82d Congress, 2d Session - - - - - House Document No. 388

INTERIM SURVEY REPORT, GRAND (NEOSHO) RIVER WATERSHED, ARKANSAS, KANSAS, MISSOURI, AND OKLAHOMA

LETTER

FROM

ACTING SECRETARY,
DEPARTMENT OF AGRICULTURE

TRANSMITTING

A SURVEY REPORT DATED APRIL 1950, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, OF THE GRAND (NEOSHO) RIVER WATERSHED IN ARKANSAS, KANSAS, MISSOURI, AND OKLAHOMA, MADE UNDER THE PROVISIONS OF THE FLOOD CONTROL ACT APPROVED JUNE 22, 1936, AS AMENDED AND SUPPLEMENTED

MARCH 10, 1952.—Referred to the Committee on Public Works and ordered to be printed with illustrations

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UNITED STATES
GOVERNMENT PRINTING OFFICE
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LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
Washington 25, D. C., February 27, 1952.

The SPEAKER, HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am submitting herewith a survey report dated April 1950, together with accompanying papers and illustrations, of the Grand (Neosho) River Watershed in Arkansas, Kansas, Missouri, and Oklahoma, made under the provisions of the Flood Control Act approved June 22, 1936, as amended and supplemented.

I recommend that the Secretary of Agriculture be authorized to carry out the program of runoff and water-flow retardation and soil-erosion prevention proposed in this report.

Enclosed are comments received from Governors of the concerned States and interested Federal agencies.

The Bureau of the Budget, in its letter of February 20, 1952, advises that there is no objection to the submission of this report to the Congress. The Bureau further states that it is in agreement with the objective contemplated in the report of carrying out measures designed to retard floods and prevent soil erosion, and that this objective is particularly desirable from the point of view of coordination of upstream measures with the flood-control programs of the Corps of Engineers. A copy of the letter from the Bureau of the Budget is enclosed.

Sincerely,

K. T. HUTCHINSON,
Acting Secretary.

INTERIM SURVEY REPORT, GRAND (NEOSHO) RIVER WATERSHED, ARKANSAS, KANSAS, MISSOURI, AND OKLAHOMA

LETTER FROM THE BUREAU OF THE BUDGET TO THE SECRETARY OF AGRICULTURE

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., February 20, 1952.

The honorable the SECRETARY OF AGRICULTURE.

MY DEAR MR. SECRETARY: This is in response to Acting Budget Officer John Wells' letter of January 31, 1951, and subsequent discussions with members of your staff concerning the relationship to the President's program of the proposals contained in your Department's report dated April 1950, entitled "Interim Survey Report, Grand (Neosho) River Watershed, Arkansas, Kansas, Missouri, and Oklahoma."

Floodwater and sediment damages occurring in the Grand (Neosho) River watershed are estimated to average $3,353,000 annually. The principal losses, estimated to average $1,476,000 annually, are caused by flooding of agricultural crops. Floods also cause damages to public roads and railroads, while sediment damages occur to water supplies, drainage channels, recreation, aquatic life, and public health.

It is proposed to alleviate these damages and to realize extensive associated benefits by installing a number of interrelated and interdependent soil and water conservation and control measures or groups of measures, mostly vegetative in character, during a 20-year period. These measures, applied in proper combination with other soil and water conservation practices and measures, would constitute a basic system of soil and water conservation in accordance with needs and capabilities of the land in the Grand (Neosho) River watershed. Educational assistance and technical services are also recommended as a part of the proposed program.

The estimated total cost of the recommended program, based on 1948 prices and an intermediate level of employment, is $83,838,000. The Federal Government would be expected to expend $44,893,000 of the total cost; non-Federal public agencies and private interests would contribute $38,945,000 or its equivalent in labor, materials, equipment, land easements, rights-of-way, and other assistance in lieu of cash payments. Operation and maintenance of the recommended works of improvement are estimated to cost $8,664,000 annually, of which $87,000 would be paid by the Federal Government and $8,577,000 or its equivalent would be borne by local interests.

It is estimated that the recommended watershed program, if installed as planned and maintained adequately, will yield average

annual benefits evaluated at $22,780,000. These benefits may be grouped under two categories—flood-control benefits and conservation benefits. The flood-control benefits, which are derived chiefly from channel improvement and stream-bank stabilization, consist of flood-water damage reductions to crops and pasture and to public roads and railroads, and sediment damage reductions, resulting in a lowering of the cost of treating public water supplies, and seem to be incidental to the over-all conservation benefits of the recommended program. It is noted that the average annual floodwater and sediment damage of $3,353,000 would be reduced by only $1,326,000, or about 40 percent. The conservation benefits of $21,454,000 would result mainly from the provision of farm waterways, terraces, pasture development, and other conservation measures.

The total average annual costs are estimated at $11,240,675. Since prices are expected to vary during the 20-year installation period, both benefits and costs were adjusted to anticipate future price levels by applying indexes provided by the Bureau of Agricultural Economics. The effect of this adjustment or alternate evaluation is to reduce monetary values of both benefits and costs. Thus, the average annual benefits are adjusted to $11,654,147 and the costs, on the same basis, to $7,438,000. This adjustment results in a revised benefit-cost ratio of 1.6 to 1 for the recommended program.

The report has been reviewed by the Governors of Arkansas, Kansas, Oklahoma, and Missouri, and also by the several concerned Federal agencies, in accordance with policies and procedures for distribution and coordination of reports as adopted by the Federal Inter-Agency River Basin Committee. The views expressed are generally favorable to the proposed program, with the suggestions limited to considerations that could be resolved cooperatively by the concerned agencies or local interests during the periods of planning and installing the watershed works of improvement.

The work envisioned in the report constitutes predominantly open-land, farm, and woodland improvement measures which will produce very high conservation benefits, accruing mainly to landowners and farm operators in the form of increased returns due to improved practices. The program recommended appears to be largely an intensification, acceleration, and adaptation of soil and water conservation activities already in progress under going programs of the Department of Agriculture. These include such programs as the conservation and use program, authorized by the Soil Conservation and Domestic Allotment Act, approved February 29, 1936, as amended; the Soil Conservation Service's program of assistance to districts and other cooperators, authorized by the act of April 27, 1935; and State and Private Forestry Cooperation, pursuant to the act of August 25, 1950, sections 1 through 5 of the act of June 7, 1924, and acts supplementary thereto.

The Bureau of the Budget is in agreement with the objective contemplated in the report of accelerating land treatment measures and installing structural measures designed to retard floods and prevent soil erosion. This objective is particularly desirable from the point of view of coordination of upstream measures with the flood control programs of the Corps of Engineers.

The measures contemplated to implement the proposed program might be grouped into two broad categories—land treatment measures and structural measures. The Bureau of the Budget is of the opinion that installation of the structural measures (shown in table 2, page 13 of the report as "Farm and Group Waterways"; "Grade Stabilizing, Terrace Outlet, and Water-flow Control Structures"; "Tributary Floodway Systems"; and "Floodwater Retarding Reservoirs") should properly be authorized under the Flood Control Act, as amended and supplemented. The Bureau a so believes that the land treatment measures set forth in the report, since they are largely an acceleration of existing programs of the Department of Agriculture, should be financed under appropriation other than that for the Flood Control Act. This would avoid confusion in the presentation of the Department's budgetary program, since many of the current land treatment programs of the Department have the objective of runoff and water-flow retardation and the prevention of soil erosion. To the extent that the acceleration of land treatment measures under existing authorities is not possible, we urge that adequate authorities for such acceleration be sought through amendment of those basic authorities.

