

GRINDSTONE-LOST-MUDDY CREEK WATERSHED #16

CLINTON, DAVIESS, DE KALB, AND GENTRY COUNTIES, MISSOURI



U. S. Department of Agriculture
Soil Conservation Service



OUR SOIL ★ OUR STRENGTH

SUPPLEMENTAL WATERSHED WORK PLAN AGREEMENT NO. 1

between the

SOIL AND WATER CONSERVATION DISTRICT OF DAVIESS COUNTY
SOIL AND WATER CONSERVATION DISTRICT OF DE KALB COUNTY
SOIL AND WATER CONSERVATION DISTRICT OF GENTRY COUNTY
SOIL AND WATER CONSERVATION DISTRICT OF CLINTON COUNTY
GRINDSTONE-LOST-MUDDY CREEK WATERSHED SUBDISTRICT

DAVIESS COUNTY COURT

DE KALB COUNTY COURT

GENTRY COUNTY COURT

CLINTON COUNTY COURT

CITY OF CAMERON, MISSOURI

(hereinafter referred to as the Sponsoring Local Organizations)
State of Missouri

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, the Watershed Work Plan Agreement for Grindstone-Lost-Muddy Creek Watershed, State of Missouri, executed by the Sponsoring Local Organizations named therein and the Service became effective on the 10th day of September, 1965; and

Whereas, in order to carry out the watershed work plan for said watershed, it has become necessary to modify said watershed work plan agreement; and

Whereas, a supplemental watershed work plan which modifies the watershed work plan dated March 1965 for said watershed has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service, which plan is annexed to and made a part of this agreement;

Now, therefore, the Sponsoring Local Organizations and the Service agree upon the following modifications, terms, conditions, and stipulations of said watershed work plan agreement:

1. The Clinton County Soil and Water Conservation District hereby agrees to become one of the local organizations sponsoring said watershed project.

2. The Clinton County Court hereby agrees to become one of the local organizations sponsoring said watershed project.
3. The city of Cameron, Missouri, hereby agrees to become one of the local organizations sponsoring said watershed project.
4. The city of Maysville, Missouri, hereby agrees to be deleted as one of the sponsoring local organizations of said watershed project.
5. The Grindstone-Lost-Muddy Creek Watershed Subdistrict hereby agrees to become one of the local sponsoring organizations.
6. Floodwater Retarding Structure Sites B-1 and B-3, in the original plan, are relocated as Sites B-1a and B-3a respectively. Structure C-2, in the original plan, is replaced by Structures C-2a and C-2b. Structure D-1 is replaced by Structures D-3 and D-4. Structure D-2 was moved downstream and redesignated as Structure D-2a.
7. The Municipal and Industrial (M&I) storage in Multipurpose Structure B-5 is hereby deleted by this supplement.
8. M&I storage for the city of Cameron and surrounding area is added to Floodwater Retarding Structure A-2 by this supplement and redesignated as Multipurpose Structure Site A-2.
9. Floodwater Retarding Structure Sites A-6, A-8, A-10a, A-11, A-12, A-13, A-14, B-10, D-5, and B-7 are added by this supplement.
10. Grade Stabilization Structures A-24, A-35, A-48, B-24, C-25, C-47, C-64, D-25, D-29, D-30, D-36, D-38, D-24, D-41, and F-66 are hereby deleted by this supplement.
11. Floodwater Retarding Structure Sites C-4 and C-6, in the original plan, are included in the plan as supplemented.
12. Grade Stabilization Structure C-62, in the original plan, is included in the plan as supplemented as Site C-62.
13. Paragraph numbered 15 is added to read as follows:

The Sponsoring Local Organizations assure that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation payments to displaced persons, and otherwise comply with 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	47.4	52.6	105,000

14. Paragraph Number 1, in the work plan agreement, is changed to read as follows: The Sponsoring Local Organizations will acquire such landrights as will be needed in connection with the works of improvement. Estimated Cost \$1,630,025.

15. Paragraph Number 3, in the work plan agreement, is changed to read as follows: 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)
Structural Measures for Flood Prevention and Stabilization	0	100	5,160,905
Stabilization Structure D-42	9.2	90.8	61,337 ^{1/}
Flood Prevention & Municipal Water Supply Development, Multipurpose Structure A-2	20.8	79.2	1,194,600
Intake Tower Delivery Line	100	0	827,600
Flood Prevention Structure C-3	14.1	85.9	310,533 ^{2/}

16. Paragraph Number 4, in the work plan agreement, is changed to read as follows: The percentages of engineering costs to be paid by the Sponsoring Local Organizations and by the Service are as follows:

^{1/} Includes nonproject costs to increase top width of dam for roadway.

^{2/} Includes nonproject costs to raise top of dam for recreation pool.

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations (percent)</u>	<u>Service (percent)</u>	<u>Estimated Engineering Cost (dollars)</u>
Structural Measures for Flood Preventions and Stabilization	0	100	832,799
Flood Prevention & Municipal Water Supply Development, Multipurpose Structure A-2	20.8	79.2	119,500
Specific Cost Items Intake Structure and Raw Water Line	100	0	124,100
Flood Prevention Structure C-3	14.1	85.9	35,462 ^{1/}

The Sponsoring Local Organizations and the Service further agree to all other terms, conditions and stipulations of said watershed work plan agreement not modified herein.

^{1/} Includes nonproject cost to raise top of dam for recreation pool.

The Soil and Water Conservation District
of Daviess County, Missouri

By Harold W. Gray

Title Chairman

Date 19 Feb 1981

Lattin, Mo. 64640
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Daviess County, Missouri, adopted at a meeting held on Feb 19, 1981

Donald C. Peins Lattin, Mo. 64640
Address Zip Code

Date February 19, 1981

The Soil and Water Conservation District
of De Kalb County, Missouri

By Clifford Adams

Title Chairman

Date 2-17-81

Box 117
Mapleville, Mo. 64469
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of De Kalb County, Missouri, adopted at a meeting held on 2-17-81

Robert F. Landvozer Savannah, Mo. 64485
Address Zip Code

Date 2-17-81

The Soil and Water Conservation District
of Gentry County, Missouri

By Arthur R. Kane

Title Chairman

Date 2/23/81

Albany, Mo. 64402
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Gentry County, Missouri, adopted at a meeting held on Feb 23, 1981

Arthur R. Kane Albany, Mo. 64402
Address Zip Code

Date Feb 23-1981

The Soil and Water Conservation District
of Clinton County, Missouri

By Mark Ruth

Title Chairman

Date 2-25-81

Plattsburg, Mo. 64477
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Clinton County, Missouri, adopted at a meeting held on 2-25-81

H. R. Chenoweth

Plattsburg, Mo. 64477
Address Zip Code

Date 2-25-81

Grindstone-Lost-Muddy Creek Watershed
Subdistrict

By Clifford Roberts

Title Chairman

Date 2-17-81

Mayeville, Mo. 64469
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Grindstone-Lost-Muddy Creek Watershed Subdistrict adopted at a meeting held on Jan 13 1981

Robert Van Hoozer

Savannah, Mo. 64485
Address Zip Code

Date 1-13-81

Daviess County Court

By Robert Cuiings

Title Presiding Judge

Date 2-24-81

Hallatan, Mo. 64640
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Daviess County Court adopted at a meeting held on February 24, 1981

Alva R. Wiker, County Clerk

Hallatan Mo 64640
Address Zip Code

Date 2-24-81

Clinton County Court

By Eldon Shipman

Title Presiding Judge

Date March 2, 1981

Plattsburg 64477
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Clinton County Court, adopted at a meeting held on March 2-1981.

John O Day
Date March 2-1981

Plattsburg Mo. 64477
Address Zip Code

De Kalb County Court

By Hugh Swade

Title Pres. Judge

Date 2-17-81

Mayville, Mo 64469
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the De Kalb County Court, adopted at a meeting held on FEB. 17, 1981.

Earnest Smith
Date 2-17-81

MAYSVILLE, MO 64469
Address Zip Code

Gentry County Court

By H. P. Stalfeier

Title Presiding Judge

Date 2-23-81

Albany Mo. 64402
Address Zip Code

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the Gentry County Court, adopted at a meeting held on 2-23-81.

