	3,670			22,040			1,640		1,640	23,680
78-4	16,020	3,200			19,220			740		740	19,960
78-5	1,230	250			1,480			50		50	1,530
80	17,020	3,400			20,420			100		100	20,520
80-1	8,900	1,780			10,680			80		80	10,760
						(8,900)	(1,780)	(80)		(10,760)	(10,760) <u>2/</u>
80-2	23,300	4,660			27,960			1,200		1,200	29,160
81	11,370	2,270			13,640			80		80	13,720
						(11,370)	(2,270)			(13,720)	(13,720) <u>2/</u>
81-1	17,250	3,450			20,700			680		680	21,380
81-3	16,240	3,250			19,490			2,220		2,220	21,710
81-4	19,380	3,880			23,260			1,400		1,400	24,660
81-5	2,580	520			3,100			50		50	3,150
81-6	16,690	3,340			20,030			620		620	20,650
83-1	12,660	2,530			15,190			820		820	16,010
83-2	14,560	2,910			17,470			240		240	17,710
84	11,430	2,290			13,720			100		100	13,820
						(11,430)	(2,290)	(100)		(13,820)	(13,820)
84-1	27,100	5,420			32,520			980		980	33,500
84-2	26,540	5,310			31,850			480		480	32,330



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L. 566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
84-3	22,180	4,440			26,620			760		760	27,380
85-1	28,220	5,640			33,860			880		880	34,740
85-2	19,940	3,990			23,930			740		740	24,670
85-3	20,610	4,120			24,730			1,100		1,100	25,830
85-5	27,550	5,510			33,060			1,240		1,240	34,300
85-6	3,020	600			3,620			50		50	3,670
85-7	20,160	4,030			24,190			1,820		1,820	26,010
85-8	14,560	2,910			17,470			940		940	18,410
86-1	37,520	7,500			45,020			980		980	46,000
86-2	29,570	5,910			35,480			2,080		2,080	37,560
86-3	18,480	3,700			22,180			1,140		1,140	23,320
86-4	22,510	4,500			27,010			960		960	27,970
<hr/>											
Subtotal - Grade Stabilization Str.	1,849,980	369,990			2,219,970	(31,700)	(6,340)	95,500 (260)		95,500 (38,300)	2,315,470 (38,300)
<hr/>											
Mitigation Measures	15,600				15,600			5,600		5,600	21,200
<hr/>											



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Item	Installation Cost P. L. 566 Funds					Installation Cost - Other Funds					Total
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total P.L.566	Construc- tion	Engi- neering	Land Rights	Reloca- tion Payments	Total Other	Installa- tion Cost
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Single Purpose Flood Prevention											
D-38	69,440	13,890		4,250	87,580			27,000	1,550	28,550	116,130
D-53	123,200	24,640		2,270	150,110			59,000	830	59,830	209,940
Subtotal - F. P.	192,640	38,530		6,520	237,690			86,000	2,380	88,380	326,070
Multi-Purp. Str.D-47	106,660	23,970	40,770	10,540	181,940	13,180	-	41,670 <sup>3/</sup>	3,860	58,710	240,650
Recreational Fac.	61,060	12,210	28,510 <sup>4/</sup>	-	101,780	61,060	12,210	30,980 <sup>5/</sup>	-	104,250	206,030
Multi-Purp. Str.D-62	123,920	26,880	61,330	10,100	222,230	10,480	-	67,630 <sup>6/</sup>	3,700	81,810	304,040
Recreational Fac.	30,350	6,070	36,200 <sup>7/</sup>	-	72,620	30,350	6,070	39,860 <sup>8/</sup>	-	76,280	148,900
Subtotal M.P. Str.	321,990	69,130	166,810	20,640	578,570	115,070	18,280	180,140	7,560	321,050	899,620
Subtotal	2,380,210	477,650	166,810	27,160	3,051,830	115,070	18,280	367,240	9,940	510,530	3,562,360
						(31,700)	(6,340)	(260)		(38,300)	(38,300)
Project Adm.	XX	XX	XX	XX	364,440	XX	XX	XX	XX	34,420	398,860
										(5,070)	(5,070)
GRAND TOTAL	2,380,210	477,650	166,810	27,160 <sup>9/</sup>	3,416,270	115,070	18,280	367,240	9,940 <sup>9/</sup>	544,950	3,961,220
						(31,700)	(6,340)	(260)		(43,370)	(43,370)

Footnotes 1 thru 9 on following page.

Date: August 1972

Sheet 7 of 8



Troublesome Creek Watershed, Iowa

Footnotes - Table 2

- 1/ Price base - 1971
- 2/ Non-project costs for road purposes
- 3/ Includes \$900 for flowage easements
- 4/ Includes \$7500 for raising bridge
- 5/ Includes \$7500 for raising bridge and \$2470 for land surveys, title searches etc.
- 6/ Includes \$6300 for flowage easements
- 7/ Includes \$6000 for raising bridge
- 8/ Includes \$6000 for raising bridge and \$3660 for land surveys, title searches, etc.
- 9/ Relocation payments for displacements prior to July 1, 1972 will be shared as provided in P.L. 91-646 and in paragraph numbered 2 of the Work Plan Agreement.



TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Troublesome Creek Watershed, Iowa

(Dollars)<sup>1/</sup>

Item	COST ALLOCATION			COST SHARING					
	PURPOSE			P.L. 566 FUNDS			OTHER FUNDS		
	Flood	Recreation	Total	Flood	Recreation	Total	Flood	Recreation	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
135 Grade Stabilization Struc.	2,315,470	-	2,315,470	2,219,970	-	2,219,970	95,500	-	95,500
2 Single Purpose Flood Prevention Structures	326,070	-	326,070	237,690	-	237,690	88,380	-	88,380
Multiple Purpose Str. D-47 } Basic Recreational Facilities }	125,900	114,750	240,650	121,560	60,380	181,940	4,340	54,370	58,710
Mitigation Measures	21,200	-	21,200	15,600	-	15,600	5,600	-	5,600
GRAND TOTAL	2,943,790	618,570	3,562,360	2,740,260	311,570	3,051,830	203,530	307,000	510,530

<sup>1/</sup> Price Base: 1971

Date: August 1972



## TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS  
 Troublesome Creek Watershed, Iowa  
 Site D-47, Audubon County

(Dollars) 1/

Item	: Number :	Estimated : Unit Cost :	Total Construc- : tion Cost
<u>General</u>			
Access road, 2 lane, 24 ft., mi.	1.42	\$30,000/mi.	\$ 42,600
Water supply system w/electric pump and distribution lines, ea.	1		2,500
Electric system, underground distribution lines, ea.	1		2,000
Gate, ea.	1		100
Fencing, 660 rods		\$5/rod	3,300
Entrance sign, ea.	1		300
Trails, mi.	2.4	\$1200/mi.	2,880
Tree planting, ac.	50	\$60/ac.	3,000
Grass seeding, ac.	100	\$50/ac.	5,000
Sewage system and lagoon			6,000
<u>Beach and Picnic Area A</u>			
Parking area with barriers, spaces	60	\$75/ space	4,500
Beach, above water line:			
Sanded, sq. ft.	6,000	\$0.30/sq. ft.	1,800
Sodded, sq. ft.	4,000	\$0.075/sq.ft.	300
Retainer wall, concrete, ft.	200	\$20/ft.	4,000
Beach, below water line:			
Sanded, sq. ft.	20,000	\$0.30/sq. ft.	6,000
Change house or bathhouse, ea.	1		2,500
Diving float with lifeguard chair, ea.			550
Lifeguard chair on beach, ea.	1		150
Toilets, flush or vault, ea.			
2 units, 2 urinals for males			
4 units for females			
Picnic tables, ea.	30	\$40 each	1,200
Grills, ea.	20	\$40 each	800
Trash can supports, ea.	10	\$10 each	100
Water hydrants, ea.	3	\$50 each	150
Security light, ea.	1		50
Shelter, ea.	1		1,500
Playground equipment, sets	1		500
Signs, ea.	5	\$20 ea.	100



TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS  
 Troublesome Creek Watershed, Iowa  
 Site D-47, Audubon County (Continued)

(Dollars) 1/

Item	:	:	Estimated	:	Total Construc-
	:	Number	Unit Cost	:	tion Cost
<u>Launch Ramp and Picnic Area B</u>					
Parking area with barriers					
Car-trailer, spaces		15	\$100/space		1,500
Car only, spaces		20	\$75/space		1,500
Ramp, single lane, ea.		1			1,000
Dock, ft.		40	\$12.50/ft.		500
Toilet, flush or vault, ea.		1			3,000
1 unit, 1 urinal for males					
2 units for females					
Picnic tables, ea.		14	\$40 each		560
Grills, ea.		10	\$40 each		400
Trash can supports, ea.		5	\$10 each		50
Security light, ea.		1			50
Playground equipment, sets		1			500
Signs		5	\$20 each		100
Water hydrants, ea.		2	\$50 each		100
<u>Picnic Area C</u>					
Parking area with barriers, spaces		40	\$75/space		3,000
Shelter, ea.		1			5,000
Picnic tables, ea.		30	\$40 each		1,200
Grills, ea.		18	\$40 each		720
Trash can supports, ea.		9	\$10 each		90
Toilets, flush or vault, ea.		1			3,000
1 unit, 1 urinal for males					
2 units for females					
Water hydrants, ea.		2	\$50 each		100
Playground equipment, sets		1			500
Signs, ea.		4	\$20 each		80
<u>Fishing Access</u>					
Parking area with barriers, spaces		10	\$75/space		750
Toilets, vault					
1 unit each sex, ea.		1			1,500
Signs, ea.		2	\$20/sign		40
TOTAL					\$122,120

1/ Price Base - 1971

Date: August 1972

Sheet 2 of 2



## TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS  
 Troublesome Creek Watershed, Iowa  
 Structure D-62, Guthrie County

(Dollars) 1/

Item	:	: Estimated	: Total Construc-
	: Number	: Unit Cost	: tion Cost
<u>General</u>			
Fencing, rods	1,100	\$5/rod	\$ 5,500
Interior roads, 2 land, 24 feet	3,700	3.80/ft.	14,000
Signs, markers, etc.	-	lump sum	1,000
Tree Planting	5,000	0.50 ea.	2,500
Grass Seeding and Sodding	-	lump sum	7,000
Well and Water Hydrant	1	-	1,500
Hiking trails, miles	1	1,200/mi.	1,200
<u>Beach Area</u>			
Beach, grading & sanding, sq. yds.	5,000	1.00/sq/yd.	5,000
Diving Board & Lifeguard Stand	-	lump sum	1,000
Double Vault Latrine	1	2,500	2,500
Change House, men & women	-	lump sum	2,500
Parking, cars	100	40.00 ea.	4,000
<u>Picnic Area</u>			
Picnic Area Site	-	lump sum	550
Double Vault Latrine	1	2,500	2,500
Picnic Tables	50	40.00 ea.	2,000
Picnic Grills	20	40.00 ea.	800
Picnic Fire Rings	5	30.00 ea.	150
Garbage Can Stands	20	10.00 ea.	200
Parking, cars	100	40.00 ea.	4,000
<u>Fishing &amp; Boating</u>			
Launching Ramp & Side Loading Dock	1	1,000	1,000
Fishing Piers	7	200 ea.	1,400
Parking, cars	10	40.00 ea.	400
TOTAL			\$60,700

1/ Price Base - 1971

Date: August, 1972



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
Troublesome Creek Watershed, Iowa

Item	Unit	STRUCTURE NUMBER								
		D-38 <sup>1/</sup>	D-47 <sup>1/</sup>	D-53 <sup>1/</sup>	D-62	10-1 <sup>2/</sup>	16-1	16-2 <sup>3/</sup>	16-3 <sup>3/</sup>	21-1
Class of Structure		b	b	b	b	a	a	a	a	a
Drainage Area	Sq.Mi.	3.90	4.00	6.67	7.50	0.20	1.82	0.80	0.30	0.69
Uncontrolled	Sq.Mi.	2.67	3.51	6.00	-	0.20	1.02	0.50	0.30	0.69
Controlled	Sq.Mi.	1.23	0.49	0.67	-	-	0.80	0.30	-	-
Curve No. (1-day)(AMC II)		76	75	76	76	74	74	74	74	74
Tc	Hrs.	2.0	3.6	3.5	4.7	-	0.50	0.30	0.20	0.75
Elevation Top of Dam	Ft.	1292.5	1306.2	1320.5	1339.0	-	1221.5	1258.0	1296.5	1256.4
Elevation Crest Emergency Spillway	Ft.	1287.5	1301.5	1315.5	1335.0	-	1219.0	1255.5	1294.5	1254.4
Elevation Crest High Stage Inlet	Ft.	1276.0	1294.0	1304.5	1326.2	-	1211.0	1247.0	1287.0	1247.0
Maximum Height of Dam	Ft.	39	39	37	33	28	27	25	24	31
Volume of Fill	Cu.Yd.	70,000	104,000	105,000	100,000	15,000	30,000	20,000	17,000	30,000
Total Capacity	Ac.Ft.	850	1210	1770	2025	-	240.0	112.5	70.0	138.0
Sediment Submerged 1st 50 years	Ac.Ft.	178	264	420	335	-	68.0	24.6	18.0	39.5
Sediment Aerated	Ac.Ft.	37	48	74	60	-	20.0	5.6	6.7	12.5
Beneficial Use - Recreation	Ac.Ft.	-	266	-	315	-	-	-	-	-
Retarding	Ac.Ft.	635	632	1276	1315	-	152.0	82.3	45.3	86.0
Surface Area										
Sediment pool	Ac.	31.3	47	74	72	3	12.5	5.5	3.7	8.4
Retarding pool	Ac.	91.0	115	172	230	5	33.0	16.7	9.3	19.3
Recreation pool	Ac.	-	70.5	-	108	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	6.1	6.1	6.1	6.1	-	6.1	6.1	6.1	5.5
Rainfall Volume (areal) (10 day)	In.	10.5	10.5	10.5	10.5	-	10.3	10.3	10.3	9.3
Runoff Volume (10 day)	In.	5.23	5.05	5.23	5.23	-	4.73	4.73	4.73	3.96
Capacity of High Stage (Max.)	cfs	105	109	106	152	20	72	39.2	19.0	41.7
Frequency operation - Emer.Splwy.	% chance	2	2	2	2	4	2	2	2	4
Size of Conduit	Dia.In.	30	30	30	36	18	30	24	18	24
Emergency Spillway - Type	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Rainfall Volume - (ESH) (areal)	In.	7.6	7.6	7.6	7.6	-	5.2	5.2	5.2	5.2
Runoff Volume (ESH)	In.	4.8	4.8	4.8	4.8	-	2.5	2.5	2.5	2.5
Bottom Width	Ft.	134	104	160	220	-	40	30	32	32
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	6.3	5.5	5.0	4.6	-	2	2	1	1
Slope of Exit Channel	Ft./Ft.	0.032	0.034	0.036	0.039	-	0.03	0.04	0.04	0.04
Maximum water surface elevation	Ft.	1289.4	1303.0	1316.8	1336.1	-	1219.3	1257.9	1294.7	1254.4
Freeboard										
Rainfall Volume (FH) (areal)	In.	13.3	13.3	13.3	13.3	-	7.6	7.6	7.6	7.6
Runoff Volume (FH)	In.	10.14	10.14	10.14	10.14	-	4.5	4.5	4.5	4.5
Maximum water surface elevation	Ft.	1292.5	1306.2	1320.5	1339.0	-	1221.3	1257.7	1296.0	1256.0
Capacity Equivalents										
Sediment Volume	In.	1.51	1.67	1.54	0.99	-	1.62	1.13	1.56	1.42
Retarding Volume	In.	3.05	2.96	3.59	3.29	-	2.80	3.09	2.86	2.33