Your staff, on the other hand, believes that the Department cannot properly meet its responsibilities under the Flood Control Act unless the full program envisioned in the report is authorized under that act. Your representatives, however, agreed that appropriations for land treatment phases implementing the program recommended in the report, upon approval by the Congress generally on the basis as submitted, would be sought as additions to going program appropriations of the agencies carrying on the work. Funds for structural works or measures would still be requested under the appropriation "Flood control." The total obligations for land treatment and structural measures in each authorized flood-control project area could, of course, be shown in a summary table to be presented in the program and performance section of the annual Budget Document.

Subject to the above understanding as to the method of presenting the budget for flood-control programs, there would be no objection to the submission of the proposed Grand (Neosho) flood-control survey report to the Congress. In the event the report or any modification thereof is approved by the Congress, submission of requests for appropriations must be justified in accordance with the policy set forth in the President's letter of July 21, 1950, which directed that all civil public works be considered with the objective, as far as practicable, of deferring, curtailing, or slowing down those projects which do not directly contribute to national defense or to civilian requirements essential to the changed international situation, or as may later be modified.

In submitting the Department's report to the Congress, it will be appreciated if you include a copy of this letter.

Sincerely yours,

ELMER B. STAATS,
Assistant Director.

LETTER FROM THE CHIEF OF ENGINEERS TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington 25, D. C., December 29, 1950.

The honorable the SECRETARY OF AGRICULTURE.

DEAR MR. SECRETARY: Further reference is made to letter of recent date from the Assistant Secretary of Agriculture enclosing for information and comment copies of your survey report on the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma.

The report recommends that the Federal Government undertake in this river basin an extensive program of watershed improvement and management. This program includes land improvement, vegetative practices and educational activities, as well as structures for water-flow retardation and flood control. The total first cost of the program is estimated at $83,838,000, based on 1948 prices, including $38,945,000 or its equivalent in local costs. The average annual benefits of this program, over 90 percent of which are conservation benefits, are estimated in the report to exceed costs and give a benefit cost ratio of about 2 to 1.

That part of the program planned and recommended in your report for watershed management appears to be necessary and worth while as a cooperative undertaking between the Federal Government and the local people concerned. Also, it would fit in with and complement plans of the Corps of Engineers for water control and conservation in the basin. I have no specific comments to make regarding the watershed management program, which constitutes the much larger part of your recommended plan of improvement. On the other hand, the flood-control structures recommended in your report for the Grand (Neosho) River Basin are of concern to the Corps of Engineers because of the legislative responsibility for flood control, and I have certain comments regarding them. In general, it is evident that flood problems exist in the upper reaches of this basin and that small reservoirs such as you propose may be the best approach to solution of this part of the basin-wide flood problem. In this case, however, it appears that the entire group of 75 reservoirs proposed are located below only a small part, apparently about 8 percent, of the basin's drainage area. I understand that the works proposed have been planned to supplement the major flood-control works being provided or authorized for construction in this basin by the Corps of Engineers, and that the report indicates that there has been no duplication of benefits in your studies of the economics of the smaller upstream reservoirs you propose.

While this office understands the sampling methods employed by your Department in setting up a general plan of improvement of this kind it appears doubtful whether such consideration is adequate for design and for estimating costs and benefits when dams and reservoirs as large as some of those proposed are contemplated. For example, these reservoirs will vary from 1,000 to 8,000 acre-feet in capacity and include earth dams up to 50 feet in height. Because of their up-

stream location and because they would control only a small part (8 percent) of the basin's drainage area, their effect would be confined largely to local tributary areas and consequences of their operation, or possible failure, upon downstream flood-control works may be quite small, although it should be carefully studied when the plan is carried out.

The group of 75 small reservoirs is estimated to cost $4,837,000. While the report does not present sufficient data to permit a thorough check of the design, cost estimates, effects, and benefits of these reservoirs, our experience indicates that costs of actual construction to provide structures with a reasonable degree of safety and utility will be considerably higher than estimated in the report. More detailed engineering studies will be required to determine accurate costs, exact locations, and probable effects upon flood flows. These engineering studies would of course be necessary before construction is undertaken and the necessity for such studies and their possible effects upon the economics of the plan, and for careful coordination of flood-control plans, as well as the watershed management phase of the program, should be recognized.

The opportunity to review your report is appreciated and I trust that the foregoing comments will be considered as constructive in nature with a view to effective coordination of the watershed management and flood-control activities which are of concern to our respective agencies.

Sincerely yours,

LEWIS A. PICK,
Major General,
Chief of Engineers.

LETTER FROM THE GOVERNOR OF ARKANSAS TO THE ASSISTANT SECRETARY OF AGRICULTURE

STATE OF ARKANSAS,
OFFICE OF THE GOVERNOR,
Little Rock, October 18, 1950.

Mr. KNOX T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: I am in receipt of your letter of August 10, requesting my comments on the Department's survey report on the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma.

I hereby express my approval of the report as an important contribution to the problem of flood control and as a practical and well designed plan of sediment control and water retardation.

It is my belief that this program fills a serious need for attention to the areas between the main rivers and headwaters of the tributaries. Its benefit-cost ratio of 1.6 to 1 indicates a sound economic basis for such a project. It is my hope that its approval and construction may be expedited.

Yours very truly,

SID MCMATH, *Governor.*

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LETTER FROM THE PUBLIC HEALTH SERVICE TO THE ASSISTANT SECRETARY OF AGRICULTURE

FEDERAL SECURITY AGENCY,
PUBLIC HEALTH SERVICE,
Washington 25, D. C., October 26, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Office of the Secretary, Washington 25, D. C.

DEAR MR. HUTCHINSON: The report entitled "Arkansas River Watershed, Grand (Neosho) River Watershed, April 1950" (report of appendixes A, B, C, D, and E) furnished by your Department has been reviewed by us according to the policies and procedures of the Federal Inter-Agency River Basin Committee.

There was not time to prepare a memorandum. In the future the practice of submitting written reviews will be adhered to, however. We are hereby giving clearance to the report and a copy of this letter is being sent to the Secretary of the Federal Inter-Agency River Basin Committee for his information.

Sincerely yours,

M. D. HOLLIS,
Assistant Surgeon General,
Associate Chief, Bureau of State Services.

LETTER FROM THE FEDERAL POWER COMMISSION TO THE SECRETARY OF AGRICULTURE

FEDERAL POWER COMMISSION,
Washington 25, November 1, 1950.

Subject: Grand (Neosho) River watershed, Arkansas, Kansas, Missouri, Oklahoma.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture, Washington 25, D. C.

DEAR MR. SECRETARY: The comments herein with respect to your Department's interim survey report on the Grand (Neosho) River watershed are transmitted in response to the Assistant Secretary's letter of August 10, 1950. The transmittal of the comments is in accordance with established procedures of the Federal Inter-Agency River Basin Committee.

The interim report recommends a program of runoff and water-flow retardation and soil-erosion prevention for the watershed of the Grand River, one of the principal tributaries of the Arkansas River, which drains an area of 12,660 square miles covering parts of four States—Arkansas, Kansas, Missouri, and Oklahoma. The program, which will consist of forest planting, grazing control, grassland conservation, terracing, other land-treatment measures, and about 145 floodwater-retarding structures, some ranging up to 8,000 acre-feet storage capacity, would be installed over a 20-year period. The estimated cost is $83,838,000, based on 1948 price levels, of which $44,893,000 would be Federal expenditure. The estimated average annual benefits amount to $11,654,000 and the charges to $7,438,000, indicating a benefit-cost ratio of about 1.6. The report states that the benefits claimed do not duplicate benefits assigned in the reports

of the Corps of Engineers pertaining to the Fort Gibson and proposed other reservoir projects of that Department in the basin.