Carolyn Stevens
Date 2-23-81

Albany Mo 64402
Address Zip Code

City of Cameron

By Ernest E. Thomas

Title Mayor

City Hall, Cameron, Mo. 64429
Address Zip Code

Date 2/17/81

The signing of this Supplemental Watershed Work Plan Agreement was authorized by a resolution of the governing body of the city of Cameron, adopted at a meeting held on 2-17-81.

Cameron, Mo. 64429
Address Zip Code

Date 2/17/81

Soil Conservation Service

United States Department of Agriculture

Approved by:

Kenneth G. McManus
Kenneth G. McManus
State Conservationist

MAR 6 1981

_____ Date

WATERSHED WORK PLAN SUPPLEMENT NO. 1

GRINDSTONE-LOST-MUDDY CREEK WATERSHED

CLINTON, DAVIESS, DE KALB, AND GENTRY COUNTIES, MISSOURI

INTRODUCTION

The Grindstone-Lost-Muddy Creek Watershed was approved for construction in September 1965. The original watershed plan included an accelerated land treatment program, 12 single-purpose floodwater retarding structures, 2 multipurpose floodwater retarding structures containing storage for water supply and recreation, and 50 structures for grade stabilization. Measures in the original plan that have been installed include 34 grade stabilization structures and 4 single-purpose floodwater retarding structures. Structure C-3 was included in the original plan as a multipurpose structure with storage for floodwater and recreation. Due to a change in sponsors, the recreational storage in this site was added as a non-project purpose and paid for by other than PL-566 funds. No provisions were made for public access to this site and all recreational benefits are deleted.

This supplement was prepared to address changes that have occurred since the original watershed plan was prepared. Included in this supplement is (1) an evaluation of the lower flood plain which, at the time the plan was prepared, was within the proposed Pattonsburg Reservoir, (2) the addition of municipal and industrial water storage in structure A-2 for the city of Cameron, Missouri, (3) the deletion of M&I storage in structure B-5 for the town of Maysville, and (4) the addition of additional floodwater retarding structures to protect flood plain in the lower end of the watershed. The plan, as supplemented, provides for the installation of 24 single-purpose floodwater retarding structures; 1 multipurpose, floodwater and M&I storage, structure; and 35 grade stabilization structures.

Prior to the passage of the National Environmental Policy Act, one single-purpose floodwater retarding structure; structure C-3, which is in the original plan as a multipurpose structure but was installed as a single-purpose floodwater site with some nonproject storage added; and 28 grade stabilization dams, were constructed. In 1976, an environmental assessment was prepared to describe the effects of constructing 2 single-purpose floodwater retarding dams and 6 grade stabilization dams. A notice of availability of a negative declaration appeared in the Federal Register June 13, 1976.

An environmental assessment and finding of no significant impact is being prepared concurrently with this supplement to assess the impacts of the remaining planned works of improvement.

Description of the Watershed

There has been no significant change in the description of the watershed since the preparation of the original work plan except the increases in property values and some minor changes in flood plain land use. This is largely a shift to more soybeans in the cropping system.

Additional inventories on wildlife habitat, water quality and aquatic biology, cultural resources, and rare and endangered species were made. This data is included as supplemental information.

The watershed is in an area of intensive cultivation and some grazing. The area exhibits the typical mix of farmland game and nongame species. The populations of most wildlife species are lower for this area in the state than others due to the intensive farming operations. Areas of good habitat do remain along streams and in isolated old fields, brushy draws, and fence rows; however, the lack of sufficient quantity is keeping the wildlife population at a lower level.

Habitat evaluation procedures of the Fish and Wildlife Service show habitat values are in the 5.0 - 7.0 range (10.0 being the highest value habitat). The majority of quality habitat is found in drainageways.

The bald eagle, peregrine falcon, and Indiana bat are species determined by the U.S. Fish and Wildlife Service to be endangered or threatened that could occur in this watershed. In compliance with Section 7 of the Endangered Species Act of 1973, as amended, the Soil Conservation Service (SCS) has conducted a biological assessment of the watershed, and has concluded with concurrence from the U.S. Fish and Wildlife Service that the project will have no impact on any of the listed species.

The extreme flow variation and erosion, which are common features in headwater streams in this highly agricultural area, exert a strong influence on the abundance and diversity of aquatic species by affecting water quality, particularly turbidity.

The data obtained were from four sets of water samples and are considered representative of the ephemeral and perennial streams in the region.

Fish sampling of Lost and Grindstone Creeks indicate a fair diversity of species characteristic of a warm water fishery. The physical characteristics of the watershed directly influence discharge, substrates, and available habitats which limit species diversity in Lost Creek; however, the small size of specimens collected and their concentration into small shallow pools during periods of low precipitation signifies a poor fishery potential. The discharge of Grindstone Creek remains sufficient to support the large forms of game and commercial species. The habitats which occur, e.g., riffles, deep pools, and undercut banks, are suitable for spawning bass, bluegill, and channel catfish. These species are important components of a warm water fishery and are relatively tolerant of the harsh physical environment found in these streams.

The lower reaches of Grindstone Creek have good potential for fishing (especially channel catfish) and canoeing.

Muddy Creek and its tributaries do not support a viable fishery.

Qualitative benthic samples show, in both Lost and Grindstone Creeks, the moderate diversity of organisms corresponds with the lack of habitat diversity. The great variation in discharge in these streams inhibits colonization because the substrates are constantly shifting. The most common forms found were tolerant of these extreme flow conditions.

The extent of cultural resources in the areas to be disturbed by project action was determined after a literature search and on the ground surveys of appropriate areas. See the environmental assessment for a complete discussion of cultural resources in the area.

Watershed Problems

The flood plain area and the benefits identified in this supplement are considerably greater than in the original work plan. The lower part of Grindstone Creek was within the pool area of the proposed Pattsonburg Reservoir when the original plan was prepared. The 100-year flood plain is 14,933 acres. The average annual acres flooded are 10,718. To analyze floodwater damages, the four structures in the original plan that had been installed were not considered in place since all structures benefited a common flood plain. For floodrouting purposes only the existing Pony Express Reservoir, constructed by the Missouri Department of Conservation, was included in the "without-project" conditions. Flooding occurs one to two times a year with some areas being inundated as much as four times a year. The primary damages are to crops and pastures. Floodwater damages to crops and pastures are estimated to be \$528,824 annually. Other damages, incurred from floodwater, include the inundation of 27 bridges and roads that cross the flood plain. Damages to roads and bridges are estimated to be \$41,472 annually. Damage to fences, livestock, machinery, and other agricultural property, and debris damages are estimated to be \$13,353 annually. Other floodwater damages quantified in this supplement include the damage from sediment and flood plain scour. The damages from these sources are estimated to be \$40,830 annually from over bank deposition and \$51,605 from flood plain scour. Damages from gully erosion that are affected by structural measures are estimated to be \$135,805 annually (see Table 5).

Project Formulation

The changes in formulation of this project resulted from the decision not to construct the Pattonsburg Reservoir, changes in the water supply needs and some physical problems encountered by sponsors in the securing of landrights.

A review of the method of treating the gully problem with the larger grade stabilization structures, included in the original plan and installed as structural measures, was made prior to formulating this supplement. It was determined more effective treatment of these areas could be achieved by installing smaller grade stabilization structures along with associated measures closer to the problem area and at considerably less cost compared to the structural measure grade structures. After a review of the structural measure grade structures not yet installed, structure C-62 was kept in this supplement and all others were deleted.

The original plan provided for the installation of 50 grade stabilization structures to be installed as structural measures. Thirty-four of the structures in the original plan have been installed. All remaining structures, except structure C-62, are deleted by this supplement.

To achieve a reduction in floodwater damages, several combinations of floodwater retarding structures were evaluated. The system of floodwater retarding structures most nearly meeting the project objectives consists of 24 single-

purpose floodwater retarding structures and 1 multipurpose structure with floodwater and M&I storage. In selecting the floodwater retarding structures included in this supplement, consideration was given to achieving a uniform level of reduction throughout the flood plain and eliminating structures with a high cost relative to the benefits expected.