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
Troublesome Creek Watershed, Iowa

Item	Unit	STRUCTURE NUMBER									
		24-1 <sup>3/</sup>	24-2	24-3	25-2 <sup>3/</sup>	25-3 <sup>3/</sup>	27-1 <sup>3/</sup>	29-1 <sup>3/</sup>	31-2 <sup>3/</sup>	31-4 <sup>3/</sup>	
Class of Structure		a	a	a	a	a	a	a	a	a	
Drainage Area	Sq.Mi.	0.94	0.52	0.65	0.67	0.38	0.41	0.22	0.33	0.17	
Uncontrolled	Sq.Mi.	0.42	0.52	0.65	0.29	0.38	0.41	0.22	0.33	0.17	
Controlled	Sq.Mi.	0.52	-	-	0.38	-	-	-	-	-	
Curve No. (1-day) (AMC II)		74	74	74	74	74	74	74	75	75	
Tc	Hrs.	0.40	0.45	0.70	0.30	0.38	0.50	0.20	0.30	0.15	
Elevation Top of Dam	Ft.	1246.0	1275.0	1254.4	1253.0	1280.0	1258.0	1266.0	1312.2	1321.0	
Elevation Crest Emergency Spillway	Ft.	1244.0	1273.0	1252.4	1251.0	1278.0	1256.0	1264.0	1310.2	1319.0	
Elevation Crest High Stage Inlet	Ft.	1238.0	1266.0	1244.0	1245.0	1271.0	1248.0	1259.0	1305.0	1315.0	
Maximum Height of Dam	Ft.	18	31	34.4	22	32	29	23	22	22	
Volume of Fill	Cu.Yd	15,000	24,000	22,000	14,000	22,000	24,000	17,500	15,000	10,500	
Total Capacity	Ac.Ft.	100.4	141.0	130.0	72.0	88.0	92.6	39.3	47.0	26.6	
Sediment Submerged 1st 50 years	Ac.Ft.	33.0	52.0	49.0	24.0	29.2	31.4	18.5	17.4	13.0	
Sediment Aerated	Ac.Ft.	6.4	16.0	8.5	4.0	14.1	9.1	4.7	4.3	2.8	
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-	
Retarding	Ac.Ft.	61.0	73.0	72.5	64.0	44.7	52.1	16.1	25.3	10.8	
Surface Area											
Sediment pool	Ac.	7.5	9.0	5.9	5.5	5.1	5.3	3.2	3.9	2.5	
Retarding pool	Ac.	15.2	16.5	13.5	11.2	11.2	10.3	5.4	7.6	4.2	
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-	
Principal Spillway											
Rainfall Volume (areal) (1 day)	In.	5.5	5.5	5.5	5.5	5.5	5.5	4.2 <sup>4/</sup>	4.2 <sup>4/</sup>	4.2 <sup>4/</sup>	
Rainfall Volume (areal) (10 day)	In.	9.3	9.3	9.3	9.3	9.3	9.3	-	-	-	
Runoff Volume (10 day)	In.	3.96	3.96	3.96	3.96	3.96	3.96	1.7 <sup>4/</sup>	1.8 <sup>4/</sup>	1.8 <sup>4/</sup>	
Capacity of High Stage (Max.)	cfs	38.0	19.6	45.0	19.8	22.7	20.2	19.0	18.8	19	
Frequency operation - Emer.Splwy.	% chance	4	4	4	4	4	4	4	4	4	
Size of Conduit	Dia.In.	24	18	24	18	18	18	18	18	18	
Emergency Spillway - Type											
Rainfall Volume - (ESH) (areal)	In.	5.2	5.2	5.2	5.2	5.2	5.2	5.5	5.2	5.2	
Runoff Volume (ESH)	In.	2.5	2.5	2.5	2.5	2.5	2.5	2.8	2.5	2.5	
Bottom Width	Ft.	40	32	32	3.2	32	32	16	30	24	
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	1	1	2	3.5	1	1	3	3	3	
Slope of Exit Channel	Ft./Ft.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	
Maximum water surface elevation	Ft.	1244.2	1273.2	1252.7	1251.8	1278.2	1256.2	1264.8	1311.2	1320.0	
Freeboard											
Rainfall Volume (FH) (areal)	In.	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	
Runoff Volume (FH)	In.	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.6	4.6	
Maximum water surface elevation	Ft.	1246.0	1275.0	1254.4	1253.0	1280.0	1258.0	1265.8	1312.2	1321.0	
Capacity Equivalents											
Sediment Volume	In.	1.75	2.48	1.66	1.82	2.16	1.83	1.99	1.24	1.73	
Retarding Volume	In.	2.71	2.68	2.10	4.15	2.24	2.36	1.38	1.45	1.18	



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
 Troublesome Creek Watershed, Iowa

Item	: Unit :	STRUCTURE NUMBER								
		32-1 <sup>3/</sup>	34-1 <sup>3/</sup>	35-1 <sup>3/</sup>	36-2 <sup>3/</sup>	36-4	36-5 <sup>3/</sup>	38-1	38-4 <sup>3/</sup>	38-6
Class of Structure		a	a	a	a	a	a	a	a	a
Drainage Area	Sq.Mi.	0.31	0.25	0.23	0.32	1.43	0.25	0.84	0.34	0.45
Uncontrolled	Sq.Mi.	0.31	0.25	0.23	0.32	0.86	0.25	0.84	0.34	0.45
Controlled	Sq.Mi.	0	0	0	0	0.57	0	0	0	0
Curve No. (1-day)(AMC II)		75	75	75	75	75	75	75	75	75
Tc	Hrs.	0.40	0.40	0.20	0.25	0.45	0.25	0.50	0.49	0.35
Elevation Top of Dam	Ft.	1260.4	1286.0	1277.0	1318.4	1259.0	1295.5	1288.4	1318.2	1332.4
Elevation Crest Emergency Spillway	Ft.	1258.4	1284.0	1275.0	1316.4	1256.5	1293.5	1286.4	1316.2	1330.4
Elevation Crest High Stage Inlet	Ft.	1254.0	1278.0	1269.0	1310.0	1250.0	1286.0	1277.0	1308.0	1322.0
Maximum Height of Dam	Ft.	23	28	26	27	29	29	38	35	37
Volume of Fill	Cu.Yd.	14,000	15,000	15,000	20,000	29,000	24,000	34,000	32,000	29,000
Total Capacity	Ac.Ft.	53.0	43.0	43.5	73.6	172.5	49.5	180.4	67.5	124.2
Sediment Submerged 1st 50 years	Ac.Ft.	24.0	19.0	22.0	30.2	52.0	19.0	57.4	20.5	42.5
Sediment Aerated	Ac.Ft.	6.2	5.0	5.1	3.5	9.4	4.1	13.0	7.4	7.9
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	22.8	19.0	16.4	39.9	111.1	25.4	110.0	39.6	73.8
Surface Area										
Sediment pool	Ac.	5.0	2.9	2.8	4.8	11.8	2.8	8.2	3.2	6.2
Retarding pool	Ac.	8.1	5.3	4.6	8.6	23.9	5.5	19.5	8.6	14.0
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	4.2 <sup>4/</sup>	4.2 <sup>4/</sup>	4.2 <sup>4/</sup>	5.5	5.5	5.5	5.5	5.5	6.1
Rainfall Volume (areal) (10 day)	In.	-	-	-	9.4	9.4	9.4	9.3	9.3	10.3
Runoff Volume (10 day)	In.	1.8 <sup>4/</sup>	1.8 <sup>4/</sup>	1.8 <sup>4/</sup>	4.18	4.18	4.18	4.08	4.08	4.87
Capacity of High Stage (Max.)	cfs	20.2	20	19.1	19.9	68.5	20.3	43.0	22.7	21.3
Frequency operation - Emer. Splwy.	% chance	4	4	4	4	4	4	4	4	2
Size of Conduit	Dia.In.	18	18	18	18	30	18	24	18	18
Emergency Spillway - Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Rainfall Volume - (ESH) (areal)	In.	4.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Runoff Volume (ESH)	In.	1.8	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6
Bottom Width	Ft.	20	20	20	20	46	20	40	34	34
Velocity of Flow (V <sub>e</sub> )	Ft/Sec.	3	3	3	0	0	0	2	2.6	2
Slope of Exit Channel	Ft/Ft.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Maximum water surface elevation	Ft.	1259.4	1285.0	1275.8	1316.4	1256.5	1294.0	1286.7	1316.7	1330.8
Freeboard										
Rainfall Volume (FH) (areal)	In.	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Runoff Volume (FH)	In.	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Maximum water surface elevation	Ft.	1260.4	1286.0	1277.0	1318.4	1259.0	1295.0	1288.4	1317.8	1332.4
Capacity Equivalents										
Sediment Volume	In.	1.83	1.80	2.17	1.97	1.33	1.73	1.56	1.54	2.12
Retarding Volume	In.	1.38	1.42	1.31	2.34	2.42	1.91	2.46	2.19	3.11



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
 Troublesome Creek Watershed, Iowa

Item	: Unit:	STRUCTURE NUMBER								
		38-8 <u>3/</u>	39-2 <u>3/</u>	39-3 <u>3/</u>	40-1 <u>3/</u>	41-1 <u>3/</u>	41-2 <u>3/</u>	42-1	42-2	44-1
Class of Structure		a	a	a	a	a	a	a	a	a
Drainage Area	Sq.Mi.	0.44	0.66	0.34	0.32	0.27	0.30	0.59	0.24	0.32
Uncontrolled	Sq.Mi.	0.44	0.31	0.34	0.32	0.27	0.30	0.35	0.24	0.32
Controlled	Sq.Mi.	0	0.34	0	0	0	0	0.24	0	0
Curve No. (1-day) (AMC II)		75	75	75	75	75	75	75	75	75
Tc	Hrs.	0.36	0.34	0.38	0.49	0.56	0.37	0.42	0.28	0.35
Elevation Top of Dam	Ft.	1343.3	1300.2	1328.3	1301.3	1311.5	1340.8	1298.7	1325.2	1308.0
Elevation Crest Emergency Spillway	Ft.	1341.3	1298.2	1326.3	1299.3	1309.5	1338.8	1296.7	1323.2	1306.0
Elevation Crest High Stage Inlet	Ft.	1334.0	1290.0	1319.0	1292.0	1302.0	1332.0	1290.0	1316.0	1300.0
Maximum Height of Dam	Ft.	30	29	33	28	31	29	32	36	38
Volume of Fill	Cu.Yd.	25,000	15,000	23,000	20,000	17,000	20,000	20,000	21,000	26,000
Total Capacity	Ac.Ft.	99.7	79.3	72.4	58.2	48.4	65.3	138.8	60.0	110.6
Sediment Submerged 1st 50 years	Ac.Ft.	34.0	20.5	24.0	17.8	17.5	27.6	62.5	31.3	61.1
Sediment Aerated	Ac.Ft.	7.6	3.2	4.2	3.2	2.6	3.5	9.5	2.4	4.8
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	58.1	55.6	44.2	37.2	28.3	34.2	66.8	26.3	44.7
Surface Area										
Sediment pool	Ac.	5.6	3.9	3.8	3.5	2.5	4.0	8.2	3.1	6.5
Retarding pool	Ac.	12.2	12.0	9.4	7.8	6.0	7.4	15.0	5.1	9.8
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Rainfall Volume (areal) (10 day)	In.	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Runoff Volume (10 day)	In.	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
Capacity of High Stage (Max.)	cfs	21.0	20.1	16.6	21.8	21.3	21.0	21.4	18.7	17.9
Frequency operation - Emer.Splwy % chance		4	4	4	4	4	4	4	4	4
Size of Conduit	Dia.In.	18	18	18	18	18	18	18	18	18
Emergency Spillway - Type										
Rainfall Volume - (ESH)(areal)	In.	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Runoff Volume (ESH)	In.	2.61	2.61	2.61	2.61	2.61	2.61	2.61	2.61	2.61
Bottom Width	Ft.	24	24	20	20	20	24	34	34	34
Velocity of Flow (V <sub>e</sub> )	Ft/Sec.	1.2	0	2.0	2.5	1.7	1.7	0	2.9	0
Slope of Exit Channel	Ft/Ft.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Maximum water surface elevation	Ft.	1341.4	1298.2	1326.6	1299.8	1309.7	1339.0	1296.7	1323.8	1306.0
Freeboard										
Rainfall Volume (FH) (areal)	In.	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Runoff Volume (FH)	In.	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Maximum water surface elevation	Ft.	1342.9	1299.7	1327.7	1300.9	1311.0	1340.5	1298.5	1324.7	1307.3
Capacity Equivalents										
Sediment Volume	In.	1.78	1.42	1.54	1.23	1.42	1.97	3.84 <u>5/</u>	2.64	3.87 <u>5/</u>
Retarding Volume	In.	2.48	3.34	2.41	2.19	2.00	2.16	3.58	2.06	3.62