The Commission staff has reviewed the report of your Department with a view to determining whether or not the plan of development would affect existing or potential hydroelectric power plants or offer any possibilities for hydroelectric power development. The Pensacola Dam project of the Grand River Dam Authority located at mile 77 on the Grand River is the only existing hydroelectric power development of importance in the basin. Located between it and the mouth of the river are the Fort Gibson project under construction by the Corps of Engineers and the proposed Markham Ferry project. These three developments, which will have a total ultimate power installation of about 250,000 kilowatts, represent the major part of the potential power in the basin. Other flood-control reservoir projects have been proposed in the basin upstream from these three plants. Besides the above developments, other plants which conceivably might be affected are the proposed and authorized navigation and power projects on the Arkansas River below the mouth of the Grand River.

Based on the results of its studies, the staff of the Commission is of the opinion that the recommended program of your Department will have little, if any, effect on existing and potential hydroelectric power in the basin or elsewhere in the area. The general results of the improvements, by effecting a possible increase in the base flows of the streams due to increased infiltration of water during storm periods and by retarding the sedimentation in main-stream reservoirs, may be beneficial to power development. It is suggested, however, that if conservation storage is to be provided in some of the proposed flood-water retarding reservoirs, consideration should be given to their operation, to the extent possible, so as to avoid conflict with existing and potential developments downstream. The staff further reports that there appear to be no possibilities for the development of power in connection with the improvements proposed in your program.

The Commission appreciates the opportunity of reviewing and commenting on the report of your Department.

Sincerely yours,

MON C. WALLGREN, *Chairman.*

LETTER FROM THE GOVERNOR OF MISSOURI TO THE SECRETARY OF AGRICULTURE

EXECUTIVE OFFICE,
STATE OF MISSOURI,
Jefferson City, November 1, 1950.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture, Washington, D. C.

DEAR MR. SECRETARY: Reference is made to your report entitled "Department of Agriculture's Survey Report on the Grand (Neosho) River Watershed in Arkansas, Kansas, Missouri, and Oklahoma." This report proposes a program for run-off and water-flow retardation and soil-erosion prevention for the watershed to be carried out over a 20-year period cooperatively by the United States Department of Agriculture, the States, and the people of the basin.

The program as outlined in your report is in general agreement with the State's attitude toward an agriculture and forestry program for the area under consideration. However, in view of the recent action of the President, directing the establishment of an inter-Agency Committee for the Arkansas-White-Red Basins, which would necessarily include the Grand (Neosho) River watershed, it seems desirable that no further action be taken on this report at the present time. The Interagency Committee is charged with the responsibility of formulating a comprehensive plan for utilization of the land and water resources of the three river basins. In discharging this responsibility it seems imperative that the Inter-Agency Committee should consider similar programs for the entire area under consideration, such as you have outlined in your report.

It, therefore, seems advisable to me that this program be given further study with a view toward incorporating it with the over-all comprehensive report of the Interagency Committee of the Arkansas-White-Red Basins.

Yours very truly,

FORREST SMITH, *Governor.*

LETTER FROM THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE TO THE ASSISTANT SECRETARY OF COMMERCE

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington 25, D. C., November 10, 1950.

Hon. K. T. HUTCHINSON,
Assistant Secretary of Agriculture, Washington, D. C.

DEAR MR. SECRETARY: Thank you for the opportunity to review the Department of Agriculture's report on the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma. We find we have no specific comments to make on this program, but appreciate your courtesy in making it available to us.

Sincerely,

H. B. MCCOY, *Director.*

LETTER FROM THE GOVERNOR OF KANSAS TO THE ASSISTANT SECRETARY OF AGRICULTURE

STATE OF KANSAS,
OFFICE OF THE GOVERNOR,
Topeka, December 6, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary,
United States Department of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: The proposed report of the United States Department of Agriculture on the Grand (Neosho) River to which you make reference in your letter of November 28, 1950, has been reviewed in behalf of the interests of the State of Kansas. The people in that portion of the basin which is within this State are deeply concerned with the serious problems of soil erosion control and runoff and water-flow retardation with which they are confronted. They

have organized soil-conservation districts throughout the area and are actively engaged with work on their land to the extent that the Soil Conservation Service is able to provide the technical assistance which is needed.

The program recommended in your report includes the intensification and acceleration of several activities being carried on under current programs of the Department. The work already done has demonstrated its great value. It is deemed highly desirable that it be continued as rapidly as possible in order that it may be accomplished within a reasonably foreseeable future period of time.

In addition, the recommended program also provides for the construction of floodwater retarding reservoirs on tributary watersheds. The need for storage as a means of controlling flood runoff in the Neosho Basin has long been recognized. It is felt that every effort should be made to develop fully all available opportunities for storage facilities within the various tributary watersheds of the basin.

The 1950 Federal Flood Control Act provides for the preparation of a comprehensive plan of development for the Arkansas, White, and Red River Basins which is to be completed in 1952. The Grand (Neosho) River is in the Arkansas River watershed and the program of the Department of Agriculture for this area, no doubt, will be included in the plan. Inasmuch as your report on the Grand (Neosho) River watershed is completed, it is urged that it be transmitted to Congress promptly for approval and authorization and that it be given separate consideration without being delayed further on account of the Arkansas-White-Red River Basins Report which just now is being undertaken.

I appreciate having had this opportunity to review your report and to express my comments thereon.

Sincerely yours,

FRANK J. HAGAMAN, *Governor.*

LETTER FROM THE OKLAHOMA PLANNING AND RESOURCES BOARD TO THE ASSISTANT SECRETARY OF AGRICULTURE

OKLAHOMA PLANNING AND RESOURCES BOARD,
Oklahoma City 5, Okla., December 9, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Washington, D. C.

DEAR MR. HUTCHINSON: We have examined with interest your Department's report on program for runoff and water-flow retardation and soil-erosion prevention on the Grand (Neosho) River, dated April 1950. Oklahoma has long advocated diligent conservation of all resources and is happy at this time to concur in the program presented in your report.

We note that the program calls for the planting of trees on lands "actively eroding" and "too poor for crops or pasture." It might be pointed out that survival of tree plantings on such land is problematical, and that plantings of perennial grasses and/or legumes may be a more practical solution in the early stages of the program.

In anticipation of future need for local supplies of irrigation water, the planning and design of floodwater retarding reservoirs mentioned

in the program should be executed with a view to possible small-scale irrigation later of adjacent farm lands wherever practical.

Yours very truly,

CLARENCE BURCH, *Chairman.*

LETTER FROM THE ASSISTANT SECRETARY OF THE INTERIOR TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., December 26, 1950.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture, Washington 25, D. C.

MY DEAR MR. SECRETARY: In accordance with Federal Inter-Agency River Basin Committee procedures, Assistant Secretary Hutchinson transmitted by letter, dated August 10, 1950, for the information and comments of the Department, copies of the Department of Agriculture's survey report on the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma.