Structure B-5, which was in the original plan as a multipurpose structure with M&I water for the city of Maysville, is changed to a single-purpose floodwater retarding structure in this supplement. The city requested this storage be deleted due to the lack of growth projected at the time the original work plan was prepared.

Floodwater retarding structure C-3, B-6, and C-5 in the original plan have been constructed. Structure C-3, which is described in the work plan as a multipurpose floodwater and recreational structure, was installed as a single-purpose floodwater retarding structure with added storage included as a nonproject cost. The local sponsoring organizations paid all nonproject costs associated with this structure. Structures A-2, C-4, and C-6 remain unchanged from the original plan. This supplement reflects the following changes: (1) Sites B-1 and B-3 in the original plan are relocated as sites B-1a and B-3a, respectively; (2) Structure C-2 in the original plan is replaced by structures C-2a and C-2b; (3) Structure D-1 is replaced by structures D-3 and D-4; (4) Structure D-2 was moved downstream and redesignated as structure D-2a; (5) The M&I storage in multipurpose structure B-5 is deleted; (6) M&I storage for the city of Cameron and surrounding area is added to site A-2; (7) Floodwater retarding sites A-6, A-8, A-10a, A-11, A-12, A-13, A-14, B-10, D-5, and B-7 are added. An evaluation of the water supply needs of the city of Cameron was performed by a consulting engineering firm. They determined that a need for an additional 1,300 acre-feet of storage for municipal and industrial water existed. This need is based on a projected population growth for the area at an annual rate of 2.7 percent plus providing a water supply for a proposed rural water district.

Alternative water supply sources investigated include ground water, pumped storage from Grindstone Creek and the temporary or detention pool of structure A-2, and expansion of the storage capacity of structure A-2.

A reservoir operation study of structure A-2 was made to determine that an adequate amount of runoff occurs to supply the need.

PLANNED WORK

Land Treatment Program

In preparing this supplement, land treatment needs were reviewed and revised to reflect current practices. Costs were updated to reflect present cost of applying needed measures. The measures to be installed and updated costs of \$4,786,718 are summarized in the revised Table 1. Technical assistance for the installation of conservation measures will be furnished by the SCS and the U.S. Forest Service.

In preparation of this supplement, only one stabilization structure that was in the original plan and not yet built was left in as a part of the plan. All other structural measure grade structures are deleted.

Structural Measures

Floodwater Retarding Structures - This supplement provides for a system of 24 single-purpose floodwater retarding structures and one multipurpose structure with floodwater retarding storage. This system of structures will control the runoff from 124.3 square miles or 38 percent of the watershed area. Design features are summarized in Table 3. A breakdown of installation costs are shown in Table 2 of this supplement. Cost sharing arrangements or percent is shown in the agreement.

Hazard classifications have been determined for each of the floodwater retarding structures based on the potential hazard to life and property downstream of the dam if it should suddenly breach. The following classifications are used:

Class (a) - rural setting - damage to farmland, county roads, or farm buildings.

Class (b) - rural setting - damage to isolated homes, main highways, minor railroads, or cause interruption of public utilities.

Class (c) - rural or urban setting - serious damage to homes, industrial or commercial buildings, public utilities, main highways or railroads, or cause loss of life.

All structures in this plan are either class (a) or (b). Table 3 gives the classification for each structure. If additional development occurs downstream of class (a) and (b) structures, a potentially more hazardous condition could be created if such development is not properly considered in relation to the dam(s).

The embankments of all structures will be compacted earth fills. Limestone rock and shale will be encountered in the abutments and foundations of the structures in the southeast part of the watershed. The excavation of the emergency spillways at several of these sites will require rock excavation. The emergency spillway at site A-2 will be under excavated in rock and backfilled with compacted earth to establish vegetation. Structures in the northwest area of the watershed will be constructed on yielding foundations. A foundation drain system is planned for all structures to control seepage in the moderately permeable foundation soils. A positive cutoff core through the permeable foundation materials is planned for all structures. The principal spillway will be reinforced concrete pipes or box culverts. These structures will contain a total floodwater detention capacity of 18,653 acre-feet. Structure B-1a is planned as a dry pool reservoir. The drawdown conduit will be utilized as the low-stage release.

Stabilization Structures - The installation cost of the stabilization structures that have been installed and the estimated cost of structure C-62 is shown in Table 2 of this supplement. Smaller land treatment type grade control structures will be used in place of the larger stabilization structures to treat the gully problem areas.

Project Installation

The Sponsoring Local Organizations will secure all landrights needed for installation of the remaining grade stabilization structure and the single-purpose floodwater retarding structures. The SCS will provide the engineering services associated with these structures. These services will include the preparation of the final designs, plans and specifications and engineering documents needed for contracting. The Sponsoring Local Organizations have requested the SCS to administer the construction contracts on all works of improvement except multipurpose structure A-2 and the grade stabilization structures installed as land treatment measures. Inspection of construction activities will be performed by SCS personnel.

The city of Cameron will secure all landrights needed for the installation of multiple-purpose structure A-2. Landrights will include, in addition to the land areas, an easement from the Missouri State Highway Commission to temporarily flood U.S. Highway 36 right-of-way. Landrights will also involve the relocation of three residences in the flood plain below structure No. A-2. The estimated relocation costs are \$105,000.

Engineering services to prepare the final design, plans, and specifications for structure A-2; including the embankment, principal and emergency spillways, and appurtenances; will be provided by a private consulting engineering firm. The services will be acquired through a contract administered by the city of Cameron. The SCS will assist the city in administering the contract. The final design, plans, and specifications will be reviewed and approved by the SCS before they are accepted by the city. The costs of these services will be shared by the city and the SCS. The city is responsible for all engineering and inspection functions associated with the intake structure and raw water line. The SCS will provide inspection of the installation of the embankment, spillways and appurtenances associated with the dam. The contract for construction of the dam will be administered by the city of Cameron.

The grade stabilization structures installed as land treatment measures will be built by formal contract with the local district responsible for contracting. The district will set priorities for planning and technical assistance for installation of these gully control measures. The SCS will furnish technical assistance to plan and install these measures.

Mitigation

The project sponsors will obtain in fee-title or by permanent easement, 244 acres of land around structure A-2 for mitigation of wildlife values lost to project purposes.

It is estimated that 100 acres of this land will be planted and fenced for wildlife purposes as part of structural costs. The planted area and remaining lands will be managed for wildlife needs. Wildlife management plans for this 244-acre area will be developed jointly between the sponsors, SCS, and Missouri Department of Conservation. These plans will be drawn up and implemented concurrently with construction of structure A-2.

PROJECT IMPACTS

Structural Measures

The grade stabilization structures already installed as structural measures and the land treatment measures included in this supplement will treat about the same acres of gully problem areas as outlined in the original work plan. Monetary benefits were reduced to reflect the structures deleted.

The percent reduction, in monetary benefits, from floodwater damage to crops, pasture, roads, bridges and other agricultural items is slightly greater in this supplement as compared to the original work plan. The system of structures in this supplement will reduce the average annual acres flooded from approximately 10,700 acres to 3,800 acres.

Of the 768 acres of water areas in the structures to be built, 329 acres are subject to mitigation under a memorandum of understanding between Soil Conservation Service, Missouri Department of Conservation and U.S. Fish and Wildlife Service. This 329 acres results from structures added by this supplement and increases in permanent pool areas resulting from resizing the structures in the original work plan. This 329 acres is composed of 11 acres of other, 116 acres of cropland, 40 acres of pasture, 148 acres of woods, and 14 acres of hay. This amounts to a loss of 1,097 wildlife habitat units. This loss will be mitigated by improving wildlife values on 244 acres of land around structure A-2.

Additional wildlife values will be gained through the application of land treatment practices. Crop residue management, various woodland practices, etc., will increase habitat quality and diversity of cover.