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY

Troublesome Creek Watershed, Iowa

Item	: Unit :	STRUCTURE NUMBER								
		45 <u>3/</u>	46 <u>2/</u>	47-3	47-4	48-3 <u>3/</u>	48-5 <u>3/</u>	49-1 <u>3/</u>	49-3 <u>3/</u>	49-5 <u>2/</u>
Class of Structure		a	a	a	a	a	a	a	a	a
Drainage Area	Sq.Mi.	0.30	0.28	0.22	0.27	0.65	0.19	0.30	0.42	0.20
Uncontrolled	Sq.Mi.	0.30	0.28	0.22	0.27	0.46	0.19	0.30	0.42	0.20
Controlled	Sq.Mi.	0	0	0	0	0.19	0	0	0	0
Curve No. (1-day)(AMC II)		75	75	75	75	75	75	75	75	75
Tc	Hrs.	0.46	-	0.26	0.22	0.35	0.30	0.25	0.51	-
Elevation Top of Dam	Ft.	1297.0	-	1344.4	1356.2	1326.6	1364.0	1309.0	1322.5	-
Elevation Crest Emergency Spillway	Ft.	1295.0	-	1342.3	1354.2	1324.6	1362.0	1307.0	1320.5	-
Elevation Crest High Stage Inlet	Ft.	1288.0	-	1336.0	1350.0	1317.0	1358.0	1302.0	1313.0	-
Maximum Height of Dam	Ft.	30	28	30	19	29	30	29	29	28
Volume of Fill	Cu.Yd.	20,000	15,000	19,000	15,000	20,000	20,000	15,000	24,000	15,000
Total Capacity	Ac.Ft.	65.5	-	39.9	41.0	109.5	53.6	51.4	93.5	-
Sediment Submerged 1st 50 years	Ac.Ft.	25.0	-	15.3	18.0	34.7	31.0	25.0	33.0	-
Sediment Aerated	Ac.Ft.	3.7	-	2.6	2.6	6.0	2.2	5.0	5.9	-
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	36.8	-	22.0	20.4	68.8	20.4	21.4	54.6	-
Surface Area										
Sediment pool	Ac.	3.9	3.9	2.7	4.0	6.0	4.2	3.9	4.9	3.0
Retarding pool	Ac.	7.9	6.0	5.2	7.0	13.4	5.9	6.5	9.8	6.0
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal)(1 day)	In.	5.5	-	5.5	5.5	5.5	5.5	4.2 <u>4/</u>	5.5	-
Rainfall Volume (areal)(10 day)	In.	9.3	-	9.3	9.3	9.3	9.3	-	9.3	-
Runoff Volume (10 day)	In.	4.08	-	4.08	4.08	4.08	4.08	1.8 <u>4/</u>	4.08	-
Capacity of High Stage (Max.)	cfs	18.6	20	18.0	20.1	39.0	21.4	22	20.8	20
Frequency operation - Emer. Splwy. % chance		4	4	4	4	4	4	4	4	4
Size of Conduit	Dia.In.	18	18	18	18	24	18	18	18	18
Emergency Spillway - Type										
Rainfall Volume - (ESH) (areal)	In.	5.2	-	5.2	5.2	5.2	5.2	-	5.2	-
Runoff Volume (ESH)	In.	2.61	-	2.61	2.61	2.61	2.61	-	2.61	-
Bottom Width	Ft.	20	-	16	24	36	16	20	30	-
Velocity of Flow (V <sub>e</sub> )	Ft/Sec.	2.1	-	2.6	3.4	0	2.5	3.0	2.1	-
Slope of Exit Channel	Ft/Ft.	0.04	-	0.04	0.04	0.04	0.04	0.04	0.04	-
Maximum water surface elevation	Ft.	1295.4	-	1342.8	1355.0	1324.6	1362.5	1308.0	1320.8	-
Freeboard										
Rainfall Volume (FH) (areal)	In.	7.6	-	7.7	7.7	7.7	7.7	-	7.7	-
Runoff Volume (FH)	In.	4.6	-	4.7	4.7	4.7	4.7	-	4.7	-
Maximum water surface elevation	Ft.	1296.5	-	1344.2	1356.2	1326.2	1363.5	1309.0	1322.4	-
Capacity Equivalents										
Sediment Volume	In.	1.81	-	1.54	1.45	1.68	3.32 <u>5/</u>	1.90	1.73	-
Retarding Volume	In.	2.32	-	1.89	1.44	2.79	2.04	1.35	2.43	-



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
 Troublesome Creek Watershed, Iowa

Item	Unit:	STRUCTURE NUMBER								
		50-1 <u>3/</u>	50-2	50-4	53-1	53-5 <u>3/</u>	53-6 <u>3/</u>	53-7 <u>3/</u>	58-1 <u>2/</u>	60-1 <u>2/</u>
Class of Structure		a	a	a	a	a	a	a	a	a
Drainage Area	Sq.Mi.	0.20	0.72	0.24	0.13	0.14	0.12	0.28	0.18	0.27
Uncontrolled	Sq.Mi.	0.20	0.48	0.24	0.13	0.14	0.12	0.28	0.18	0.27
Controlled	Sq.Mi.	0	0.24	0	0	0	0	0	0	0
Curve No. (1-day)(AMC II)		75	75	75	75	75	75	75	76	76
Tc	Hrs.	0.28	0.70	0.34	0.23	0.30	0.25	0.25	-	-
Elevation Top of Dam	Ft.	1310.5	1326.4	1369.0	1344.3	1414.0	1397.7	1340.0	-	-
Elevation Crest Emergency Spillway	Ft.	1308.5	1324.4	1367.0	1342.3	1412.0	1395.7	1338.0	-	-
Elevation Crest High Stage Inlet	Ft.	1304.0	1316.0	1360.0	1338.0	1407.0	1392.0	1333.0	-	-
Maximum Height of Dam	Ft.	24	31	28	23	29	22	30	26	27
Volume of Fill	Cu.Yd.	19,000	34,000	20,000	15,000	15,000	12,000	17,000	15,000	17,000
Total Capacity	Ac.Ft.	37.2	163.1	46.5	26.1	20.9	15.5	50.2	-	-
Sediment Submerged 1st 50 years	Ac.Ft.	17.8	55.8	15.8	11.5	10	7.4	23.5	-	-
Sediment Aerated	Ac.Ft.	2.3	5.4	2.4	2.2	3.1	1.2	6.5	-	-
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	17.1	101.9	28.3	12.4	7.8	6.9	20.2	-	-
Surface Area										
Sediment pool	Ac.	3.1	8.3	2.8	2.4	1.6	1.7	4.1	3	4
Retarding pool	Ac.	5.6	17.1	6.0	4.1	2.9	2.8	7.3	5	8
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	5.5	5.5	5.5	5.5	4.2 <u>4/</u>	3.6 <u>4/</u>	4.2 <u>4/</u>	-	-
Rainfall Volume (areal) (10 day)	In.	9.3	9.3	9.3	9.3	-	-	-	-	-
Runoff Volume (10 day)	In.	4.08	4.08	4.08	4.08	1.8 <u>4/</u>	1.4 <u>4/</u>	1.8 <u>4/</u>	-	-
Capacity of High Stage (Max.)	cfs	19.2	21.8	20.7	18.5	20.5	5.0	21.2	20.0	20.0
Frequency operation - Emer.Splwy.	% chance	4	4	4	4	4	10	4	4	4
Size of Conduit	Dia.In.	18	18	18	18	18	12	18	18	18
Emergency Spillway - Type	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Rainfall Volume - (ESH) (areal)	In.	5.2	5.2	5.2	5.2	5.2	-	5.2	-	-
Runoff Volume (ESH)	In.	2.61	2.61	2.61	2.61	2.61	-	2.6	-	-
Bottom Width	Ft.	16	36	34	16	16	16	24	-	-
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	2.6	0	2.3	2.7	2.3	4.4	3.9	-	-
Slope of Exit Channel	Ft./Ft.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-	-
Maximum water surface elevation	Ft.	1309.0	1324.4	1368.2	1342.8	1412.4	1396.7	1338.8	-	-
Freeboard										
Rainfall Volume (FH) (areal)	In.	7.7	7.7	7.7	7.7	7.6	-	7.6	-	-
Runoff Volume (FH)	In.	4.7	4.7	4.7	4.7	4.6	-	4.6	-	-
Maximum water surface elevation	Ft.	1310.4	1325.6	1369.0	1343.7	1414.0	1397.7	1340.0	-	-
Capacity Equivalents										
Sediment Volume	In.	1.94	2.39 <u>5/</u>	1.41	1.98	1.75	1.38	2.00	-	-
Retarding Volume	In.	1.65	3.98	2.21	1.79	1.81	1.04	1.35	-	-



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
 Troublesome Creek Watershed, Iowa

Item	Unit	STRUCTURE NUMBER								
		66-4 <u>2/</u>	69-2 <u>2/</u>	75-2 <u>2/</u>	78-3 <u>3/</u>	78-4 <u>3/</u>	80-1	80-2	81-1 <u>3/</u>	81-3 <u>3/</u>
Class of Structure		a	a	a	a	a	a	a	a <u>6/</u>	a <u>6/</u>
Drainage Area	Sq.Mi.	0.14	0.27	0.19	0.48	0.28	0.79	0.46	0.94	0.61
Uncontrolled	Sq.Mi.	0.14	0.27	0.19	0.48	0.28	0.33	0.46	0.33	0.42
Controlled	Sq.Mi.	0	0	0	0	0	0.46	0	0.61	0.19
Curve No. (1-day) (AMC II)		76	76	74	74	74	75	75	75	75
Tc	Hrs.	-	-	-	0.45	0.25	0.20	0.25	0.25	0.25
Elevation Top of Dam	Ft.	-	-	-	1288.0	1300.0	1258.0	1294.0	1253.6	1284.5
Elevation Crest Emergency Spillway	Ft.	-	-	-	1286.0	1298.0	1255.0	1292.0	1250.6	1281.5
Elevation Crest High Stage Inlet	Ft.	-	-	-	1278.0	1292.0	1248.0	1284.0	1242.0	1274.0
Maximum Height of Dam	Ft.	24	26	28	28	32	32	36	31	26
Volume of Fill	Cu.Yd.	15,000	17,000	15,000	22,000	21,000	24,000	20,000	17,000	18,000
Total Capacity	Ac.Ft.	-	-	-	106	52.0	89.0	130.7	99.0	100.0
Sediment Submerged 1st 50 years	Ac.Ft.	-	-	-	32.0	23.7	33.9	60.0	32.0	25.0
Sediment Aerated	Ac.Ft.	-	-	-	8.8	8.0	7.8	6.7	5.3	4.3
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	-	-	-	65.2	20.3	47.3	64.0	61.7	70.7
Surface Area										
Sediment pool	Ac.	2	4	3	6.0	3.1	5.5	6.1	4.5	5.8
Retarding pool	Ac.	3	7	5	13.0	6.9	10.4	12.1	11.8	13.9
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	-	-	-	5.5	4.2 <u>4/</u>	6.1	6.1	6.1	6.1
Rainfall Volume (areal) (10 day)	In.	-	-	-	9.3	-	10.3	10.3	10.3	10.3
Runoff Volume (10 day)	In.	-	-	-	3.96	1.8 <u>4/</u>	4.87	4.87	4.87	4.87
Capacity of High Stage (Max.)	cfs	20.0	20.0	20.0	19.3	21	38.5	21.1	45.5	40.5
Frequency operation - Emer.Splwy. % chance		4	4	4	4	4	2	2	2	2
Size of Conduit	Dia.In.	18	18	18	18	18	24	18	24	24
Emergency Spillway - Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Rainfall Volume - (ESH) (areal)	In.	-	-	-	5.2	4.2	5.2	5.2	7.6	7.6
Runoff Volume (ESH)	In.	-	-	-	2.6	1.8	2.6	2.6	4.6	4.6
Bottom Width	Ft.	-	-	-	20	30	18	34	100	70
Velocity of Flow (V <sub>e</sub> )	Ft./Sec.	-	-	-	0	0	0	0	2.5	4.7
Slope of Exit Channel	Ft./Ft.	-	-	-	0.04	0.04	0	0.04	0.03	0.038
Maximum water surface elevation	Ft.	-	-	-	1286.0	1298.0	1255.0	1292.0	1251.0	1282.6
Freeboard										
Rainfall Volume (FH) (areal)	In.	-	-	-	7.6	7.6	7.6	7.6	13.3	13.3
Runoff Volume (FH)	In.	-	-	-	4.6	4.6	4.6	4.6	9.9	9.9
Maximum water surface elevation	Ft.	-	-	-	1287.9	1299.8	1257.8	1293.7	1253.6	1284.5
Capacity Equivalents										
Sediment Volume	In.	-	-	-	1.58	2.11	2.38	2.71 <u>5/</u>	2.13	1.30
Retarding Volume	In.	-	-	-	2.56	1.35	2.70	2.60	3.52	3.13



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
Troublesome Creek Watershed, Iowa