The report recommends a program of runoff and water-flow retardation and soil-erosion prevention over a 20-year period at an estimated total cost of approximately $84,000,000, and an estimated annual operation and maintenance cost of near $8,700,000. The program includes the construction of subwatershed waterways, farm waterways, terraces and field diversions, gully stabilization, pasture development, adequate fire control, and other soil and water conservation practices and measures in accordance with the needs and capabilities of the land of the watershed. The average annual value of the total benefit of the recommended program is approximately $11,600,000, and the average annual value of the total cost of the recommended program is about $7,400,000.

In the review of the report at regional level, field representatives of the Bureau of Reclamation, Bureau of Mines, Fish and Wildlife Service, and the Geological Survey have commented on your report. Opportunity for such review in accordance with the procedures of the Federal Inter-Agency River Basin Committee is appreciated.

Evaluation of the future effects of land management programs on various aspects of water flow involves many problems. Our knowledge of hydrology has not yet advanced to a point where methods for making such evaluations are completely satisfactory. In view of the increasing needs for water, though objectives such as control of erosion and floods are of great importance, the measures to achieve such control must take cognizance of possible increased evaporation or transpiration which may offset benefits achieved through regulation of stream flow or increased ground-water recharge.

Information received from the Geological Survey indicates that few basic data are available for the watershed with respect both to topographic mapping and the water resources. Fortunately, data on sediment discharge are more adequate than in many other areas. Though there are several references to ground water, the assumptions of runoff and surface storage do not consider the effect of variations in ground water storage. Obviously the position of the ground-water table affects the quantity of runoff for any given quantity of precipi-

tation. In the mention of the soil moisture in the surface mantle, it is not clear whether ground-water storage was considered as a part thereof.

Undoubtedly with respect to reforestation the planting of trees on 216,000 acres of land may increase the possibility of infiltration, but the amount of evaporation and transpiration may be greater than the increase in infiltration. Additional research on evapo-transpiration would help greatly in clarifying this situation.

Considering the information presented in the report, together with results of investigations to date in the Arkansas River Basin, it does not appear that the Department of Agriculture's program will interfere with any probable projects contemplated by the Bureau of Reclamation in the Grand (Neosho) Basin.

The report makes it quite clear that the success of the proposed plan depends upon cooperation of Federal and State agencies, as well as the owners and operators of the lands within the area. It is noted that some $8,350,000, or its equivalent, is to be expended annually by landowners and operators for operation and maintenance of conservation measures and for supporting the increased cost of operating a more beneficial system of conservation farming and woodland management. Perhaps the report is somewhat optimistic in assuming 100 percent cooperation in conservation farming and woodland management throughout the basin, since approximately 40 percent of the farmers are tenants and it might well contain additional evidence that such cooperation will be realized or the conservation benefits should be scaled down accordingly.

The report states that the present normal yield of cultivated crops was obtained from farm schedules and agricultural reports for a 5-year period, 1934 to 1938, inclusive. The present normal yield during this period was compared with yields which might be obtained under the most modern conservation practices, similar to those employed at agricultural experiment stations. We do not feel that it is reasonable to expect that the average yield of the entire watershed could be brought up to this level during the 20-year period. The average yield figures are based on the 5 years 1934 to 1938, and it is noted that two of these years were exceptionally dry and that 4 years were below the average in precipitation. It is believed that the present normal yield as derived in the report is somewhat below the actual normal yield of the watershed. In a like manner, the present yields of the grazing land and farm wood lots tend to be somewhat lower than is believed actually exist on the basin; whereas, the predicted yields under the recommended program are quite optimistic.

Reduction in sedimentation resulting from sheet and rill erosion and the reduction of sedimentation damages along highways as set forth in the report appears to be unduly high. It would be quite helpful if additional data were available to better substantiate these estimates.

The information given in the report is insufficient to support the estimates of the costs of the proposed program. In this connection, it would be helpful if the report included a discussion of the sampling techniques used in planning the program and typical design data and cost estimates for the types of structures proposed.

The Department feels that the over-all program will result in net benefits to fish and wildlife resources. Two elements in the plan which may affect fish and wildlife resources appreciably are the construction of 145 flood retarding (detention) structures and the construction of 90 miles of main floodways. The number of structures which will be erected on permanent streams is unknown. The report mentions that some of the main floodways involve improvement of existing natural channels, but the mileage of streams to be channelized is not given. Channel straightening and dredging can be harmful to fishery resources.

Indian lands in the basin are intermixed with other lands and any program of watershed development and proper land use cannot be complete if they are omitted. Indian lands in Oklahoma within the Neosho Basin total 196,773 acres or 10.3 percent of the watershed area in that State; 2.4 percent of the entire watershed in all States is Indian land. The type of work and control measures outlined in the report harmonize with the objectives of the Indian Bureau conservation program and are acceptable in every sense.

These considerations are very similar to the ones faced by the Department of the Interior in work on public lands. Similar technical problems are met with in our programs. The report indicates, and it has been amply demonstrated in work of this nature done by the Department of the Interior agencies, that more basic facts are necessary before great improvements can be made in methodology of analysis. As these programs are installed in the field, we believe that there should be a concurrent program of evaluation and analysis and research initiated in order that the estimates of the effect of land management on water and land can be progressively improved as time goes on. Agencies of the Department would be pleased to cooperate in such investigations.

The program proposed will benefit departmental interests within the basin, especially if opportunity is afforded the agencies of this Department such as Bureau of Indian Affairs to coordinate their conservation program with that of the Department of Agriculture, and the Fish and Wildlife Service of the Department to cooperate with your Department and the State conservation departments concerned in devising measures to insure that damages to fish and wildlife resources are minimized and that such increased benefits to these resources as may be practicable are realized.

Finally, we wish to note that the Grand Neosho River is a part of the Arkansas-White-Red Rivers system now under study by an inter-agency committee. You may wish to consider the appropriateness of seeking the views of that group in regard to this report.

Sincerely yours,

WILLIAM E. WARNE,
Assistant Secretary of the Interior.

UNITED STATES DEPARTMENT OF AGRICULTURE

INTERIM SURVEY REPORT

ARKANSAS RIVER WATERSHED
GRAND (NEOSHO) RIVER WATERSHED
ARKANSAS, KANSAS, MISSOURI, AND OKLAHOMA

Program for Runoff and Water-flow Retardation and Soil-Erosion Prevention

Prepared by

Soil Conservation Service

and

Forest Service

Pursuant to the Act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented

April 1950

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NEOSHO

List of appendixes made in connection with the report

(These appendixes are not printed in this document)