PROJECT BENEFITS

Benefits to grade stabilization structures were updated for this supplement. Benefits to floodwater retarding structures were reevaluated using 1978 Current Normalized Prices with yields projected to year 2000 for agricultural commodities and current prices for other agriculture and roads and bridges.

Benefits to municipal and industrial water were evaluated using the least costly alternative. All benefits for changed land use, more intensive land use, incidental recreation and secondary benefits were not used in this supplement.

Total benefits in this supplement are \$706,472 annually. This includes floodwater reduction benefits of: \$341,235 for crop and pasture, \$8,496 for other agriculture, and \$24,427 for roads and bridges. Damage reduction benefits to sediment and scour in the flood plain are \$28,198 and \$34,811 respectively. Benefits to the grade control structures are \$135,805, this includes the 34 structures that are installed plus the site remaining to be installed. Benefits to M&I water in structure Site A-2 are \$133,500.

The average annual benefits from the structural measures in this project as supplemented are \$706,472; compared with the average annual cost of \$596,235 gives a cost benefit ratio of 1.2:1.0.

OPERATION AND MAINTENANCE

Maintenance of land treatment will be the responsibility of the Soil and Water Conservation District in which the measures are located. The Districts will use the cooperative agreement with the individual landowners as the operation and maintenance agreement for the maintenance of land treatment on individual farms,

Structural measures except multipurpose structure A-2 will be operated and maintained by the Grindstone-Lost-Muddy Creek Watershed Subdistrict. The estimated cost of maintaining these measures is \$39,800 annually. Funds for this purpose will be from taxes collected in the subdistrict. Multipurpose structure A-2 and the surrounding mitigation area will be operated and maintained by the city of Cameron, Missouri. The estimated cost of maintaining this structure is \$5,400 annually. The city of Cameron will incur an estimated \$23,300 for operating and maintaining the raw water line and intake structure. Costs in revised Table 4 reflect \$1,200 annually for maintaining the mitigation measures in the area around structure A-2. Maintenance items to be performed are explained in the operation and maintenance section of the original work plan.

TABLE 1, REVISED - ESTIMATED INSTALLATION COST
GRINDSTONE-LOST-MUDDY CREEK WATERSHED, MISSOURI

INSTALLATION COST ITEM	NUMBER	ESTIMATED COST (DOLLARS) 1/										TOTAL INSTALLED COST 1979 PRICE 2/
		FL-366 FUNDS		OTHER FUNDS		TOTAL		NONFEDERAL LAND		TOTAL		
		FEDERAL LAND SCS 3/	NONFEDERAL LAND FS 2/	FEDERAL LAND SCS 3/	NONFEDERAL LAND FS 2/	FEDERAL LAND SCS 3/	NONFEDERAL LAND FS 2/	FEDERAL LAND SCS 3/	NONFEDERAL LAND FS 2/	FEDERAL LAND SCS 3/	NONFEDERAL LAND FS 2/	
LAND TREATMENT												
LAND AREAS												
CROPLAND												
GRASSLAND												
WILDLIFE LAND												
TREATED	18,942											
" "	11,549											
" "	1,840											
RECREATION LAND	57											
FOREST LAND	6,595											
TECHNICAL ASSISTANCE												
TOTAL LAND TREATMENT		156,541	32,223	188,764								
STRUCTURAL MEASURES												
GRADE STABILIZATION												
STRUCTURES												
FLOODWATER RETARDING												
STRUCTURES	NUMBER	1,298,568		1,298,568								
MULTIPLE PURPOSE	NUMBER	5,805,630		5,805,630								
STRUCTURES	NUMBER	1,200,497		1,200,497								
INFAME STRUCTURE &	NUMBER											
RAW WATER LINE	LIN. FT.											
TOTAL STRUCTURAL MEASURES		8,304,695		8,304,695								
TOTAL PROJECT		8,461,236	32,223	8,493,459								

1/ PRICE BASE 1979 OR AS CONSTRUCTED

2/ All costs 1979 Price Base.

3/ FEDERAL AGENCY RESPONSIBLE FOR ASSISTING IN INSTALLATION OF WORKS OF IMPROVEMENT.

TABLE 2. REVISED - ESTIMATED COST DISTRIBUTION
 STRUCTURAL AND NONSTRUCTURAL MEASURES
 GRINDSTONE-LOST-MUDDY CREEK WATERSHED, MISSOURI
 (DOLLARS) 1/

ITEM	INSTALLATION COST - PL-566 FUNDS						INSTALLATION COST - OTHER FUNDS						TOTAL INSTALLED COST 1979 13/ PRICE		
	CONST.	ENGR.	LAND RIGHTS	CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS	PROJECT ADMIN.	TOTAL PL-566	CONST.	ENGR.	LAND RIGHTS	CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS		PROJECT ADMIN.	TOTAL OTHER
STRUCTURAL MEASURE GRADE STABILIZATION STRUCTURE C-62	88,300	17,700				22,100	128,100			1,000			200	1,200	129,300
COMPLETED															
A-23	35,375	4,050				1,545	40,970			1,780			400	2,180	80,690
A-26	15,433	4,771				1,819	22,023			2,147			420	2,567	24,590
A-27	17,483	3,793				1,446	22,722			1,651			390	2,041	24,763
A-28	15,170	5,993				2,286	23,449			2,453			450	2,903	26,352
A-33	21,009	5,533				2,109	28,651			2,240			440	2,680	31,331
A-39	24,239	6,508				2,481	33,228			3,042			460	3,502	36,730
A-52	12,928	6,428				2,451	21,807			2,999			460	3,459	25,266
B-20	15,275	4,405				1,679	21,359			1,960			410	2,370	23,729
B-21	48,931	5,829				2,222	56,982			2,383			440	2,823	59,805
B-22	36,561	5,532				2,109	44,202			2,537			440	2,977	47,179
B-25	32,104	4,371				1,743	38,418			2,050			410	2,460	40,878
B-36	26,961	6,339				2,417	33,717			2,610			460	3,070	36,787
C-20	15,713	5,774				2,201	23,688			2,667			440	3,107	26,795
C-22	19,261	4,188				1,597	25,046			1,854			400	2,254	27,300
C-27	32,631	4,961				2,132	37,594			2,250			420	2,670	39,264
C-28	18,962	5,593				1,891	25,814			2,570			440	3,010	28,884
C-29	30,878	7,223				2,132	40,356			3,018			480	3,498	43,854
C-35	27,680	8,094				3,085	38,859			3,430			470	3,920	42,779
C-36	16,097	6,760				2,577	25,434			2,804			470	3,274	28,708
C-38a	22,692	5,653				2,155	30,500			2,298			440	2,738	33,238
C-39b	20,212	5,223				1,992	27,427			2,381			430	2,811	30,238
C-60	21,793	5,922				2,257	29,972			2,737			450	3,187	33,159
C-63	17,944	5,522				2,106	25,572			2,532			440	2,972	28,544
C-75	20,925	4,069				1,551	26,545			1,790			400	2,190	28,735

TABLE 2, REVISED, ESTIMATED COST DISTRIBUTION
(Continued)