Item	: Unit :	S T R U C T U R E N U M B E R									
		81-4 <sup>3/</sup>	81-6 <sup>3/</sup>	83-1 <sup>3/</sup>	83-2 <sup>3/</sup>	84-1	84-2	84-3	85-1	85-2 <sup>6/</sup>	
Class of Structure		a	a <sup>5/</sup>	a	a	b	a <sup>5/</sup>	a <sup>5/</sup>	b	a	
Drainage Area	Sq.Mi.	0.44	0.19	0.20	0.16	1.16	0.70	0.35	1.22	0.78	
Uncontrolled	Sq.Mi.	0.44	0.19	0.20	0.16	0.46	0.35	0.35	0.44	0.36	
Controlled	Sq.Mi.	0	0	0	0	0.70	0.35	0	0.78	0.42	
Curve No. (1-day) (AMC II)		75	75	75	75	75	75	75	75	75	
Tc	Hrs.	0.40	0.25	0.20	0.15	0.41	0.38	0.35	0.25	0.25	
Elevation Top of Dam	Ft.	1251.0	1328.1	1279.4	1282.0	1261.0	1292.0	1322.0	1262.0	1306.5	
Elevation Crest Emergency Spillway	Ft.	1249.0	1325.6	1277.4	1280.0	1257.5	1288.5	1319.0	1258.0	1303.0	
Elevation Crest High Stage Inlet	Ft.	1240.0	1320.0	1274.0	1276.0	1252.0	1282.0	1312.0	1252.0	1296.0	
Maximum Height of Dam	Ft.	31	26	22	35	29	40	40	27	32	
Volume of Fill	Cu.Yd.	21,000	21,000	13,000	15,000	18,000	30,000	24,000	20,000	22,000	
Total Capacity	Ac.Ft.	88.0	41.4	35.2	32.8	117.0	215.0	131.0	76.0	125.0	
Sediment Submerged 1st 50 years	Ac.Ft.	28.6	15.2	17.8	21.7	55.3	115.0	73.2	28.8	55.7	
Sediment Aerated	Ac.Ft.	5.3	2.4	3.0	2.2	7.1	5.8	5.1	3.9	4.9	
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-	
Retarding	Ac.Ft.	54.1	23.8	14.4	8.9	54.6	94.2	52.7	43.3	64.4	
Surface Area											
Sediment pool	Ac.	4.2	3.2	4.1	2.3	8.3	11.4	6.3	5.3	6.9	
Retarding pool	Ac.	9.6	6.0	5.8	3.6	14.2	18.1	10.4	12.2	13.0	
Recreation pool	Ac.	-	-	-	-	-	-	-	-	-	
Principal Spillway											
Rainfall Volume (areal) (1 day)	In.	6.1	6.1	4.2 <sup>4/</sup>	4.2 <sup>4/</sup>	6.1	6.1	6.1	6.1	6.1	
Rainfall Volume (areal) (10 day)	In.	10.3	10.3	-	-	10.4	10.4	10.4	10.3	10.3	
Runoff Volume (10 day)	In.	4.87	4.87	1.8 <sup>4/</sup>	1.8 <sup>4/</sup>	4.97	4.97	4.97	4.87	4.87	
Capacity of High Stage (Max.)	cfs	43.6	21.0	19.3	21.0	105.5	19.2	19.1	98.0	42	
Frequency operation - Emer. Splwy. % chance		2	2	4	4	2	2	2	2	2	
Size of Conduit	Dia.In.	24	18	18	18	30	18	18	30	24	
Emergency Spillway - Type	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	
Rainfall Volume - (ESH) (areal)	In.	5.2	7.6	5.2	5.2	7.6	7.6	7.6	7.7	7.7	
Runoff Volume (ESH)	In.	2.6	4.6	2.6	2.6	4.6	4.6	4.6	4.76	4.76	
Bottom Width	Ft.	20	40	16	16	68	42	46	74	50	
Velocity of Flow (V <sub>e</sub> )	Ft/Sec.	0	3.3	0	0	4.1	3.6	4.8	4.6	4.3	
Slope of Exit Channel	Ft/Ft.	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	
Maximum water surface elevation	Ft	1249.0	1326.5	1277.4	1280.0	1258.5	1289.3	1320.1	1259.4	1304.1	
Freeboard											
Rainfall Volume (FH) (areal)	In.	7.6	13.3	7.6	7.6	13.3	13.3	13.3	13.3	13.3	
Runoff Volume (FH)	In.	4.6	9.9	4.6	4.6	9.9	9.9	9.9	9.9	9.9	
Maximum water surface elevation	Ft.	1251.0	1328.1	1279.0	1281.4	1261.0	1292.0	1322.0	1262.0	1306.5	
Capacity Equivalents											
Sediment Volume	In.	1.45	1.76	1.95	2.87 <sup>5/</sup>	2.58 <sup>5/</sup>	6.44 <sup>5/</sup>	4.19 <sup>5/</sup>	1.40	3.16 <sup>5/</sup>	
Retarding Volume	In.	2.32	2.38	1.35	1.07	2.26	5.02	2.87	1.85	3.36	



TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY  
Troublesome Creek Watershed, Iowa

Item	Unit	STRUCTURE NUMBER								TOTAL
		85-3	85-5	85-7 <u>2/</u>	85-8 <u>3/</u>	86-1	86-2	86-3	86-4	
Class of Structure		a <u>6/</u>	a	a	a	b	a <u>6/</u>	a <u>6/</u>	a <u>6/</u>	
Drainage Area	Sq.Mi.	0.42	0.64	0.47	0.235	1.47	1.08	0.31	0.31	44.63
Uncontrolled	Sq.Mi.	0.42	0.64	0.235	0.235	0.39	0.47	0.31	0.30	
Controlled	Sq.Mi.	0	0	0.235	0	1.08	0.61	0	0	
Curve No. (1-day) (AMC II)		75	75	75	75	75	75	75	75	
Tc	Hrs.	0.25	0.25	0.15	0.15	0.25	0.35	0.35	0.35	
Elevation Top of Dam	Ft.	1340.0	1288.4	1285.8	1327.0	1257.0	1289.8	1332.3	1332.0	
Elevation Crest Emergency Spillway	Ft.	1337.0	1286.4	1283.8	1325.0	1251.5	1286.0	1329.5	1328.7	
Elevation Crest High Stage Inlet	Ft.	1328.0	1280.0	1276.0	1318.0	1245.0	1280.0	1323.0	1321.0	
Maximum Height of Dam	Ft.	37	36	33	32	35	29	25	29	
Volume of Fill	Cu.Yd	27,000	30,000	18,000	21,000	50,000	27,000	20,000	28,000	1,955,000
Total Capacity	Ac.Ft.	110.0	188.0	84.0	47.6	103.8	114.0	82.5	70.1	11,744.3
Sediment Submerged 1st 50 years	Ac.Ft.	39.4	102.4	33.4	18.6	43.0	37.7	28.5	22.6	3,464.8
Sediment Aerated	Ac.Ft.	2.9	2.7	4.5	5.0	11.8	3.7	5.6	4.0	608.3
Beneficial Use - Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	581.0
Retarding	Ac.Ft.	67.7	82.9	46.0	24.0	49.0	72.6	48.4	43.5	7,109.2
Surface Area										
Sediment pool	Ac.	4.9	10.9	4.7	2.8	6.1	8.0	4.7	4.0	598.8
Retarding pool	Ac.	11.6	15.8	8.6	5.6	13.5	16.6	10.5	8.4	1,362.3
Recreation pool	Ac.	-	-	-	-	-	-	-	-	178.5
Principal Spillway										
Rainfall Volume (areal) (1 day)	In.	6.1	5.5	5.5	5.5	6.1	6.1	6.1	6.1	
Rainfall Volume (areal) (10 day)	In.	10.3	9.3	9.3	9.3	10.3	10.3	10.3	10.3	
Runoff Volume (10 day)	In.	4.87	4.08	4.08	4.08	4.87	4.87	4.87	4.87	
Capacity of High Stage (Max.)	cfs	21	42	20	21.0	104	67	20.4	21.8	
Frequency operation - Emer. Splwy.	% chance	2	4	4	4	2	2	2	2	
Size of Conduit	Dia.In.	18	24	18	18	30	30	18	18	
Emergency Spillway - Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	
Rainfall Volume - (ESH) (areal)	In.	7.7	5.2	5.2	5.2	7.6	7.6	7.6	7.6	
Runoff Volume (ESH)	In.	4.76	2.6	2.6	2.6	4.6	4.6	4.6	4.6	
Bottom Width	Ft.	58	34	20	20	70	74	42	34	
Velocity of Flow (V)	Ft/Sec.	4.3	2	0	1	6.2	5.0	4.1	4.4	
Slope of Exit Channel	Ft/Ft.	0.04	0.04	0.04	0.04	0.0	0.04	0.04	0.04	
Maximum water surface elevation	Ft.	1338.2	1286.8	1283.1	1325.2	1253.7	1287.5	1330.6	1329.9	
Freeboard										
Rainfall Volume (FH) (areal)	In.	13.3	7.7	7.7	7.7	13.3	13.3	13.3	13.3	
Runoff Volume (FH)	In.	9.9	4.76	4.76	4.76	9.9	9.9	9.9	9.9	
Maximum water surface elevation	Ft.	1340.0	1288.4	1285.5	1327.0	1257.0	1289.8	1332.3	1332.0	
Capacity Equivalents										
Sediment Volume	In.	1.87	3.07 <u>5/</u>	3.04 <u>5/</u>	1.92	2.64	1.66	2.05	1.68	
Retarding Volume	In.	3.01	2.42	3.65	1.90	2.35	2.90	2.90	2.75	



TROUBLESOME CREEK WATERSHED

FOOTNOTES TO TABLE 3 - STRUCTURAL DATA

- 1/ For structure design, structures upstream were ignored in flood routing, but were credited for sediment storage.
- 2/ Structure does not fall within the limiting criteria of SCS Engineering Memorandum 27; designed per SCS-Iowa criteria; surveys not available; quantities are estimated.
- 3/ Structure does not fall within the limiting criteria of SCS Engineering Memorandum 27; designed for SCS-Iowa criteria.
- 4/ 6-hour storm used for design.
- 5/ The principal spillway crest elevation was established for grade stabilization or sediment storage, whichever was greater; therefore, the storage at the crest elevation of some structures is greater than that required for sediment.
- 6/ Class "b" hydrology used for design.



TABLE 3B - STRUCTURAL DATA  
GRADE STABILIZATION STRUCTURES

Troublesome Creek Watershed, Iowa

Site No.	Drainage Area			Drop (Feet)	Concrete (Cu. Yds.)	Type of Structures <u>1/</u>
	Uncon- trolled (Acre)	Con- trolled (Acre)	Total (Acre)			
7-1	320	-	320	4	9	IC
8-1	450	-	450	6	60	IC
15-1	140	-	140	4	8	IC
20-1	125	-	125	4	9	IC
21	260	440	700	12	95	CH
23-2	260	-	260	5	9	IC
25	295	415	710	12	90	CH
27-2	75	-	75	4	6	IC
28	420	-	420	12	115	CH
28-1	260	-	260	8	21	IC
31-1	595	320	915	6	75	DS - BI
38-2	360	-	360	18	125	CH
38-5	175	-	175	6	12	IC
38-7	110	-	110	4	8	IC
38-9	305	-	305	6	60	DS - BI
39-1	190	420	610	4	10	IC



TABLE 3B - STRUCTURAL DATA

GRADE STABILIZATION STRUCTURES (continued)

Troublesome Creek Watershed, Iowa

Site No.	Drainage Area			Drop (Feet)	Concrete (Cu. Yds.)	Type of Structures <u>1/</u>
	Uncon- trolled (Acre)	Con- trolled (Acre)	Total (Acre)			
41-4	230	-	230	10	55	DS
47-5	155	-	155	5	30	DS
47-6	385	-	385	8	20	IC
48-4	180	120	300	6	12	IC
49-2	40	270	310	6	12	IC
49-4	365	345	710	4	10	IC
49-8	290	-	290	6	18	IC
50-3	90	155	245	6	12	IC
51-1	160	-	160	4	9	IC
53-2	150	-	150	6	35	DS
53-8	220	-	220	9	61	DS
53-9	700	-	700	5	4	IC
53-10	105	-	105	4	6	IC
53-11	160	-	160	6	47	DS-BI
53-12	635	-	635	6	24	IC



TABLE 3B - STRUCTURAL DATA  
GRADE STABILIZATION STRUCTURES (continued)  
 Troublesome Creek Watershed, Iowa

Site No.	Drainage Area			Drop (Feet)	Concrete (Cu. Yds.)	Type of Structures <u>1/</u>
	Uncon- trolled (Acre)	Con- trolled (Acre)	Total (Acre)			
56-1	565	-	565	10	25	IC
56-2	126	-	126	10	13	IC
57-1	330	-	330	5	3	IC
57-2	290	-	290	7	15	IC
59-1	280	-	280	7	40	DS - BI
62-3	380	-	380	6	47	DS
62-4	70	-	70	5	26	DS
62-5	376	-	376	6	50	DS - BI
62-6	360	-	360	6	50	DS - BI
62-7	140	-	140	6	15	IC
66-1	175	-	175	5	26	DS - BI
66-2	260	-	260	8	53	DS
66-3	230	90	320	5	14	IC
67-1	180	-	180	4	9	IC
68	396	-	396	5	33	DS - BI



TABLE 3B - STRUCTURAL DATA  
GRADE STABILIZATION STRUCTURES (continued)  
 Troublesome Creek Watershed, Iowa

Site No.	Drainage Area			Drop (Feet)	Concrete (Cu. Yds.)	Type of Structures <u>1/</u>
	Uncon- trolled (Acre)	Con- trolled (Acre)	Total (Acre)			
69-1	100	-	100	5	27	DS
70-2	320	-	320	4	8	IC
70-3	120	-	120	5	6	IC
75-1	410	120	530	5	40	DS-BI
76-2	80	-	80	4	7	IC
78-1	100	-	100	5	12	IC
78-2	595	485	1080	14	180	DI <u>2/</u>
78-5	60	-	60	4	1	IC
80	330	505	835	8	85	DS
81	280	880	1160	10	120	DI <u>3/</u>
81-5	130	-	110	4	9	IC
84	215	735	950	10	120	DI <u>3/</u>
85-6	135	-	135	5	12	IC

- 1/ DS - Straight drop spillway  
 DS-BI - Drop spillway, box inlet  
 CH - chute spillway  
 IC - inlet on culvert
- 2/ DI - full flow drop inlet
- 3/ Located on County roads

Sheet 4 of 4

Date: August 1972



TABLE 4 - ANNUAL COSTS

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Eval. Unit	Structural Measures	Amortization of Installation Cost <sup>2/</sup>	Operation and Maintenance	Total
(1)	(2)	(3)	(4)	(5)
1	Structure 7-1 through Structure 69-2 (99 structures)	94,280	4,410	98,690 <sup>3/</sup>
2	Structure 70-2 through Structure 86-4 (36 Structures)	43,680 <sup>4/</sup>	2,170 <sup>5/</sup>	45,850 <sup>3/</sup>
3	D-38, D-53, D-47 & Rec. Fac. D-62 & Rec. Fac.	72,390	15,230 <sup>6/</sup>	87,620

Project Administration	23,560	23,560
TOTAL	233,910	255,720

1/ Price Base: Installation Costs are based on 1971 price level.