Appendix A. Description of the watershed.
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Appendix C. Floodwater and sediment damages.
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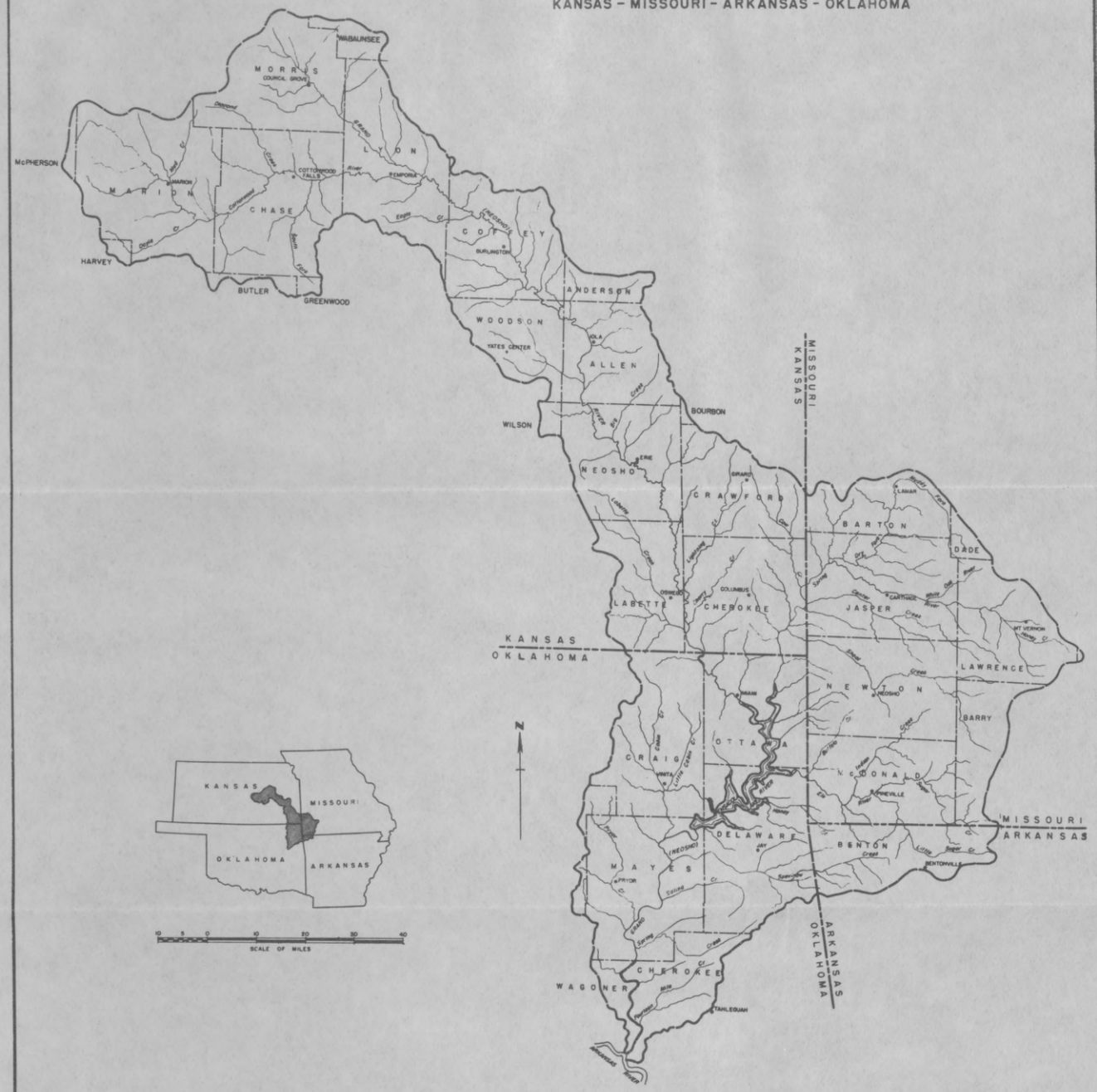
Figure 1

LOCATION MAP
GRAND (NEOSHO) RIVER WATERSHED

KANSAS - MISSOURI - ARKANSAS - OKLAHOMA



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INTERIM SURVEY REPORT, GRAND (NEOSHO) RIVER WATERSHED, ARKANSAS, KANSAS, MISSOURI, AND OKLAHOMA

INTRODUCTION

Authority.—This interim report is submitted under the provisions of the act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented.

Purpose and scope of report.—The purpose of this interim report is to outline a program of runoff and water-flow retardation and soil erosion prevention for the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma, and to present recommendations for installing and maintaining the program together with an analysis of the costs and benefits thereof.

The Grand (Neosho) River, a tributary of the Arkansas River, has a watershed area of 12,660 square miles. It is anticipated that a survey will be conducted and a report submitted on the remainder of the Arkansas River watershed at a later date under the authority contained in the above acts.

RECOMMENDATIONS

It is recommended that a program of runoff and water-flow retardation and soil-erosion prevention be installed during a 20-year period in the Grand (Neosho) River watershed in Arkansas, Kansas, Missouri, and Oklahoma at an estimated cost of $44,893,000 to the Federal Government, and at an estimated cost of $38,945,000 or its equivalent [1] to local interests, making an estimated total cost of $83,838,000 [2] for the installation of the complete program.

The program will be operated and maintained at an estimated annual cost of $87,000 to the Federal Government and at an estimated annual cost of $8,577,000 or its equivalent to local interests, making an estimated total annual cost of $8,664,000 [2] for operating and maintaining the complete program. Of the amount to be expended by local interests, it is expected that $8,344,000 or its equivalent will be expended by landowners and operators for maintaining conservation measures and for the increased cost of operating a more profitable system of conservation farming and woodland management, that $147,000 or its equivalent will be expended by local agencies acceptable to the Secretary of Agriculture for operating and maintaining those installations which are not considered a part of farm or timber operations, and that $87,000 will be expended by State governments for maintaining forest fire protection and furnishing technical assistance to forest owners and operators.

[1] Labor, materials, equipment, land, easements, rights-of-way, and other contributions in lieu of cash payments.
[2] 1948 prices.

The program herein recommended includes the intensification, acceleration, and adaptation of certain activities of current programs of the Department of Agriculture, and additional measures not now regularly carried out in such programs, all of which are necessary to complete a balanced runoff and water-flow retardation and erosion-control program for the watershed. It is recommended that the Secretary of Agriculture be authorized to carry out this program. Although the current activities of the Department primarily related to the Flood Control Act are not included in the program herein specifically recommended, this program is based on the continuation of such current activities at least at their present level.

The following recommended program includes those measures and practices that contribute directly to substantial and measurable reductions in floodwater and sediment damage:

1. Planting trees on approximately 216,000 acres. This area includes 84,000 acres of open land which is not suited for pasture or crops, 39,000 acres of actively eroding lands, and 93,000 acres of understocked woodland.
2. Strengthening and extending forest fire protection on approximately 1,192,000 acres.
3. Controlling of grazing to protect approximately 492,000 acres of farm woodlands.
4. Seeding and reseeding of approximately 463,000 acres to grass or grass and legumes.
5. Liming and fertilizing of approximately 471,000 acres for the establishment of grass or grass and legumes.
6. Establishment of systems of grazing on 1,110,000 acres of grassland.
7. Establishment of other grassland conservation measures on approximately 1,110,000 acres.
8. Construction of approximately 1,260 miles of field diversions.
9. Construction of approximately 52,000 miles of terraces.
10. Liming and fertilizing of approximately 1,064,000 acres for the establishment of improved rotations.
11. Establishment of other cropland-conservation measures on approximately 1,064,000 acres.
12. Stabilization of approximately 52,800 acres of farm and group waterways.
13. Construction of approximately 8,320 grade-stabilizing, terrace-outlet, and waterflow-control structures.
14. Construction of tributary floodway systems which include approximately 70 floodwater-retarding reservoirs, 90 miles of floodway, and 70 miles of diversion dikes and ditches.
15. Construction of approximately 75 floodwater-retarding reservoirs in addition to those built in connection with floodways.

Technical assistance will be made available for planning and applying the necessary land-use adjustments; for planning and applying conservation measures on open land; for planning, improving, and managing woodland; and for integrating the measures included in the recommended program. Conservation educational assistance will be provided to facilitate the installation of the recommended program.

The Secretary of Agriculture may construct such buildings and other improvements as are needed to carry out the measures included in the recommended program. In order to achieve the objectives of the

recommended program, the Secretary of Agriculture may make such modifications or substitutions of the measures described herein as may be deemed necessary or advisable on account of changed physical or economic conditions or improved techniques.