ITEM	INSTALLATION COST - PL-566 FUNDS										INSTALLATION COST - OTHER FUNDS			TOTAL INSTALLED COST 1979 13/ PRICE		
	CONST.	ENGR.	LAND RIGHTS	CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS	PROJECT ADMIN.	TOTAL PL-566	CONST.	ENGR.	LAND RIGHTS	CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS	PROJECT ADMIN.		TOTAL OTHER	TOTAL INSTALLATION COST
D-22	29,907	7,986				3,045	40,938			3,378			490	3,868	44,806	57,160
D-23	36,138	7,471				2,849	46,458			3,138			480	3,618	50,076	84,910
D-31	21,878	4,332				1,652	27,862			1,921			410	2,331	30,193	51,830
D-34	32,593	5,680				2,170	40,453			2,316			440	2,756	43,209	76,010
D-39	30,782	6,528				2,489	39,799			2,702			460	3,162	42,961	57,890
D-42	55,694	6,417				2,446	64,557			3,148			460	3,608	68,165	99,180
F-20	32,987	4,671				1,781	39,439			2,094			420	(5,643) 2/	(6,215)	(6,215)
F-30	43,094	4,575				1,744	49,413			2,052			410	2,514	41,953	77,930
F-32	30,047	4,266				1,627	35,940			1,896			400	2,462	51,875	89,910
F-61	29,932	4,402				1,679	36,013			1,896			400	2,296	38,236	55,530
Subtotal	997,609	206,772				94,187	1,298,568			83,787			15,060	98,847	1,397,415	2,480,660
FWR Str.														(5,643)	(5,643)	(6,215)
A-6	229,800	34,500				34,500	298,800			96,200 1/			3,600	99,800	398,600	398,600
A-8	90,800	18,200				22,700	131,700			9,400			200	9,600	141,300	141,300
A-10a	142,000	28,400				28,400	198,800			17,000			4,800	21,800	220,600	220,600
A-11	134,400	26,900				26,900	188,200			18,000			3,000	21,000	209,200	209,200
A-12	164,700	32,900				32,900	230,500			126,400 4/			4,200	130,600	361,100	361,100
A-13	539,500	54,000				54,000	648,500			264,900 5/			4,800	269,700	918,200	918,200
A-14	158,800	31,800		1,000		31,800	226,400			20,600			1,000	16,600	251,200	251,200
B-1a	126,200	17,300		4,000		25,200	176,600			15,600			200	16,800	193,200	193,200
B-3a	86,400	17,300				21,600	125,300			10,800			200	11,000	136,300	136,300
B-5	144,200	28,800				28,800	201,800			12,400			200	12,600	214,400	214,400
B-7	105,300	21,100				26,300	152,700			10,900			200	11,100	163,800	163,800
B-10	116,400	23,300				23,300	163,000			18,600			4,800	23,400	186,400	186,400
C-2a	89,400	17,900				22,300	129,600			15,300			3,500	19,000	148,600	148,600
C-2b	120,500	24,100				24,100	168,700			17,700			1,800	19,500	188,200	188,200
C-4	288,300	23,200		2,000		35,800	329,300			35,800			2,400	38,200	367,500	367,500
C-6	123,200	24,600		1,000		24,600	173,400			13,600			1,700	15,300	188,700	188,700

TABLE 2, REVISED, ESTIMATED COST DISTRIBUTION
(Continued)

ITEM	INSTALLATION COST - PL-566 FUNDS					INSTALLATION COST - OTHER FUNDS					TOTAL INSTALLED COST 1979 13/ PRICE				
	CONST.	ENGR.	LAND RIGHTS	CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS	PROJECT ADMIN.	TOTAL PL-566	CONST.	ENGR.	LAND RIGHTS		CULTURAL RESOURCES PROTECTION	RELOCATION PAYMENTS	PROJECT ADMIN.	TOTAL OTHER
D-2a	728,500	72,900		1,000		72,900	875,300			192,700 ^{6/}			9,000	201,700	1,077,000
D-3	158,000	31,600		1,000		31,600	222,200			25,900			1,800	27,700	1,077,000
D-4	164,600	32,900				32,900	230,400			19,600			2,400	22,000	249,900
D-5	212,000	31,800				31,800	275,600			32,100			3,600	35,700	232,400
Completed															311,300
B-4	76,777	6,292				2,399	85,468			4,020			460	4,480	124,000
B-6	69,385	6,059				2,310	77,754			3,428			450	3,878	113,000
C-3	266,748	30,462				11,614	308,824			48,045			8,406 ^{10/}	56,451	365,275
C-5	169,828	12,276				4,680	186,784			(9,980) ^{9/}			500	(58,765)	760,980
Subtotal	4,485,738	656,489		10,000		653,403	5,805,630			1,037,638			67,216	1,104,854	370,300
Multiple Purpose Structure A-2	946,123	94,644		10,000		94,500	1,200,497			493,600 ^{11/}			25,000 ^{12/}	841,703	2,042,200
Intake Structure & Water Main	946,123	94,644		10,000		94,500	1,200,497			15,000			41,000	1,007,700	1,007,700
Subtotal	6,429,470	957,905		20,000		862,090	8,304,695			508,600			66,000	1,849,403	3,049,900
Total Project															11,357,799
															(117,569)

1/ Price Base 1979 or as constructed.

2/ Nonproject construction cost to increase top width dam for road, not included in total project cost.

3/ Includes \$30,000 for raising road.

4/ Includes \$50,000 for raising road.

5/ Includes \$100,000 for raising road.

6/ Includes \$20,000 for raising road and building ramp to power poles.

7/ Nonproject construction cost to raise top dam for recreation pool, not included in total project cost.

8/ Nonproject engineering cost, not included in total project cost.

9/ Nonproject land rights costs, not included in total project cost.

10/ Includes \$5,000 legal fees, \$1,906 installation services and \$1,500 for contract administration.

11/ Includes \$30,000 for riprap around piers of U.S. Highway 36 bridge.

12/ Includes \$2,000 for title insurance, \$5,000 for surveying, \$2,500 for legal fees, and \$3,000 for relocation assistance advisory services.

13/ All cost 1979 Price Base.

TABLE 3 - STRUCTURAL DATA
DAMS WITH PLANNED STORAGE CAPACITY

Item	Unit	Structure Number				
		A-2 ^{2/}	A-6	A-8	A-10a	A-11
Class of Structure		"b"	"a"	"a"	"a"	"a"
Seismic Zone		1	1	1	1	1
Uncontrolled Drainage Area	Sq. Mi.	20.91	6.02	1.38	2.58	2.22
Controlled Drainage Area	Sq. Mi.	--	--	--	--	--
Total Drainage Area	Sq. Mi.	20.91	6.02	1.38	2.58	2.22
Runoff Curve No. (1-day) (AMC II)		76	76	76	76	76
Time of Concentration (T _c)	Hrs.	3.90	1.80	0.48	1.00	0.75
Elevation Top of Dam	Ft.	919.3	955.9	907.8	902.8	891.5
Elevation Crest Emergency Spillway	Ft.	913.1	952.9	904.8	899.8	888.5
Elevation Crest High Stage Inlet	Ft.	907.0	950.5	893.6	887.7	877.6
Elevation Crest Low Stage Inlet	Ft.	897.1	938.8	--	--	--
Emergency Spillway Type		Veg.	Veg.	Veg.	Veg.	Veg.
Emergency Spillway Bottom Width	Ft.	300	150	60	80	80
Emergency Spillway Exit Slope	% slope	6.25	5.4	9.0	6.0	4.0
Maximum Height of Dam	Ft.	53.3	35.5	35.8	34.8	29.5
Volume of Fill	Cu. Yd.	343,000	52,350	27,500	47,430	46,950
Total Capacity ^{1/}	Ac. Ft.	6,248	1,212	284	514	485
Sediment Submerged	Ac. Ft.	569	198	74	91	98
Sediment Aerated	Ac. Ft.	100	27	10	12	13
Beneficial Use	Ac. Ft.	1,300	--	--	--	--
Floodwater Retarding	Ac. Ft.	4,279	987	200	411	374
Between High and Low Stage	Ac. Ft.	2,200	760	--	--	--
Surface Area						
Sediment Pool	Acres	(93)	35	11	18	19
Beneficial Use Pool	Acres	177	--	--	--	--
Floodwater Retarding Pool ^{1/}	Acres	385	131	27	55	55
Principal Spillway Design						
Rainfall Volume (1-day)	In.	6.45	5.93	5.93	5.93	5.93
Rainfall Volume (10-day)	In.	11.44	10.20	10.20	10.20	10.20
Runoff Volume (10-day)	In.	6.09	5.06	5.06	5.06	5.06
Capacity of Low Stage (Max.)	cfs	286	97	31	43	32
Capacity of High Stage (Max.)	cfs	1,058	229	--	--	--
Dimensions of Conduit	Ft./In.	6X6	42"	18"	20"	18"
Frequency Operation-Emergency Spillway	% chance	2	4	4	4	4
Emergency Spillway Hydrograph						
Rainfall Volume	In.	7.59	5.58	5.58	5.58	5.58
Runoff Volume	In.	4.79	3.02	3.02	3.02	3.02
Storm Duration	Hrs.	6	6	6	6	6
Velocity of Flow (V _e)	Ft./Sec.	5.18	--	3.08	--	--
Max. Reservoir Water Surface Elevation	Ft.	914.0	951.8	905.0	899.5	887.9
Freeboard Hydrograph						
Rainfall Volume	In.	13.01	8.05	8.05	8.05	8.05
Runoff Volume	In.	9.87	5.20	5.20	5.20	5.20
Storm Duration	Hrs.	6	6	6	6	6
Max. Reservoir Water Surface Elevation	Ft.	919.3	954.7	907.0	902.3	890.6
Discharge per Foot of Width (O _{e/b})	Ac. Ft.	20.2	2.5	1.2	3.1	2.5
Bulk Length	Ft.	190	170	150	160	180
Capacity Equivalents						
Sediment Volume	In.	0.60	0.74	1.14	0.75	0.94
Floodwater Retarding Volume	In.	3.83	3.25	2.72	2.99	3.16
Beneficial Volume	In.	1.16	--	--	--	--

1/ Crest Emergency Spillway

2/ Reservoir contains beneficial water. Sediment pool inundated.