Operation and maintenance costs are based on adjusted normalized prices.

2/ 50 years @ 5½ percent interest.

3/ Includes costs for mitigation measures

4/ Does not include the sponsor's share of construction cost of structure and land to provide for roadway.

5/ Does not include sponsor's share of O&M Cost of that portion of the structure required to provide for roadway.

6/ Includes \$13,670 for operation, maintenance and replacement costs for 2 recreational developments.

Date: August 1972



TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

## Troublesome Creek Watershed, Iowa

(Dollars) <sup>1/</sup>

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
(1)	(2)	(3)	(4)
Gully Erosion <sup>2/</sup>			
Land	159,520	7,600	151,920
Other Agricultural Damages	9,600	460	9,140
Non-Agricultural Damages	18,430	880	17,550
Subtotal	187,550	8,940	178,610
Floodwater			
Crop and Pasture	53,640	24,430	29,210
Other Agricultural Damages	8,350	390	7,960
Subtotal	61,990	24,820	37,170
Indirect	27,200	3,370	23,830
TOTAL	276,740	37,130	239,610

<sup>1/</sup> Price Base: Adjusted normalized prices, April 1966.

<sup>2/</sup> Damages and benefits are included for only the principal gully erosion areas which are affected by the project improvements.

Date: August 1972



TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Troublesome Creek Watershed, Iowa

(Dollars) <sup>1/</sup>

Evaluation Unit	Structural Measures	AVERAGE ANNUAL BENEFITS						Average Annual Cost	Benefit Cost Ratio	
		Damage Reduction	More Intensive use of land	Changed Land Use	Recreation Benefits	Secondary Benefits	Total			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
1	Str. 7-1 through 69-2 (99 structures)	133,920	-	-	-	2,470	136,390	98,690 <sup>2/</sup>	1.4 to 1.0	
2	Str. 70-2 through 86-4 (36 structures)	60,970	-	-	-	1,520	62,490	45,850 <sup>2/</sup>	1.4 to 1.0	
3	D-38, D-53 D-47 & Rec. Fac. D-62 & Rec. Fac.	44,720	38,070	5,910	73,500	14,900	177,100	87,620	2.0 to 1.0	
Project Administration		XX	XX	XX	XX	XX	XX	XX	23,560	XX
GRAND TOTAL		XX	239,610	38,070	5,910	73,500	18,890	375,980	255,720	1.5 to 1.0

<sup>1/</sup> Price Base: Adjusted normalized prices, April 1966, for benefits; costs from Table 4.

<sup>2/</sup> Includes costs for mitigation measures.

Date: August 1972



TABLE 7 - CONSTRUCTION UNITS

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Construction Unit	Structures	Annual Benefits	Annual Costs
1	7-1	1,030	350
2	8-1	1,240	1,090
3	10-1	1,240	1,090
4	15-1	440	410
5	16-1, 16-2, 16-3	6,110	4,980
6	20-1	380	270
7	21, 21-1	3,220	3,010
8	23-2	1,620	1,230
9	24-1, 24-2, 24-3	7,460	4,860
10	25, 25-2, 25-3	4,110	3,450
11	27-1, 27-2	2,010	1,600
12	28, 28-1	2,710	2,080
13	29-1	1,130	970
14	31-1, 31-2, 31-4	4,920	3,150
15	32-1	1,140	1,140
16	34-1	1,310	1,090
17	35-1	1,140	1,030
18	36-2, 36-4, 36-5	4,830	4,800
19	38-1, 38-2	3,700	3,550
20	38-4	2,320	1,840
21	38-5	740	230
22	38-6, 38-7	2,030	1,970
23	38-8	1,700	1,650
24	38-9	1,510	1,290
25	39-1, 39-2, 39-3	4,430	3,030
26	40-1	1,660	1,360
27	41-1	1,570	1,310
28	41-2	1,660	1,280
29	41-4	1,270	770
30	42-1, 42-2	4,760	2,880
31	44-1	2,380	1,670
32	45	1,360	1,330
33	46	1,850	1,150



TABLE 7 - CONSTRUCTION UNITS (CONTINUED)

Troublesome Creek Watershed, Iowa

(Dollars)  $\frac{1}{100,000}$ 

Construction Unit	Structures	Annual Benefits	Annual Costs
34	47-3	1,250	1,210
35	47-4	1,830	1,130
36	47-5, 47-6	1,540	870
37	48-3, 48-4, 48-5	4,060	3,160
38	49-1	1,310	1,240
39	49-2, 49-3	2,000	1,750
40	49-4, 49-5	2,300	1,330
41	49-8	880	290
42	50-1	1,320	1,290
43	50-2, 50-3, 50-4	3,890	3,390
44	51-1	440	160
45	53-1	1,160	1,050
46	53-2, 53-5, 53-6	2,680	2,480
47	53-7	1,790	1,160
48	53-8	1,530	880
49	53-9, 53-10, 53-11, 53-12	3,100	1,550
50	56-1, 56-2	1,620	640
51	57-1, 57-2	3,340	510
52	58-1	1,870	920
53	59-1	2,080	620
54	60-1	1,190	1,080
55	62-3, 62-4, 62-5	3,070	2,380
56	62-6, 62-7	2,330	1,420
57	66-1	1,490	470
58	66-2	1,740	760
59	66-3, 66-4	1,510	1,510
60	67-1	1,770	180
61	68	1,400	930
62	69-1	1,090	470
63	69-2	1,840	1,090
64	70-2, 70-3	1,600	320



TABLE 7 - CONSTRUCTION UNITS (CONTINUED)

Troublesome Creek Watershed, Iowa

(Dollars) 1/

Construction Unit	Structures	Annual Benefits	Annual Costs
65	75-1, 75-2	2,330	1,980
66	76-2	520	160
67	78-1, 78-2, 78-3, 78-4, 78-5	5,310	5,200
68	80-1, 80-2	7,000	2,500
69	80, (80-1, 80-2) <u>2/</u>	9,990	3,770
70	81-1, 81-3, 81-6	4,700	3,940
71	81-4, 81-5	2,280	1,730
72	81 (81-1, 81-3, 81-4, 81-5, 81-6)	10,020	6,560
73	83-1, 83-2	2,470	2,080
74	84, 84-1, 84-2, 84-3	8,950	6,670
75	85-1, 85-2, 85-3	5,280	5,270
76	85-5, 85-6	4,080	2,360
77	85-7, 85-8	3,060	2,750
78	86-1, 86-2, 86-3, 86-4	8,770	8,330
79	D-47 & Recreation Facilities D-62 & Recreation Facilities	126,540	67,690
80	D-38, D-53, D-47 & Recreation Fac., D-62 & Recreation Facilities <u>2/</u>	177,400	87,620

1/ Price base - 1971 price level for installation costs amortized at 5½ percent over 50 years; adjusted normalized prices, April 1966, for maintenance costs.

2/ Structures not in parentheses are dependent upon prior or concurrent construction of those structures within parentheses.  
Mitigation measures will be installed as land rights are obtained.

Date: August 1972



## INVESTIGATIONS AND ANALYSES

Land Use and Treatment Studies

An inventory of present land use was developed for the entire watershed area. This inventory included the present major classification of land use such as cropland, pasture, woodland, urban, and other uses. The land treatment measures that have been installed on cropland and pasture areas were itemized for each land capability class. This inventory was developed from information of record and from the district conservationist.

The amount of soil lost from sheet erosion under present conditions and with the planned land treatment measures installed, was studied and computed for use in formulating an adequate land treatment program for watershed protection.

A total conservation needs study was then made of the watershed area to show all of the land treatment measures that would be required to reduce soil loss from sheet erosion to tolerable amounts according to technical guides for the District.

In consideration of the above information, Service technicians with assistance of District Commissioners, developed a table of land use changes and land treatment measures that would be installed during the project installation period. The information was tabulated by various capability classes and indicated the land use, the mechanical practices, and the crop rotations that would be installed on the cropland areas. The land treatment measures to be applied during the project installation period represents the expected accomplishments of the sponsors and farmers.

Erosion Investigation

A field reconnaissance was made to study the type and general extent of the erosion problems that are causing damage to land and to improvements in the watershed.

It was determined that sheet erosion is a problem on some of the sloping cropland areas that are still in need of land treatment. Gully erosion is severe in many areas and is causing voiding of crop and pasture lands and depreciation of adjacent and intervening areas. Damage to roads, fences, farm crossings, and other property from gully erosion has occurred at many places in the watershed.

Gully Erosion: Studies were made of the gully systems above all of the proposed structures in the watershed to determine the rate of land voiding by gully erosion and the rate of land depreciation which accompanies the expansion of a gully system. Depreciation is considered as a damage which occurs when land reverts to a less intensive use due to inaccessibility of areas for normal farm operations and the dissection of fields into small unfarmable units.

A set of (8-inch to the mile scale) 1938, 1940, 1950, and 1955 aerial photos which were the oldest flight, and 1966 flight which was the most recent of the areas, was studied and the extent of the rate of gully



then calculated by considering the effectiveness of the project in reducing gully erosion and in retaining sediment in the conservation pools of the structures.

Sheet Erosion: Studies were made of the upland areas of the watershed to determine the rates of sheet erosion both without and with the installation of proposed land treatment measures.

The Universal Soil Loss Equation for Predicting Soil Loss in Iowa was used to compute soil losses by sheet erosion on the basis of cover, slope length, percent of slope, soil characteristics, rainfall, and management practices. The data needed for these computations were obtained from the local SCS district conservationist, area staff and soil scientist, state technical staff, farm plans, field inspection, and a study of soil conservation surveys. The volume of sheet erosion under existing conditions and the volume with the project installed was thus developed for the entire watershed.

Sheet erosion from a sizeable area of the watershed has been reduced to what is considered a tolerable amount by terracing, contour farming, strip cropping, crop rotations, pasture improvement and by other improved land management practices. Similar reductions will occur on additional areas receiving treatment measures scheduled in this work plan.

An estimate of sheet erosion delivery ratio from an envelope curve formulated from state survey data was used for structure sites and based upon other general information secured in past studies. It was estimated that a range from 35 to 70 percent of the gross sheet erosion is transported to downstream sites as sediment. The losses that occur in transit are deposited on the colluvial and alluvial slopes, in the valleys, in road ditches and channels, along fence lines, and in or adjacent to waterways.

Erosion estimates and estimates of the sediment conveyed to all structure sites in the watershed were recorded on Form SCS-309. Information from this form was used by the engineer in providing for sediment storage needs in the design of the structures.

Other Damage: Preliminary investigation revealed that swamping, scouring, infertile overwash and other damages were negligible and therefore were not evaluated.

#### Geologic Investigation

A field reconnaissance was made of the watershed to observe the geological, physiographical, and other features of the watershed which might influence the selection of satisfactory sites and the design of structural measures. Construction experience in other watershed with somewhat similar



The evaluation of the extent and frequency of flooding was made using Technical Release No. 20 - Project Formulation Program - Hydrology.

The hydraulic characteristics of the 13 reaches were determined by 12 ranges. Available guides and pictures were used in the determination of Mannings roughness coefficient "n" for each range. Stage-discharge-area inundated data were developed for each range.

Runoff amounts for eight rainfall events, ranging in frequency from 0.5 years to 100 years, were routed through these reaches to determine the peak flow discharges.

The extent and frequency of flooding, as determined by these methods, was field checked by interviewing farmers within these stream reaches. The interviews supported the present condition routings.

Water budget analyses were made for multiple purpose structures D-47 and D-62. These analyses showed that the surface areas of these reservoirs will be relatively stable and not subject to frequent large fluctuations. Structure D-47's pool could drop up to 0.5 feet, lose 2.5 acres surface area and 37 acre feet at some time every year. The following losses can be expected for D-47: 25 years out of 100, 1 foot, 5 acres, and 75 acre feet; 10 years out of 100, 1.7 feet, 9.5 acres, and 140 acre-feet; 2 years out of 100, 2.1 feet, 11.5 acres and 250 acre feet.

The pool of structure D-62 during some month every year could fluctuate up to 0.4 foot resulting in a loss of 5 acres and 40 acre feet. The losses that can be expected for D-62 are: 25 years out of 100, 0.8 feet, 10 acres, and 90 acre feet; 10 years out of 100, 1.6 feet, 18 acres and 160 acre feet; 2 years out of 100, 3.1 feet, 26 acres and 310 acre feet.

#### Economic Investigations

Gully Erosion Damage: The evaluation of gully erosion damage to land was based on the annual land losses from voiding and from depreciation to less intensive use of the adjacent fields. These annual rates, for voiding and for depreciation, were multiplied by the per acre damageable values to find total damages that occur at each site. These per acre values represent losses that will occur in years that follow, since the damage cannot be recovered.

The land use and crop rotations considered for these evaluations were those which are within the criteria and standards of the use capabilities of the land, determined through soil surveys and land use capability classifications. The level of yields used were those obtained by farmers following a moderately high level fertility and management program and an intensity of farming operations consistent with the most intensive practical cropping pattern applicable within the area. Where associated soil and water conservation measures were necessary to make possible the above level of intensity of farming, the average annual value of the cost of these required associated measures were deducted from the total average annual damage.



Changed land use will take place on some lands when protection is received from floodwater damages. The net income value for composite acre without project was subtracted from net income value of composite acre with project. This difference was multiplied by the acres to be placed into production. Associated costs were deducted and necessary discounting was completed to arrive at value shown in Table 6.

Indirect damages were computed at 10 percent of flood prevention damages and 15 percent of the road damages. These damages include the additional expense and loss of time of operators used for repairing and clean-up after floods. It also includes the additional distances driven by farmers, vehicles of local business establishments, school busses, etc. because of flooded road crossings.