The authority of the Secretary of Agriculture to prosecute the recommended program shall be supplemental to all other authority vested in him, and nothing in this report shall be construed to limit the exercise of powers heretofore or hereafter conferred on him by law to carry out any of the measures described herein or any other measures that are similar or related to the measures described herein.

The attainment of the flood-control benefit evaluated in this report is dependent upon the installation and proper maintenance of all phases of the recommended program.

It is estimated that the recommended program will yield an average annual flood-control benefit of $1,331,000.[2] In addition to this flood-control benefit, an estimated average annual benefit of $21,448,000[3] from conservation farming and woodland management will accrue to landowners and operators in the watershed.

The ratio of the average annual value of the total benefit to the average annual value of the total cost of the recommended program is 1.6 to 1.[3]

It is anticipated that the recommended measures will be installed under cooperative arrangements with individuals, or with soil conservation districts, State and local governments, or other agencies acceptable to the Secretary of Agriculture.

DESCRIPTION OF WATERSHED

The watershed of the Grand (Neosho) River, a principal tributary of the Arkansas River, has an area of 12,660 square miles. Fifty percent of the watershed is located in Kansas, 24 percent in Missouri, 23 percent in Oklahoma, and 3 percent in Arkansas (fig. 1). The river rises in Morris County, Kans., and flows in a southeasterly direction to the vicinity of Wyandotte, Okla., where it is joined by Spring River. The river is known as the Neosho River above, and as the Grand River below, this junction.

The watershed has moderate winters and comparatively long summers characteristic of the central portion of the United States. The average frost-free period over the watershed ranges from about 180 to 200 days. The average annual precipitation, computed from United States Weather Bureau records of 6- to 69-year duration, ranges from about 28 inches in the headwaters of the watershed to about 46 inches in the Ozark Hills area of Missouri and Arkansas. About 68 percent of the precipitation occurs during the warm season, April to September, inclusive.

Soils in the watershed have been developed under both prairie and forest types of vegetation. Much of the topsoil of the watershed is shallow and, in general, underlain with compact subsoil or bedrock.

Moderate to severe sheet erosion predominates on cultivated lands in the watershed with approximately 60 percent of the treatable area thus affected. Somewhat less than 30 percent of the treatable area, including the alluvial lands, has been subjected to slight erosion. Less than 10 percent has suffered from very severe erosion.

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[2] 1948 prices.
[3] With average annual benefits and costs adjusted to predicted average levels.

The topography ranges from steep and rolling hills in the Ozark region of Missouri and Arkansas and in the Flint Hills of the headwaters to flat and undulating areas of the claypan prairies in the central part of the watershed.

The native vegetation is characteristic of the transition between the tall grass prairie zone and the deciduous forest zone. The headwaters of the watershed extend into the tall grass zone, with the short grasses, grama and buffalo, coming into dominance on the heavily grazed pastures in the upper part of the headwaters. The Ozark Hills have forest vegetation. The forest cover extends out along the creeks and protected breaks over most of the watershed. The Flint Hills of the headwaters are considered the best native (bluestem) pastures in Kansas. In contrast, the more desirable perennial grasses have nearly disappeared from many of the native grass pastures of the central claypan area and have been replaced by weeds, annual grasses, and other less desirable perennial grasses. The original area of forest cover within the Ozark Hills has been reduced approximately 35 percent through conversion to cropland and pasture. The remaining forest is, in general, an open uneven-aged stand of black oaks, white oaks, and hickories with some 60 percent of the stems under 2 inches in diameter. The balance of the stand is composed of trees up to 24 inches but most of these over 14 inches are cull trees, the natural result of almost a century of annually cutting out the best timber.

Approximately 41 percent of the land in the watershed is in cultivation; 30 percent in pasture, range, and meadow; 17 percent in forest and woods; and the remaining 12 percent in miscellaneous use. Of the cultivated land, about 41 percent is in row crops such as corn, soybeans, and sorghum, and about 59 percent in close growing crops such as wheat, oats, and flax.

The principal source of farm income is grain, livestock, and livestock products.

FLOOD PROBLEMS

Flooding of tributary flood plains occurs on the average from one to two times a year. Flooding may last for 7 to 10 days in the lower portions of the tributary flood plains; however, flows above flood stage do not usually last more than 2 days. Prolonged flooding occurs in certain areas because of inadequate outlets. Floods are being aggravated by the intensive use of the watershed lands for cash crops and by the misuse of land which results in excessive runoff. This, in turn, causes accelerated erosion and increased sediment loads in tributary channels. In general, the tributary streams flow through wide flat flood plains which are cropped intensively.

Floodwater damage, which is largely to cash and forage crops, is most severe during the growing season. Other agricultural damage from floodwaters occurs to farm improvements, stored crops, livestock, and farm equipment. Nonagricultural damage occurs to urban residences, commercial buildings and merchandise, public utilities, and transportation facilities.

Damage to land by stream-bank erosion, scour, and deposition is minor except in the Ozark region of the watershed. In this region gravel carried by floodwaters has caused the plugging of the channels, resulting in bank erosion, overbank scour, and deposition. Sediment damage to roads is serious because of the deposition of silt carried by runoff from adjacent fields.

Indirect damage in this watershed includes interruption of trade and transportation, dislocation or break-down of manufacturing and mining industries, costs of rescue and care of flood victims, costs of policing and sanitation, disruption of educational programs, and costs of weed eradication following flooding.

Table 1 lists the monetary evaluation of the average annual floodwater and sediment damage.

ACTIVITIES RELATED TO FLOOD CONTROL

The Department of the Army, Corps of Engineers, has been authorized (H. Doc. 107, 76th Cong., 1st sess.) to construct the Fort Gibson and Markham Ferry Dams on the lower main stem of the Grand (Neosho) River. These two dams together with the existing Pensacola Reservoir will have a combined flood-control storage of 1,695,000 acre-feet, the benefits from which will accrue principally to the Arkansas and Mississippi Rivers. In addition, the Corps of Engineers has proposed a system of four flood-control and conservation storage reservoirs with a total capacity of 604,000 acre-feet and a flood-control capacity of 478,200 acre-feet (H. Doc. 442, 80th Cong., 2d sess.). The benefits claimed for these projects in the reports of the Corps of Engineers have not been duplicated in this report.

The Department of Agriculture, through its several agencies and in cooperation with State and local agencies, is currently assisting owners and operators of farm, ranch, and forest lands in the application of measures which are deemed of primary importance to the objectives of the Flood Control Act. On forest lands or on lands being converted to woodland these measures include tree planting and protection of stands of timber against the damages by fire and by the grazing of livestock. On grasslands or on lands being converted from cropland to grassland these measures are grass seeding, the application of lime and fertilizer for the establishment of grass, provision of adequate water supplies, control of grazing, and the eradication of brush and weeds.

TABLE 1.—*Estimated average annual monetary damage, Grand (Neosho) River watershed*

	Average annual damage (1948 prices)
Floodwater damage:	
Agricultural and nonagricultural:	
Crops and pasture	$1, 476, 000
Other agricultural	124, 000
Nonagricultural	282, 000
Subtotal	1, 882, 000
Land:	
Floodplain scour	40, 000
Gully erosion	34, 000
Streambank erosion	27, 000
Subtotal	101, 000
Sediment damage:	
Deposition of infertile overwash	61, 000
Swamping	2, 500
Water treatment	55, 000
Roads	1, 085, 500
Subtotal	1, 204, 000
Indirect damage	166, 000
Total average annual damage	3, 353, 000

Measures being installed on cropland include terraces, diversion dikes and ditches, establishment of farm and group waterways, grade stabilizing and terrace outlet structures, the application of lime and fertilizer, proper crop rotations, crop residue management, and contour farming. The Department of Agriculture is expending approximately $1,969,000 annually to assist in the application of these measures on the lands of the watershed.