October 1980

TABLE 3 - STRUCTURAL DATA
DAMS WITH PLANNED STORAGE CAPACITY

Item	Unit	Structure Number				
		A-12	A-13	A-14a	B-1a	B-3a
Class of Structure		"b"	"a"	"b"	"a"	"a"
• Seismic Zone		1	1	1	1	1
Uncontrolled Drainage Area	Sq. Mi.	3.20	8.94	2.87	2.13	1.40
Controlled Drainage Area	Sq. Mi.	--	--	--	--	--
Total Drainage Area	Sq. Mi.	3.20	8.94	2.87	2.13	1.40
Runoff Curve No. (1-day) (AMC II)		76	76	76	76	76
Time of Concentration (T_c)	Hrs.	0.65	1.39	0.63	0.61	0.58
Elevation Top of Dam	Ft.	891.3	890.3	894.6	957.5	945.7
Elevation Crest Emergency Spillway	Ft.	886.8	883.7	889.7	954.5	942.7
Elevation Crest High Stage Inlet	Ft.	873.7	877.9	873.5	943.2	932.6
Elevation Crest Low Stage Inlet	Ft.	--	868.5	--	935.0	--
Emergency Spillway Type		Veg.	Veg.	Veg.	Veg.	Veg.
Emergency Spillway Bottom Width	Ft.	90	100	80	60	60
Emergency Spillway Exit Slope	% slope	5.8	5.0	7.1	7.0	6.0
Maximum Height of Dam	Ft.	33.3	38.2	38.6	30.2	31.7
Volume of Fill	Cu. Yd.	66,230	170,000	65,500	41,190	27,500
Total Capacity ^{1/}	Ac. Ft.	769	2,493	791	408	268
Sediment Submerged	Ac. Ft.	123	369	114	61	56
Sediment Aerated	Ac. Ft.	17	50	16	8	8
Beneficial Use	Ac. Ft.	--	--	--	--	--
Floodwater Retarding	Ac. Ft.	629	2,074	661	339	204
Between High and Low Stage	Ac. Ft.	--	1,027	--	--	--
Surface Area						
Sediment Pool	Acres	27	65	22	2	11
Beneficial Use Pool	Acres	--	--	--	--	--
Floodwater Retarding Pool ^{1/}	Acres	94	219	66	52	34
Principal Spillway Design						
Rainfall Volume (1-day)	In.	6.64	5.93	6.64	5.93	5.93
Rainfall Volume (10-day)	In.	11.60	10.20	11.60	10.20	10.20
Runoff Volume (10-day)	In.	6.22	5.06	6.22	5.06	5.06
Capacity of Low Stage (Max.)	cfs	62	129	56	38	31
Capacity of High Stage (Max.)	cfs	--	395	--	--	--
Dimensions of Conduit	Ft./In.	24"	54"	21"	20"	18"
Frequency Operation-Emergency Spillway	% chance	2	4	2	4	4
Emergency Spillway Hydrograph						
Rainfall Volume	In.	8.05	5.58	8.05	5.58	5.58
Runoff Volume	In.	5.20	3.02	5.20	3.02	3.02
Storm Duration	Hrs.	6	6	6	6	6
Velocity of Flow (V_e)	Ft./Sec.	5.44	--	6.36	--	2.34
Max. Reservoir Water Surface Elevation	Ft.	887.9	884.5	890.7	954.2	942.9
Freeboard Hydrograph						
Rainfall Volume	In.	13.80	8.05	13.80	8.05	8.05
Runoff Volume	In.	10.62	5.20	10.62	5.20	5.20
Storm Duration	Hrs.	6	6	6	6	6
Max. Reservoir Water Surface Elevation	Ft.	891.3	883.5	894.3	956.9	944.8
Discharge per Foot of Width ($O_{e/b}$)	Ac. Ft.	2.1	1.8	11.1	3.3	2.5
Bulk Length	Ft.	170	160	160	160	160
Capacity Equivalents						
Sediment Volume	In.	0.82	0.87	0.85	0.61	0.86
Floodwater Retarding Volume	In.	3.69	3.26	4.32	2.98	2.73
Beneficial Volume	In.	--	--	--	--	--

^{1/} Crest emergency spillway.

TABLE 3 - STRUCTURAL DATA
DAMS WITH PLANNED STORAGE CAPACITY

Item	Unit	Structure Number				
		B-5	B-7	B-10	C-2a	C-2b
Class of Structure		"b"	"a"	"a"	"a"	"a"
Seismic Zone		1	1	1	1	1
Uncontrolled Drainage Area	Sq. Mi.	1.14	1.39	2.20	1.86	2.53
Controlled Drainage Area	Sq. Mi.	--	--	--	--	--
Total Drainage Area	Sq. Mi.	1.14	1.39	2.20	1.86	2.53
Runoff Curve No. (1-day) (AMC II)		79	76	76	76	76
Time of Concentration (T _c)	Hrs.	0.58	0.48	0.44	0.68	0.96
Elevation Top of Dam	Ft.	942.2	904.2	876.4	984.4	986.9
Elevation Crest Emergency Spillway	Ft.	936.2	901.2	873.4	981.4	983.9
Elevation Crest High Stage Inlet	Ft.	928.8	890.9	863.2	971.3	972.0
Elevation Crest Low Stage Inlet	Ft.	--	--	--	--	--
Emergency Spillway Type		Veg.	Veg.	Veg.	Veg.	Veg.
Emergency Spillway Bottom Width	Ft.	60	60	60	60	60
Emergency Spillway Exit Slope	% slope	6.0	5.5	7.0	5.5	7.5
Maximum Height of Dam	Ft.	25.0	26.2	27.4	24.4	28.9
Volume of Fill	Cu. Yd.	37,900	29,550	38,710	35,000	40,740
Total Capacity ^{1/}	Ac. Ft.	349	263	486	389	506
Sediment Submerged	Ac. Ft.	54	46	93	64	74
Sediment Aerated	Ac. Ft.	7	6	13	9	10
Beneficial Use	Ac. Ft.	--	--	--	--	--
Floodwater Retarding	Ac. Ft.	288	211	380	316	422
Between High and Low Stage	Ac. Ft.	--	--	--	--	--
Surface Area						
Sediment Pool	Acres	13	12	21	17	17
Beneficial Use Pool	Acres	--	--	--	--	--
Floodwater Retarding Pool ^{1/}	Acres	44	33	59	48	59
Principal Spillway Design						
Rainfall Volume (1-day)	In.	6.60	5.93	5.93	5.93	5.93
Rainfall Volume (10-day)	In.	11.70	10.20	10.20	10.20	10.20
Runoff Volume (10-day)	In.	6.84	5.06	5.06	5.06	5.06
Capacity of Low Stage (Max.)	cfs	--	29	31	28	38
Capacity of High Stage (Max.)	cfs	20	--	--	--	--
Dimensions of Conduit	Ft./In.	24"	18"	20"	18"	20"
Frequency Operation-Emergency Spillway	% chance	2	4	4	4	4
Emergency Spillway Hydrograph						
Rainfall Volume	In.	8.00	5.58	5.58	5.58	5.58
Runoff Volume	In.	5.51	3.02	3.02	3.02	3.02
Storm Duration	Hrs.	6	6	6	6	6
Velocity of Flow (V _e)	Ft./Sec.	6.30	--	--	--	--
Max. Reservoir Water Surface Elevation	Ft.	940.0	901.2	872.7	980.8	983.3
Freeboard Hydrograph						
Rainfall Volume	In.	13.80	8.05	8.05	8.05	8.05
Runoff Volume	In.	11.05	5.20	5.20	5.20	5.20
Storm Duration	Hrs.	6	6	6	6	6
Max. Reservoir Water Surface Elevation	Ft.	942.1	903.3	875.6	983.5	986.4
Discharge per Foot of Width (O _{e/b})	Ac. Ft.	6.7	2.4	3.0	2.7	3.7
Bulk Length	Ft.	145	170	160	170	160
Capacity Equivalents						
Sediment Volume	In.	1.00	0.70	0.90	0.73	0.62
Floodwater Retarding Volume	In.	4.74	2.85	3.24	3.19	3.12
Beneficial Volume	In.	--	--	--	--	--