Information needed for farm fences was obtained by field observation. Boundary fences were the only fences evaluated. Length of fence affected by gully erosion or floodwater was determined and multiplied times cost per foot to arrive at the benefit.

Farm crossings were evaluated from the standpoint of reduction in maintenance costs. This is due to reduction in growth of gully or control of flow from structural measures proposed in the project.

Information on roads and bridges was obtained by field observation. Reduction in costs for maintenance, repair and replacements were considered as a benefit to the project.

The estimated cost of land rights for structural measures is as follows:

	<u>Bottomland</u>	<u>Upland</u>
Cropland	\$500	\$400/ac
Pasture	200	100/ac
Other	50	20/ac (Gully)

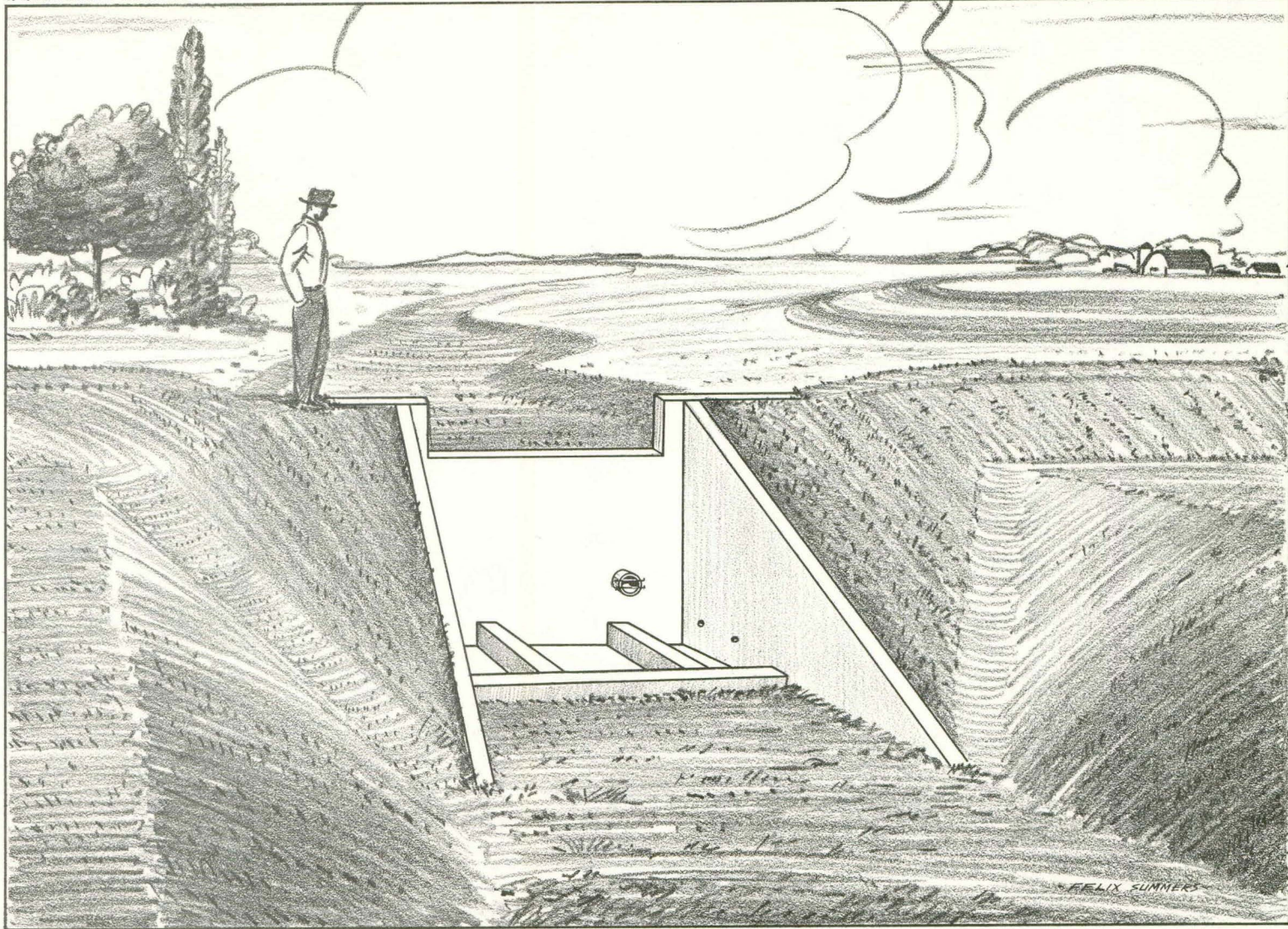
Flowage easements are needed on the two multiple purpose structures. The estimated cost per acre is \$300. The estimated cost of land for mitigation is \$50 per acre.

These costs have been agreed upon by the local sponsors and the Service.

Installation costs of structural measures were amortized at 5½ percent interest for a period of 50 years. Operation and maintenance costs were computed at 0.35 percent of the estimated construction cost of structural measures. Replacement costs of recreational facilities was determined by using an estimated cost of 35 cents per day times the number of visitor days for each recreational site. Associated costs were computed at an interest rate of seven percent.

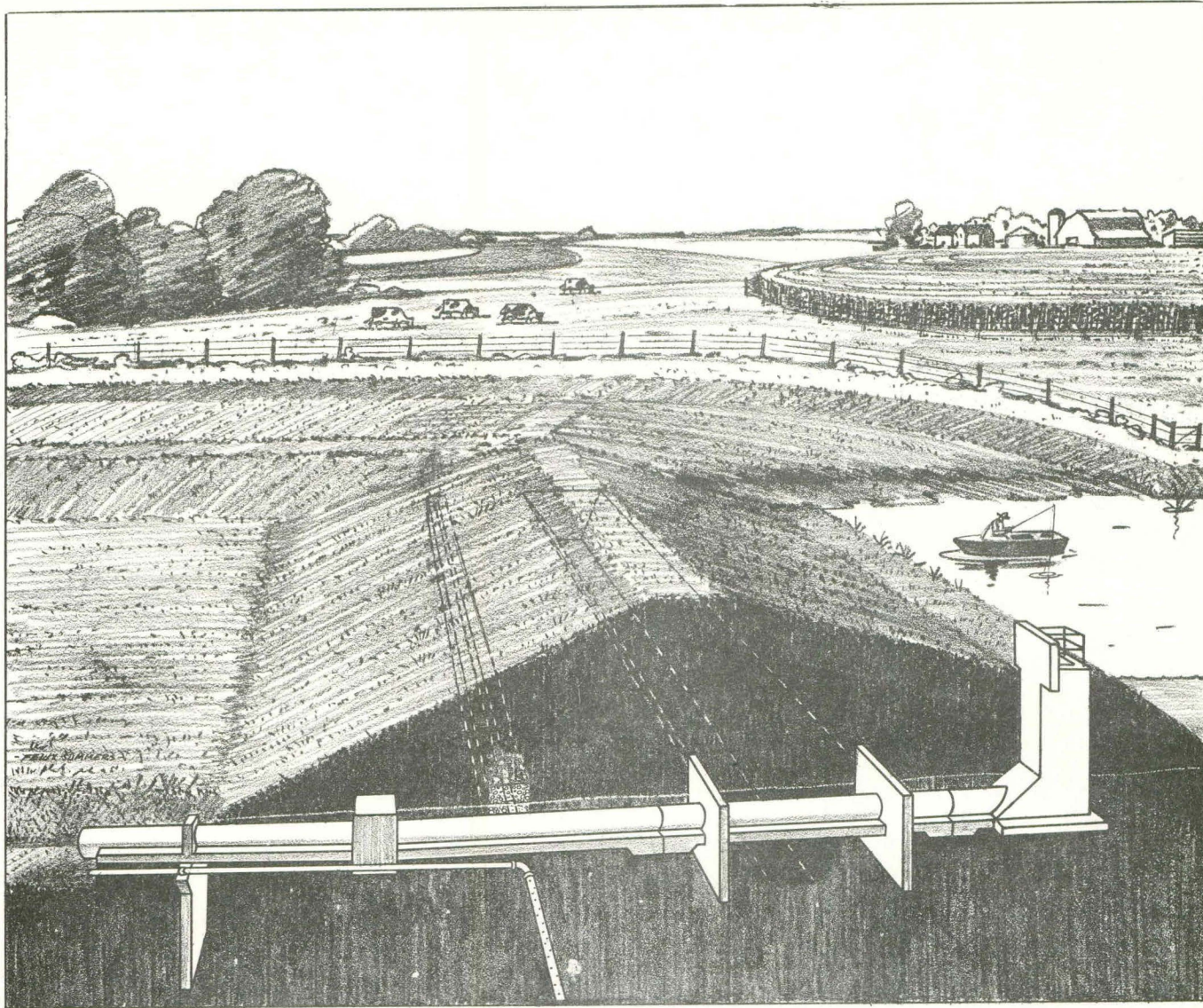
The "use of facilities" method was used in allocating costs of the two multiple purpose structures.