The various States in the watershed operate through several of their departments and institutions to provide valuable conservation services to farmers, ranchers, municipalities, and industries. These include research and dissemination results, educational activities, administration of State lands, and services and materials. Soil-conservation districts, drainage districts, and similar organizations as public instrumentalities of the States perform valuable functions in the management and use of soil and water resources.

Numerous levee works have been constructed by levee districts, private groups, and individuals on both the main stem and tributaries of the Grand (Neosho) River.

RECOMMENDED PROGRAM

The recommended program of runoff and waterflow retardation and soil erosion prevention includes the following measures:

1. Planting trees on approximately 84,000 acres of open land too poor for pastures or crops on 39,000 acres of actively eroding lands, and on 93,000 acres of understocked woodland. This planting will restore watershed forest cover and increase infiltration. Trees or shrubs will be planted on farms for the control of gullies, the control of stream-bank erosion, for the control of erosion on spoil banks, and for erosion control in other areas of low land use capability. In addition, planting will provide future timber supplies.

2. Strengthening and extending fire protection on approximately 1,192,000 acres. Fire protection is a first requisite in restoring woodland watershed cover. Without it, tree planting and other measures will achieve little success. Only under fire protection will forest lands develop an adequate litter and ground cover which is essential in stabilizing soil and promoting water infiltration and storage. Fire protection also reduces timber damage and safeguards the young growth which produces future watershed cover and timber crops.

3. Grazing control to protect approximately 492,000 acres of farm woodlands. Control or sometimes total exclusion of grazing is essential if farm woodland is to be improved for watershed protection purposes. Even light grazing compacts soil and destroys surface accumulations of litter and young trees. This measure does not contemplate complete fencing of woodland but, rather, the exclusion of stock from key areas. It assumes that maximum use will be made of existing fences by reconstructing or relocating them to control woodland grazing.

4. Seeding and reseeding of grass or grass-legume mixtures on approximately 463,000 acres of land, including that land which is presently cropped but not adapted to cropping; idle lands with inadequate protective cover; or grasslands if the cover is depleted to the extent that it is inadequate for watershed protection.

5. Liming and fertilizing of approximately 471,000 acres for grassland establishment. Lime will be applied to neutralize acidity and fertilizer will be applied to correct other mineral deficiencies prior to the seeding of grass or grass-legume mixtures. This treatment will be used when necessary to promote and maintain the vigorous root growth and foliage production essential for the protection of the watershed. Federal participation in the direct cost of installing this practice on individual tracts of land will be limited to the initial cost of installation, and will be subject to a competent technical determination that lime and fertilizer, or both, are essential to the establishment of grass on such land.

6. Establishment of systems of grazing on 1,110,000 acres of grassland. The use of grazing systems will permit optimum forage growth which will build up vitality and soil-binding root growth, provide cover which will reduce run-off and protect the soil, and produce adequate seed for natural reseeding. These systems of grazing will include rotation, deferred, and seasonal grazing, implemented by the construction and rearrangement of fences where necessary.

7. Other grassland conservation measures will be applied individually or in combination as needed to approximately 1,110,000 acres. These measures include the provision and distribution of water supplies and the eradication of weeds and brush, if their competition with grass for moisture is detrimental to the protective cover. These measures will be installed for the purpose of improving and maintaining the grasslands to insure adequate protection for the watershed.

8. Construction of approximately 1,260 miles of field diversions. A field diversion is a graded channel with a supporting ridge on the lower side, designed to intercept runoff from grassland and cropland and route it to the stabilized outlets and waterways described in items 12 and 13. These diversions protect severely eroded areas and divert runoff from local high-damage areas. Field diversions may in some cases be used as the top terrace in a terrace system. The use of field diversions will assist in the establishment of grassland and cropland measures that are needed for watershed cover protection and erosion control.

9. Construction of approximately 52,000 miles of terraces to reduce soil erosion and maintain soil resources. Terraces of the drainage type will be constructed on farm lands to conduct runoff at nonerosive velocities to the stabilized outlets and waterways described in items 12 and 13. The installation of this measure will reduce erosion and sediment production by decreasing the length of unbroken slopes. All terraced land will be farmed parallel to the terraces.

10. Liming and fertilizing of approximately 1,064,000 acres for the establishment of improved rotations. Acid soils in the watershed require the application of agricultural limestone. This application of lime will make possible the establishment of legumes in crop rotations. These legume-carrying rotations will build up the soil fertility or counteract the losses of soil fertility by crop removal, maintain organic content, and improve soil structure, all of which are important in the improvement of watershed conditions. The necessary fertilizers or combinations of fertilizers will be applied when necessary to cropland and will also build up and maintain soil fertility or counteract losses of

soil fertility by crop removal. This will permit the increased use of soil-conserving crops in the crop rotations. These rotations will improve soil structure, increase or maintain the organic content of the soil, and promote vigorous plant growth. The resulting improvements in watershed conditions will reduce runoff and erosion. Federal participation in the direct cost of installing this practice on individual tracts of land will be limited to the initial cost of installation, and will be subject to a competent technical determination that lime and fertilizer, or both, are essential to the establishment of legumes on such land.

11. Other cropland conservation measures will be applied as needed, either singly or in combinations, to approximately 1,064,000 acres of cropland on which additional treatment is necessary for the conservation of moisture, for retardation of runoff, and for the protection of the watershed against erosion. Treatment may vary from area to area, depending upon physical conditions. Measures such as the production of green manure and cover crops will protect the soil from erosion when other crops are not growing on the land, and will increase the organic matter in the soil. Using crop residues to retard runoff and reduce erosion is another practical means of increasing watershed protection. On land requiring mechanical measures but not in need of terraces, contour farming will be used as a means of improving watershed conditions. Strip cropping will be used in connection with terraces and contour farming on some of the steeply sloping lands as an additional protective measure.

12. Stabilizing of approximately 52,800 acres of farm and group waterways to reduce sediment yields and land destruction resulting from uncontrolled runoff and to insure permanence of terracing. Waterways will be stabilized by reshaping, if necessary, and by establishment of vegetative cover. The use of structures in conjunction with these practices is provided for in item 13.

13. Construction of approximately 8,320 grade stabilizing, terrace outlet, and waterflow control structures. These structures include gully control structures, terrace outlet drops, and small detention-type dams. They will aid in the stabilization of waterways by reducing the grades of the channels, arrest head cutting of gullies, and reduce the rate of discharge of runoff through natural or artificial channels. In areas where these structures are needed, grassland and cropland conservation measures alone cannot prevent the ultimate destruction of agricultural land by erosion. Structures will provide the support to grassland and cropland conservation measures that is needed for permanent watershed protection.

14. Construction of tributary floodway systems to protect 32,200 acres of floodplain lands. These systems will include approximately 70 floodwater retarding reservoirs, 90 miles of floodways, and 70 miles of diversion dikes. Throughout the upper part of the watershed the floodwaters from some tributary streams are discharged upon the flood plain of the Grand (Neosho) River. This water stands for prolonged periods of time because of inadequate channels, natural levees, and poor drainage pattern, which prohibits the development of the land to its highest agricultural use. The remedial treatment planned for these areas consists of constructing floodways, either by excavating new channels or by improving existing natural channels; building diversion dikes and ditches to collect runoff from uplands and direct

it to the floodways; and constructing small retarding reservoirs in the system to regulate the flows and reduce peak discharge rates for which the floodways must be designed. Small retarding reservoirs will permit the use of present channel locations for floodways in most instances. The measures included in the floodway systems are interrelated and a system must be constructed as a unit.