^{1/} Crest Emergency Spillway.

TABLE 3 - STRUCTURAL DATA
DAMS WITH PLANNED STORAGE CAPACITY

Item	Unit	Structure Number				
		C-4	C-6	D-2a	D-3	D-4
Class of Structure		"a"	"a"	"b"	"a"	"a"
Seismic Zone		1	1	1	1	1
Uncontrolled Drainage Area	Sq. Mi.	5.19	1.73	22.53	3.45	2.45
Controlled Drainage Area	Sq. Mi.	--	--	--	--	--
Total Drainage Area	Sq. Mi.	5.19	1.73	22.53	3.45	2.45
Runoff Curve No. (1-day) (AMC II)		76	76	76	76	76
Time of Concentration (T_c)	Hrs.	1.70	0.86	4.33	0.81	0.69
Elevation Top of Dam	Ft.	914.0	906.1	880.2	942.5	947.1
Elevation Crest Emergency Spillway	Ft.	911.0	903.1	874.1	939.5	944.1
Elevation Crest High Stage Inlet	Ft.	907.8	893.0	869.6	928.6	933.9
Elevation Crest Low Stage Inlet	Ft.	898.7	--	860.5	--	--
Emergency Spillway Type		Veg.	Veg.	Veg.	Veg.	Veg.
Emergency Spillway Bottom Width	Ft.	140	50	300	100	60
Emergency Spillway Exit Slope	% slope	9.0	7.5	6.1	7.0	2.5
Maximum Height of Dam	Ft.	33.0	31.1	40.2	27.5	31.1
Volume of Fill	Cu. Yd.	64,600	44,250	185,690	46,100	67,790
Total Capacity ^{1/}	Ac. Ft.	1,102	354	5,321	693	526
Sediment Submerged	Ac. Ft.	175	76	645	110	115
Sediment Aerated	Ac. Ft.	24	10	88	15	16
Beneficial Use	Ac. Ft.	--	--	--	--	--
Floodwater Retarding	Ac. Ft.	903	268	4,588	568	395
Between High and Low Stage	Ac. Ft.	567	--	2,463	--	--
Surface Area						
Sediment Pool	Acres	40	16	158	28	22
Beneficial Use Pool	Acres	--	--	--	--	--
Floodwater Retarding Pool ^{1/}	Acres	116	41	521	84	60
Principal Spillway Design						
Rainfall Volume (1-day)	In.	5.93	5.93	6.64	5.93	5.93
Rainfall Volume (10-day)	In.	10.20	10.20	11.60	10.20	10.20
Runoff Volume (10-day)	In.	5.06	5.06	6.22	5.06	5.06
Capacity of Low Stage (Max.)	cfs	77	31	328	57	40
Capacity of High Stage (Max.)	cfs	228	--	979	--	--
Dimensions of Conduit	Ft./In.	42"	18"	6X6	24"	20"
Frequency Operation-Emergency Spillway	% chance	4	4	2	4	4
Emergency Spillway Hydrograph						
Rainfall Volume	In.	5.58	5.58	8.05	5.58	5.58
Runoff Volume	In.	3.02	3.02	5.20	3.02	3.02
Storm Duration	Hrs.	6	6	6	6	6
Velocity of Flow (V_e)	Ft./Sec.	--	--	3.15	--	--
Max. Reservoir Water Surface Elevation	Ft.	909.8	903.0	874.9	939.0	943.7
Freeboard Hydrograph						
Rainfall Volume	In.	8.05	8.05	13.80	8.05	8.05
Runoff Volume	In.	5.20	5.20	10.62	5.20	5.20
Storm Duration	Hrs.	6	6	6	6	6
Max. Reservoir Water Surface Elevation	Ft.	913.4	905.8	880.2	941.8	947.0
Discharge per Foot of Width ($O_{e/b}$)	Ac. Ft.	2.3	3.4	21.3	3.1	3.4
Bulk Length	Ft.	150	160	190	160	210
Capacity Equivalents						
Sediment Volume	In.	0.72	0.93	0.61	0.68	1.00
Floodwater Retarding Volume	In.	3.26	2.90	3.82	3.09	3.02
Beneficial Volume	In.	--	--	--	--	--

^{1/} Crest Emergency Spillway.

TABLE 3 - STRUCTURAL DATA
DAMS WITH PLANNED STORAGE CAPACITY

Item	Unit	Structure Number				Total
		D-5				
Class of Structure		"a"				XXXX
Seismic Zone		1				XXXX
Uncontrolled Drainage Area	Sq. Mi.	4.06				100.18
Controlled Drainage Area	Sq. Mi.	--				--
Total Drainage Area	Sq. Mi.	4.06				100.18
Runoff Curve No. (1-day) (AMC II)		76				XXXX
Time of Concentration (T_c)	Hrs.	0.87				XXXX
Elevation Top of Dam	Ft.	920.3				XXXX
Elevation Crest Emergency Spillway	Ft.	917.3				XXXX
Elevation Crest High Stage Inlet	Ft.	906.7				XXXX
Elevation Crest Low Stage Inlet	Ft.	--				XXXX
Emergency Spillway Type		Veg.				
Emergency Spillway Bottom Width	Ft.	120				XXXX
Emergency Spillway Exit Slope	% slope	4.5				XXXX
Maximum Height of Dam	Ft.	32.3				XXXX
Volume of Fill	Cu. Yd.	76,100				1,554,080
Total Capacity ^{1/}	Ac. Ft.	893				24,354
Sediment Submerged	Ac. Ft.	191				3,396
Sediment Aerated	Ac. Ft.	26				485
Beneficial Use	Ac. Ft.	--				1,300
Floodwater Retarding	Ac. Ft.	676				19,173
Between High and Low Stage	Ac. Ft.	--				
Surface Area						
Sediment Pool	Acres	37				684
Beneficial Use Pool	Acres	--				177
Floodwater Retarding Pool ^{1/}	Acres	98				2,281
Principal Spillway Design						
Rainfall Volume (1-day)	In.	5.93				XXXX
Rainfall Volume (10-day)	In.	10.20				XXXX
Runoff Volume (10-day)	In.	5.06				XXXX
Capacity of Low Stage (Max.)	cfs	62				XXXX
Capacity of High Stage (Max.)	cfs	--				XXXX
Dimensions of Conduit	Ft./In.	24"				XXXX
Frequency Operation-Emergency Spillway	% chance	4				XXXX
Emergency Spillway Hydrograph						
Rainfall Volume	In.	5.58				XXXX
Runoff Volume	In.	3.02				XXXX
Storm Duration	Hrs.	6				XXXX
Velocity of Flow (V_e)	Ft./Sec.	--				XXXX
Max. Reservoir Water Surface Elevation	Ft.	916.8				XXXX
Freeboard Hydrograph						
Rainfall Volume	In.	8.05				XXXX
Runoff Volume	In.	5.20				XXXX
Storm Duration	Hrs.	6				XXXX
Max. Reservoir Water Surface Elevation	Ft.	920.0				XXXX
Discharge per Foot of Width ($O_{e/b}$)	Ac. Ft.	3.0				XXXX
Bulk Length	Ft.	170				XXXX
Capacity Equivalents						
Sediment Volume	In.	1.00				
Floodwater Retarding Volume	In.	3.12				
Beneficial Volume	In.	--				

^{1/} Crest Emergency Spillway.