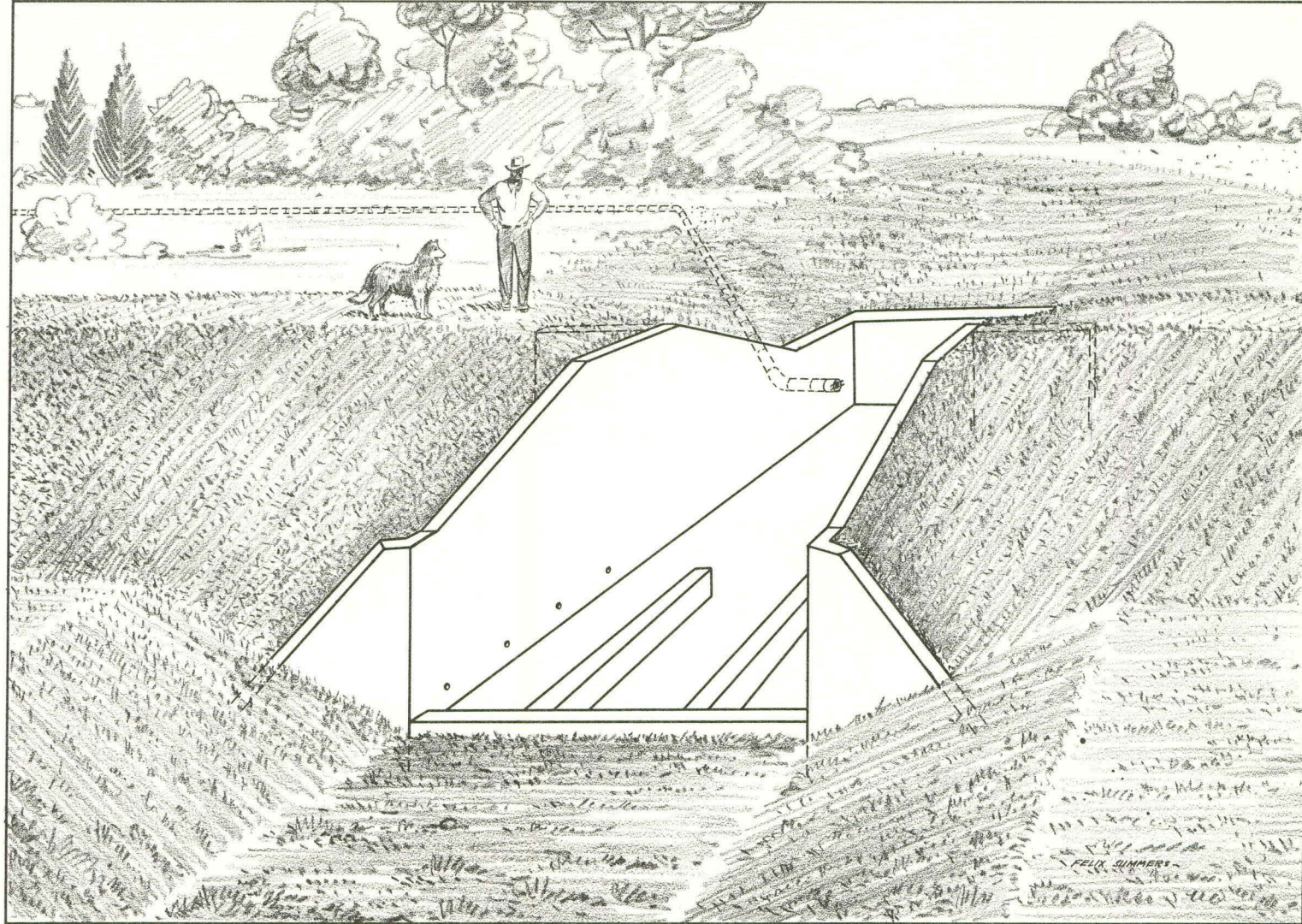
*Drop Spillway*





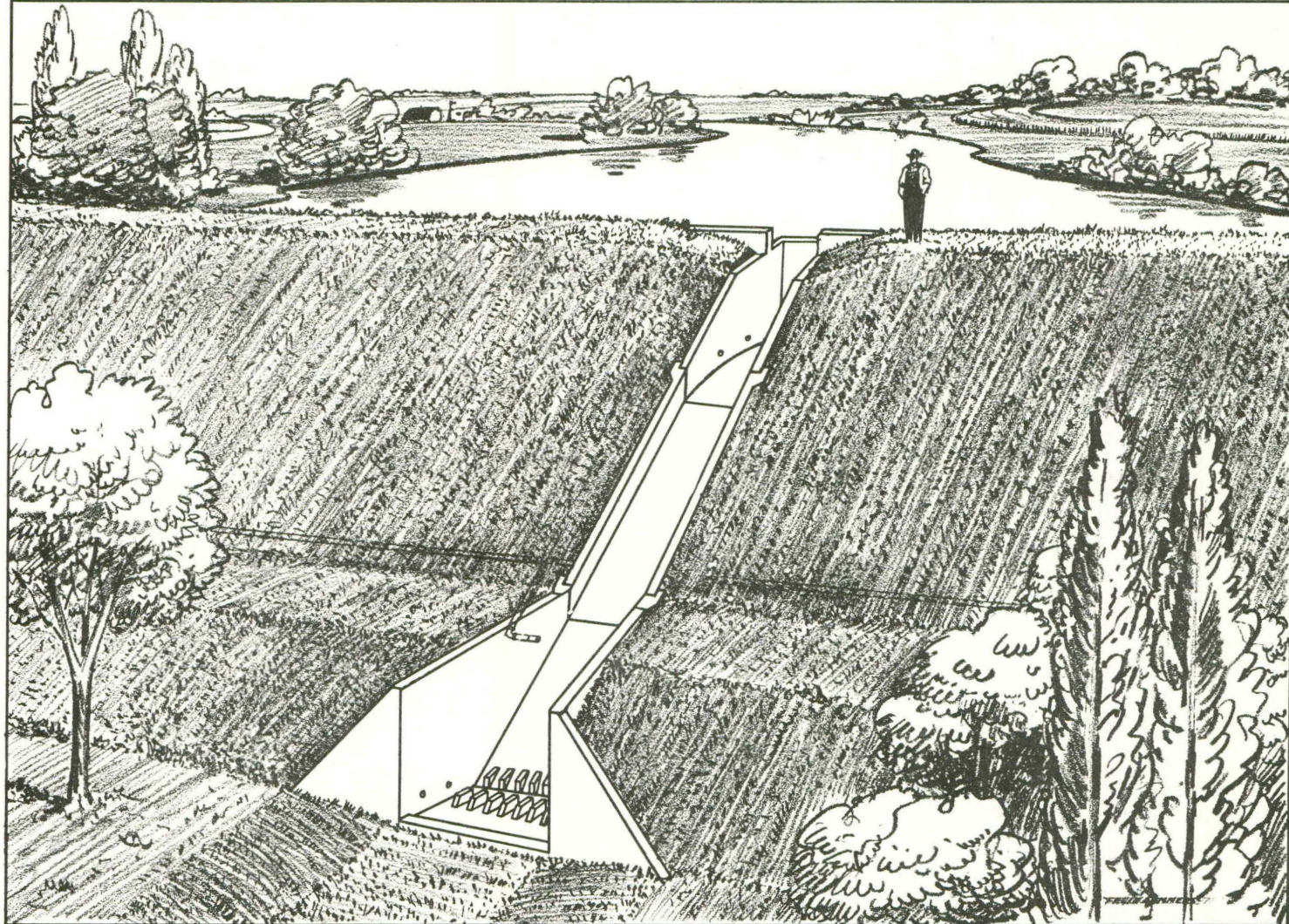
*Earth fill dam with concrete drop inlet and conservation pool.*





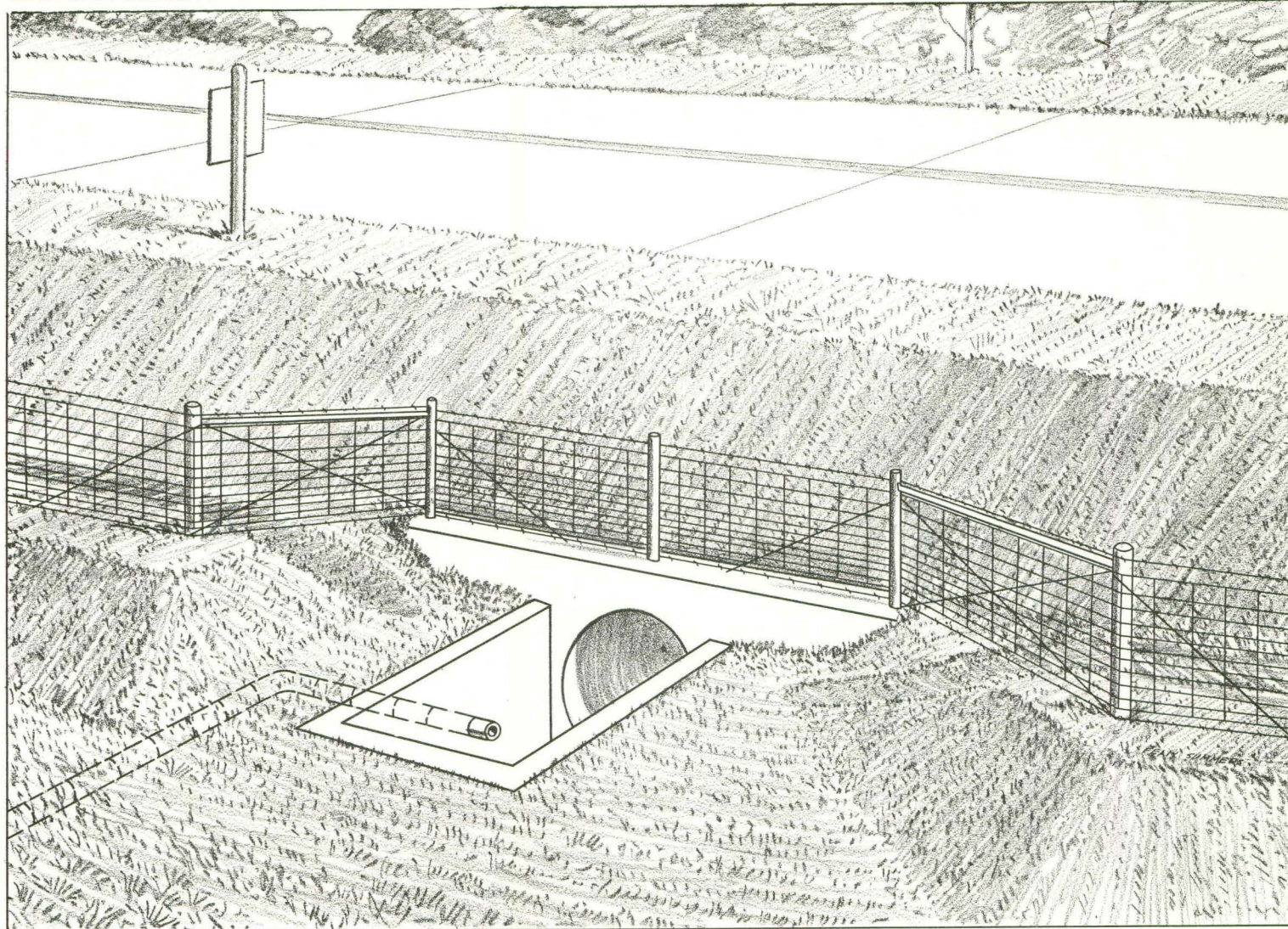
*Box-inlet drop spillway.*





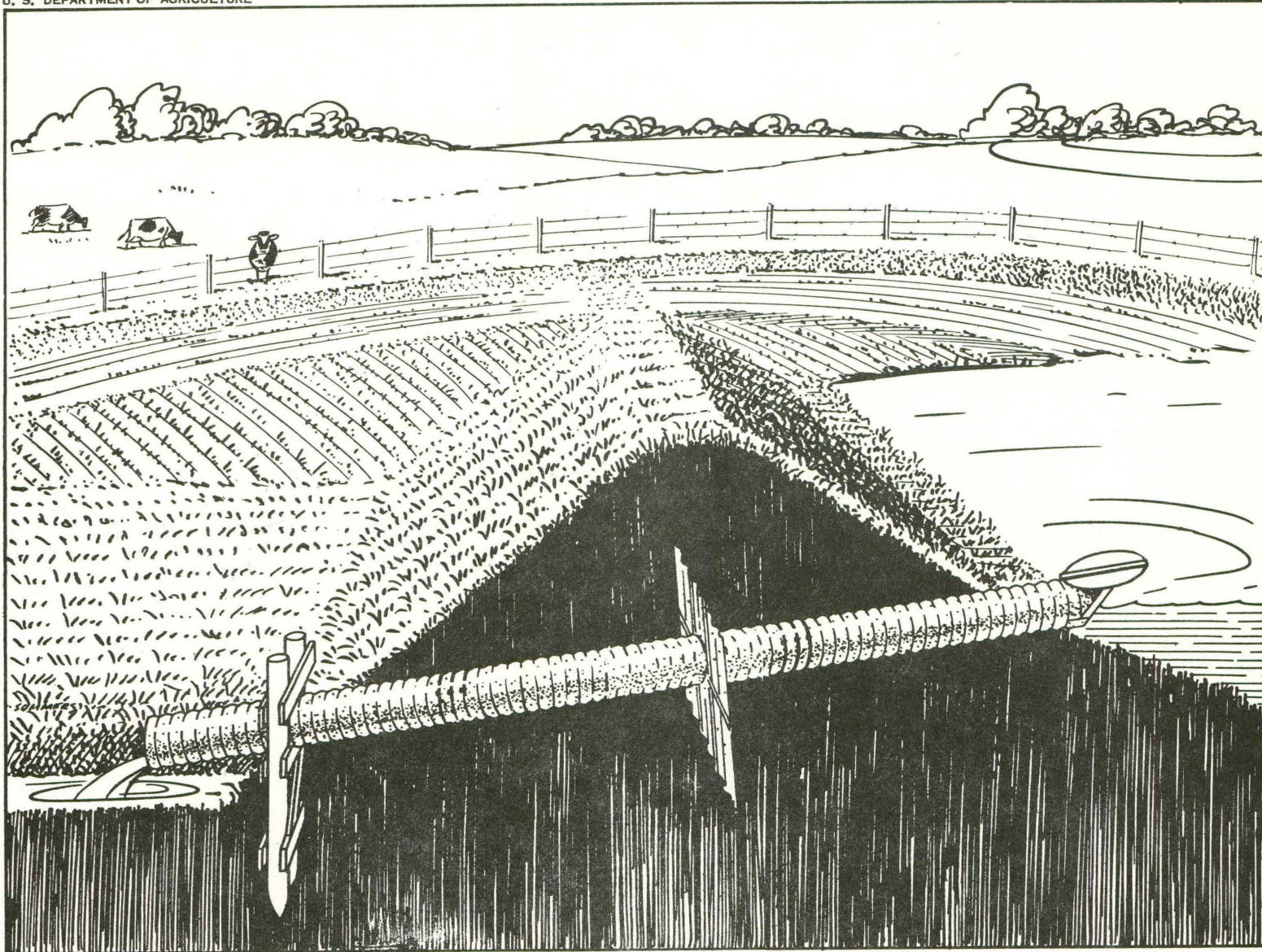
*Chute Spillway*





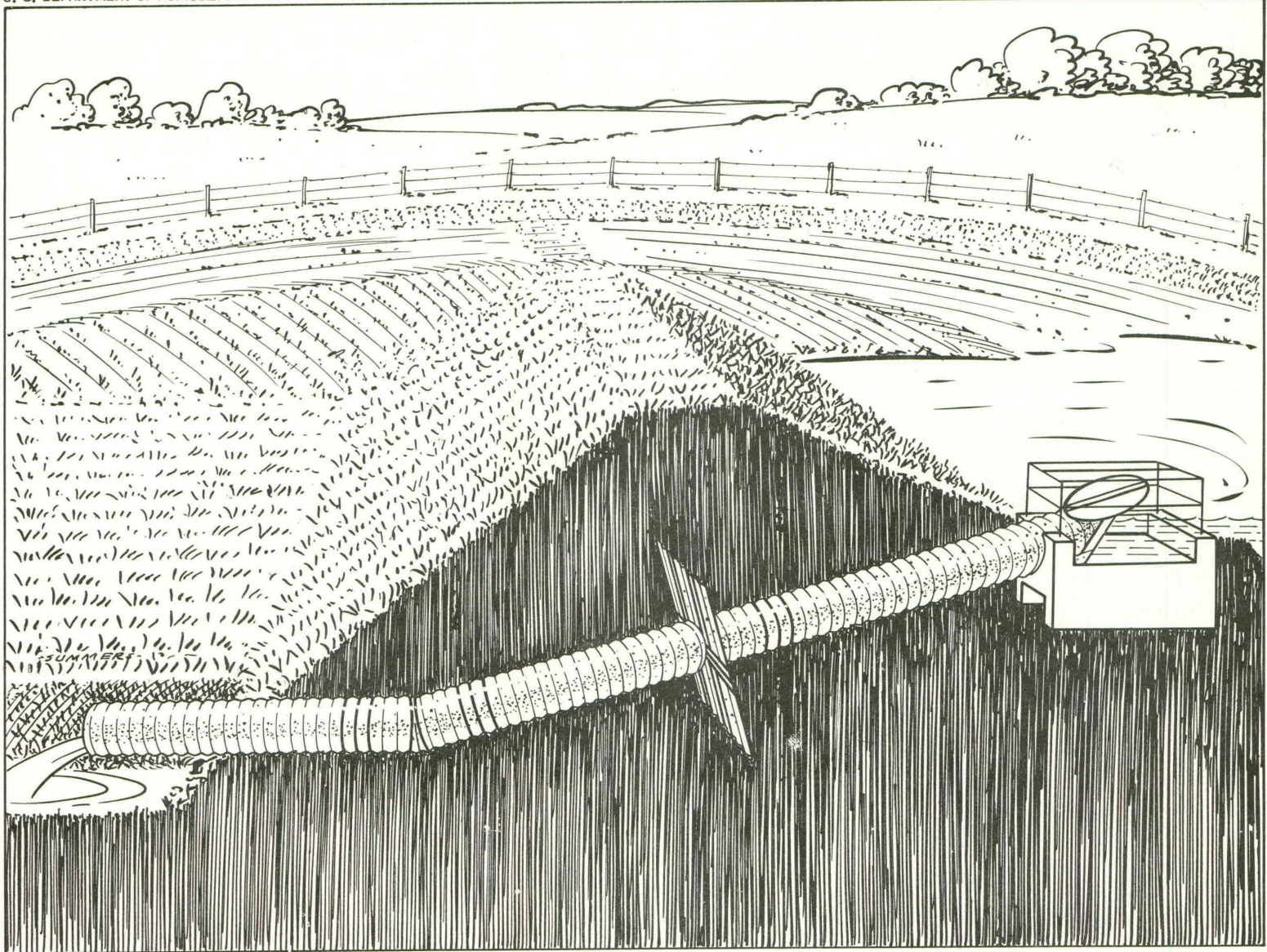
*Culvert box-inlet.*





*Metal pipe with hooded inlet.*





*Metal pipe with hooded inlet and trash guard.*



R-33-W

# TROUBLESOME CREEK WATERSHED

GUTHRIE COUNTY, IOWA  
STRUCTURE SITE D-62  
PUBLIC RECREATION DEVELOPMENT

T 79 N

17 16  
20 21

16 15  
21 22

20 21  
29 28

21 22  
28 27

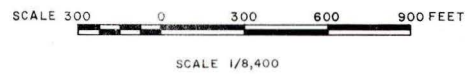
RECREATION POOL ELEVATION - 1326.2  
SURFACE AREA - 108 ACRES

FLOOD POOL ELEVATION - 1335.0

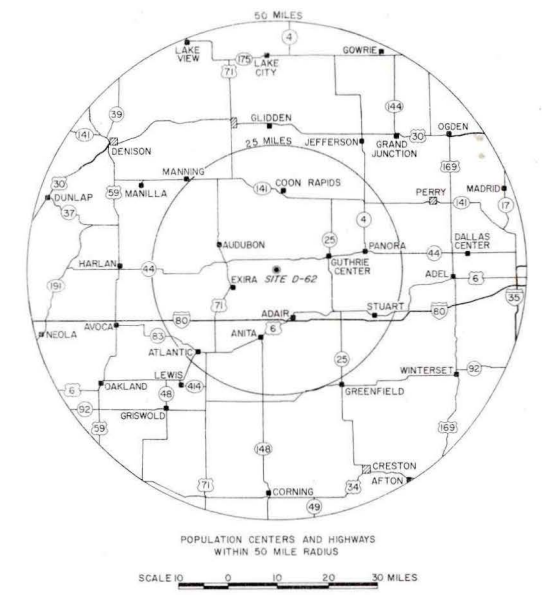
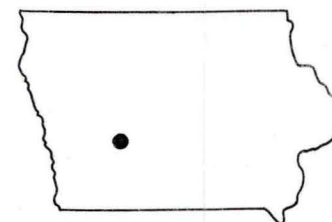
PURCHASE AREA BOUNDARY