15. Construction of approximately 75 additional floodwater retarding reservoirs. These structures, by providing temporary floodwater storage, will reduce flood peak discharges in flood plains of tributary watersheds having a drainage area of from 70 to 500 square miles. Drainage areas above individual dams range from 5 to 30 square miles in size, and the dams provide temporary floodwater storages ranging from 1,000 to 8,000 acre-feet. In the watersheds the structures will be so located in relation to each other that a high degree of protection to flood plains will be obtained.

Technical assistance will be made available for planning and applying the necessary land-use adjustments; for planning and applying conservation measures; for planning, improving, and managing woodland; and for integrating the measures included in the recommended program.

Conservation educational assistance will be furnished to landowners and operators and others in the watershed relative to the need for the recommended program and its purposes and objectives. Information will be supplied as to the manner in which landowners and operators now obtain services and assistance that are available through the various governmental agencies, and how they can and should, by their own efforts, contribute successfully and most economically to the accomplishment of the over-all objectives. Intensified educational efforts will be directed to familiarizing farmers with the specific practices and measures essential to runoff and waterflow retardation and soil erosion prevention, how to install and apply those measures not requiring the detailed assistance of a specialized technician, how to maintain such installations and measures, and how to integrate all into the soundest farming system to produce the greatest benefit over a long period of time.

The Department is committed to a watershed and subwatershed approach in carrying out its responsibilities under the authority of the flood-control acts. It is essential that educational assistance provided for this activity be directed toward furthering the specific objectives of flood water and sediment damage reduction and that it be fitted as to method and synchronization into subwatershed operations activities.

COST OF THE RECOMMENDED PROGRAM

The estimated cost of installing the recommended program in the Grand (Neosho) River watershed is $83,838,000, as shown in table 2. Of this cost, it is estimated that the Federal Government will expend $44,893,000; non-Federal public agencies, $3,369,000; and private interests, $35,576,000.

The program will be operated and maintained at an estimated annual cost of $87,000 to the Federal Government and at an estimated annual cost of $8,577,000 or its equivalent to local interests, making an estimated total annual cost of $8,664,000 for operating and maintaining the complete recommended program. The Federal share of

this cost will be expended for maintaining forest fire protection and furnishing continuing technical assistance to forest owners and operators. Of the amount to be expended by local interests, it is expected that $8,344,000 or its equivalent will be expended by land owners and operators for maintaining conservation measures and for the increased cost of operating a more profitable system of conservation farming and woodland management, that $147,000 or its equivalent will be expended by local agencies acceptable to the Secretary of Agriculture for operating and maintaining tributary floodway systems and floodwater retarding reservoirs, and that $87,000 will be expended by State Governments for maintaining forest fire protection and furnishing continuing technical assistance to forest owners and operators.

TABLE 2.—*Estimated cost of installing the recommended program, Grand (Neosho) River watershed*

Measure	Unit	Quantity	Cost (1948 prices)
Tree planting:			
On open land	Acres	84,000	$3,630,000
On actively eroding land	do	39,000	2,612,000
On understocked woodland	do	93,000	3,191,000
Forest-fire protection:			
Extensive	do	135,000	50,000
Intensive	do	1,057,000	509,000
Grazing control (farm woodlands)	do	492,000	408,000
Seeding and reseeding grass	do	463,000	6,232,000
Liming (grassland establishment)	do	471,000	3,995,000
Fertilizing (grassland establishment)	do	471,000	4,779,000
Systems of grazing	do	1,110,000	4,997,000
Other grassland conservation measures	do	1,110,000	5,127,000
Field diversions	Miles	1,260	487,000
Terraces	do	52,000	12,243,000
Liming (establishment of improved rotations)	Acres	1,064,000	5,460,000
Fertilizing (establishment of improved rotations)	do	1,064,000	12,133,000
Other cropland conservation measures	do	1,064,000	4,247,000
Farm and group waterways	do	52,800	5,864,000
Grade stabilizing, terrace outlet, and water-flow control structures.	Each	8,320	1,792,000
Tributary floodway systems:			
Floodwater retarding reservoirs	do	70	714,000
Floodways	Miles	90	448,000
Diversion dikes and ditches	do	70	83,000
Floodwater retarding reservoirs	Each	75	4,837,000
Total			83,838,000

Approximately 14 percent of the estimated total cost of the recommended program is for technical assistance, conservation education, and administration. Of this amount it is recommended that non-Federal public agencies bear approximately ½ the cost of (1) technical assistance on privately owned woodland and (2) conservation education.

BENEFITS FROM THE RECOMMENDED PROGRAM

The recommended program has the effect of reducing damages caused by floodwater and sediment, increasing production on bottomlands, enhancing land values, and increasing the income of landowners and operators in the watershed.

The benefits due to the reduction of floodwater and sediment damages accrue by virtue of reducing runoff at its source, reducing the production of sediment by controlling erosion, and regulating flood flows in the tributary streams. It is estimated that this program will reduce floodwater damage to crops, pastures, and other agricultural property by approximately 35 percent, floodwater damage to land by approximately 27 percent, sediment damage by approximately 26 percent, and indirect damage by approximately 34 percent. Other benefits accrue by virtue of measures which make possible the

more intensive use of floodplain lands. Benefits in the form of increased crop and pasture yields will result from the installation of the land treatment portion of the program.

The estimated average annual monetary benefit resulting from the recommended program for the Grand (Neosho) River watershed is shown in table 3.

In addition to the monetary benefits, there are unevaluated benefits of the recommended program. Conditions that result in loss of life, illness, hardship, and disease epidemics following flood disaster will be alleviated. The improved cover conditions will provide increased shelter and food for wild fowl and game animals. Clearer streams of more even flow will support a greater population of game fish. Other recreational facilities will be improved.

Another benefit not included in the monetary evaluation is the reduction in sediment damage to the existing and proposed reservoirs in the watershed.

COMPARISON OF BENEFIT AND COST [4]

The average annual value of the total benefit of the recommended program is $11,654,000 and the average annual value of the total cost of the recommended program is $7,438,000. The ratio of the annual benefit to the annual cost is 1.6 to 1.

TABLE 3.—*Estimated average annual monetary benefit from the recommended program—Grand (Neosho) River watershed*

Source	*Average annual benefit (1948 prices)*
Reduction in floodwater damage:	
Agricultural and nonagricultural:	
Crops and pasture	$522, 000
Other agricultural	45, 000
Nonagricultural	96, 000
Subtotal	663, 000
Land:	
Floodplain scour	9, 000
Gully erosion	17, 000
Streambank erosion	1, 500
Subtotal	27, 500
Reduction in sediment damage:	
Deposition of infertile overwash	18, 000
Swamping	240
Water treatment	15, 860
Roads	274, 000
Subtotal	308, 100
Reduction in indirect damage	57, 100
Benefit on bottonland protected by floodways	270, 300
Enhancement of land values	6, 000
Conservation benefit [1]	21, 448, 000
Total average annual benefit	22, 780, 000

[1] The benefit which accrues to the owners and operators of the land on which the recommended program is installed.

[4] The comparison of benefits and costs is based on prices adjusted to predicted average levels.