TABLE 4, REVISED - ANNUAL COST
GRINDSTONE-LOST-MUDDY CREEK WATERSHED, MISSOURI
(DOLLARS)^{1/}

EVALUATION UNIT	AMORTIZATION OF INSTALLATION COST ^{2/}	OPERATION AND MAINTENANCE COST	TOTAL
STRUCTURAL MEASURES			
TOTAL PROJECT	526,535	69,700	596,235

^{1/} Price Base 1979

^{2/} All measures are amortized for 50-year life at 3 1/4 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Grindstone-Lost-Muddy Creek Watershed Supplement No. 1, Missouri

(Dollars)^{1/}

Item	Estimated Average Annual Damage		Damage Reduction Benefit ^{2/}
	Without Project	With Project	
Floodwater			
Crop and Pasture	528,824	187,589	341,235
Other Agricultural	13,353	4,857	8,496
Road and Bridge	41,472	17,045	24,427
Subtotal	583,649	209,491	374,158
Sediment			
Overbank deposition	40,830	12,632	28,198
Subtotal	40,830	12,632	28,198
Erosion			
Flood plain scour	51,605	16,794	34,811
Gullies ^{3/}	135,805	0	135,805
Subtotal	187,410	16,794	170,616
Total	811,889	238,917	572,972

^{1/} Price base Oct. 1978 CNP for cropland and pastureland and 1978 for all other.

^{2/} Excludes Effects of Accelerated Land Treatment Measures.

^{3/} This includes only the damages and benefits occurring from voiding or land deterioration that are affected by structural measures.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Grindstone-Lost-Muddy Creek Watershed Supplement, Missouri

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS ^{1/}		Total	Average ^{2/} Annual Cost	Benefit Cost Ratio
	Damage Reduction	Municipal Water Supply			
Total Project	572,972	133,500	706,472	596,235	1.2:1.0
GRAND TOTAL	572,972	133,500	706,472	596,235	1.2:1.0

^{1/} Price base Oct. 1978 CNP for cropland and pastureland and 1978 for all other.

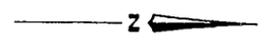
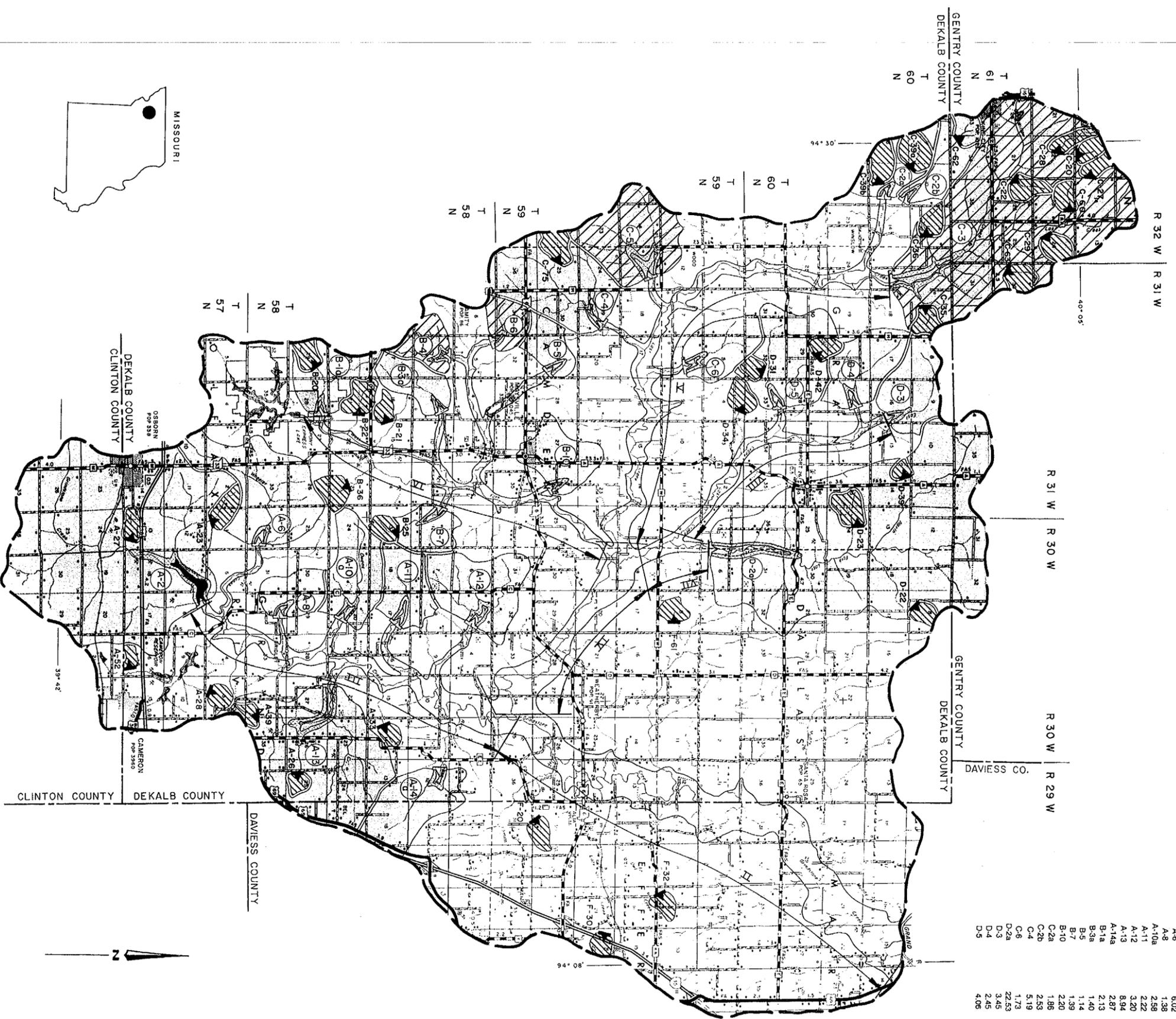
^{2/} From Table 4.

LEGEND

	AREA BENEFITED		PROJECT MEASURES
	DRAINAGE AREA CONTROLLED		MULTIPLE-PURPOSE STRUCTURE
	DRAINAGE AREA CONTROLLED, STRUCTURE COMPLETED		FLOOD RETARDING STRUCTURE
	EROSION DAMAGE AREA		PERMANENT POOL
	EROSION DAMAGE AREA, STRUCTURE NOT COMPLETED		TEMPORARY POOL
	EROSION DAMAGE AREA, STRUCTURE COMPLETED		STRUCTURE NUMBER
	RESERVOIR (EXISTING)		STABILIZATION STRUCTURE
			REACH

STRUCTURE DRAINAGE AREA TABLE

STR. NO.	D.A.(SQ. MI.)
A-2	20.91
A-6	6.02
A-8	1.38
A-10a	2.58
A-11	2.22
A-12	3.20
A-13	8.94
A-14a	2.87
B-1a	2.13
B-2a	1.40
B-7	1.39
B-10	2.20
C-2a	1.86
C-4	2.53
C-6	5.19
D-2a	1.73
D-3	22.23
D-4	3.45
D-5	2.45
	4.06



PROJECT MAP

GRINDSTONE - LOST - MUDDY CREEKS WATERSHED CLINTON, DAVIESS, DEKALB, AND GENTRY COUNTIES MISSOURI



SOURCE:
LATE DATE COUNTY HIGHWAY MAPS
FIELD REVISION FROM S.C.S.
POLYCONIC PROJECTION
USDA/SSALINCOIN NBR. 1980