### LEGEND

- ① PARK ENTRANCE
- ② PICNIC AREA
- ③ SHELTER HOUSE
- ④ COMFORT STATION
- ⑤ WATER STATION
- ⑥ PARKING AREA
- ⑦ BOAT TRAILER PARKING
- ⑧ BOAT RAMP
- ⑨ BOAT DOCKS
- ⑩ SAND BEACH
- ⑪ CHANGE BUILDING
- ⑫ OVERLOOK
- ⑬ NATURE & HIKING TRAILS
- ⑭ PARK ROAD
- ⑮ WILDLIFE PLANTINGS
- ⑯ YOUTH CAMPING AREA



IOWA



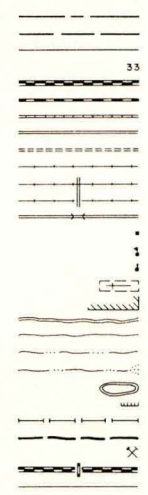
SOURCE:  
BASE MAP AND BASE DATA  
FURNISHED BY FIELD TECHNICIANS

FIGURE 3

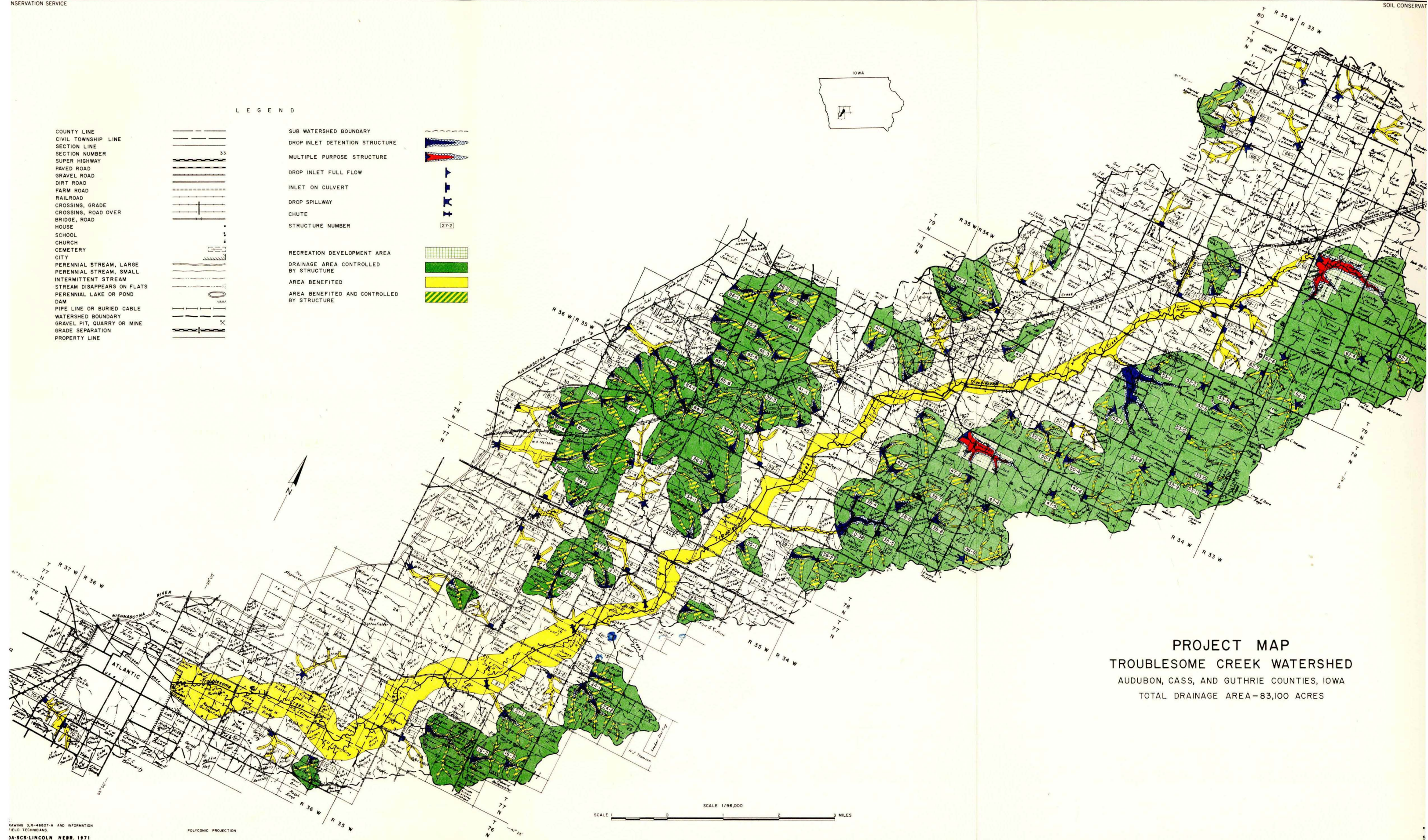
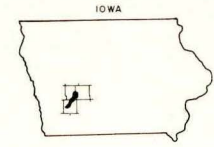
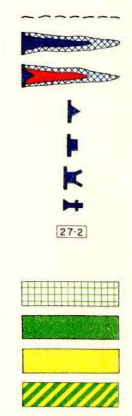


LEGEND

- COUNTY LINE
- CIVIL TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER
- SUPER HIGHWAY
- PAVED ROAD
- GRAVEL ROAD
- DIRT ROAD
- FARM ROAD
- RAILROAD
- CROSSING, GRADE
- CROSSING, ROAD OVER
- BRIDGE, ROAD
- HOUSE
- SCHOOL
- CHURCH
- CEMETERY
- CITY
- PERENNIAL STREAM, LARGE
- PERENNIAL STREAM, SMALL
- INTERMITTENT STREAM
- STREAM DISAPPEARS ON FLATS
- PERENNIAL LAKE OR POND
- DAM
- PIPE LINE OR BURIED CABLE
- WATERSHED BOUNDARY
- GRAVEL PIT, QUARRY OR MINE
- GRADE SEPARATION
- PROPERTY LINE



- SUB WATERSHED BOUNDARY
- DROP INLET DETENTION STRUCTURE
- MULTIPLE PURPOSE STRUCTURE
- DROP INLET FULL FLOW
- INLET ON CULVERT
- DROP SPILLWAY
- CHUTE
- STRUCTURE NUMBER
- RECREATION DEVELOPMENT AREA
- DRAINAGE AREA CONTROLLED BY STRUCTURE
- AREA BENEFITED
- AREA BENEFITED AND CONTROLLED BY STRUCTURE



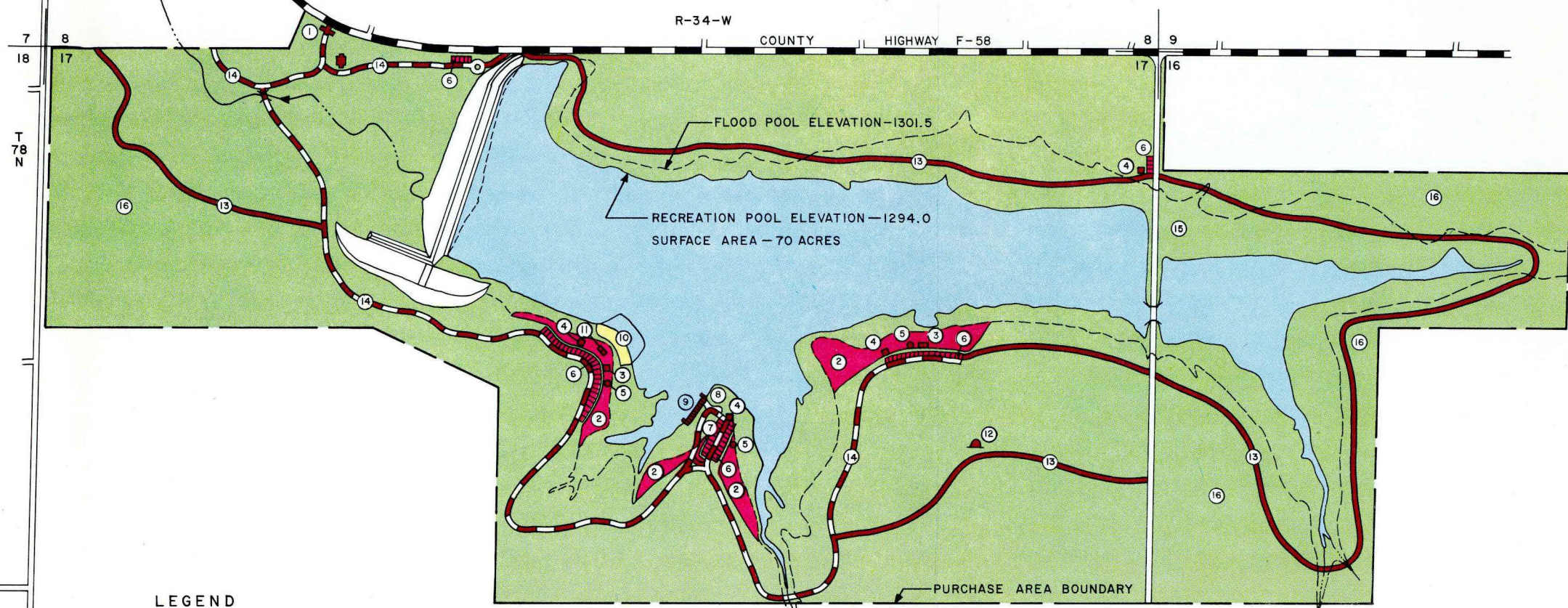
**PROJECT MAP**  
**TROUBLESOME CREEK WATERSHED**  
 AUDUBON, CASS, AND GUTHRIE COUNTIES, IOWA  
 TOTAL DRAINAGE AREA—83,100 ACRES

SCALE 1/96,000  
 0 1 2 3 MILES



# TROUBLESOME CREEK WATERSHED

AUDUBON COUNTY, IOWA  
STRUCTURE SITE D-47  
PUBLIC RECREATION DEVELOPMENT



### LEGEND

- ① PARK ENTRANCE
- ② PICNIC AREA
- ③ SHELTER HOUSE
- ④ COMFORT STATION
- ⑤ WATER STATION
- ⑥ PARKING AREA
- ⑦ BOAT TRAILER PARKING
- ⑧ BOAT RAMP
- ⑨ BOAT DOCKS
- ⑩ SAND BEACH
- ⑪ CHANGE BUILDING
- ⑫ OVERLOOK
- ⑬ NATURE & HIKING TRAILS
- ⑭ PARK ROAD
- ⑮ FISHING ACCESS
- ⑯ WILDLIFE PLANTINGS

SCALE 300 0 300 600 900 FEET

SCALE 1/7,920

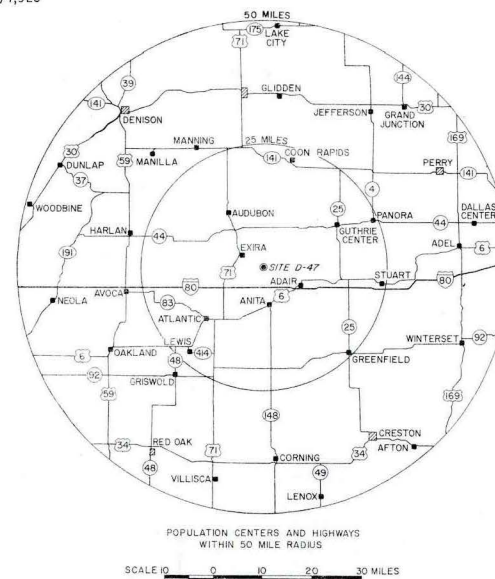
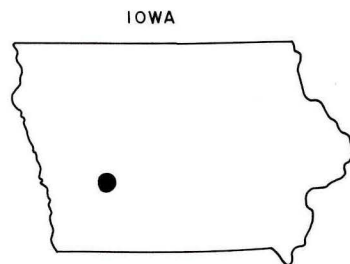


FIGURE 2

JRCE:  
BASE MAP AND BASE DATA  
FURNISHED BY FIELD TECHNICIANS



