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A LOCAL COST-SHARING PLAN FOR WATERSHEDS UNDER THE
WATERSHED PROTECTION AND FLOOD PREVENTION ACT

By

Henry N. Ziegler

A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science at South Dakota
State College of Agriculture
and Mechanic Arts

August, 1957

A LOCAL COST-SHARING PLAN FOR WATERSHEDS
UNDER THE WATERSHED PROTECTION
AND FLOOD PREVENTION ACT

This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser

Head of the Major Department

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CHAPTER I

INTRODUCTION

The "Watershed Protection and Flood Prevention Act" as amended was passed for the purpose of initiating a program to eliminate or reduce flood damages as well as to promote better use of land through better control of water. The multi-responsibility feature of Public Law 566 and the amended portion, Public Law 1018, attempts to coordinate the talents of the Federal and State agencies with that of the local sponsoring group. The latter has a large share of the responsibility of carrying out the successful operation of the project. One of the important features of the law is the Federal and local sharing of costs.

Under Public Law 566 the local groups shall assume several non-Federal costs. They must provide monies for acquiring easements and rights-of-way of lands as well as all water rights that are necessary for completion of the project. Fees for conducting the bids and letting of contracts are also included. Costs for any purposes other than flood prevention, as stated in the Act, must be shared by the local organization. Another non-Federal cost is the cost of operation and maintenance of the structures.

Purpose of the Study

The method of raising monies and other credits can be accomplished by donations, local taxation, income producing features such as sale of water to municipalities, or assessment according to some preconceived scheme. It is believed that the most equitable means for paying of non-Federal costs would be by assessing those who benefit

directly from the project in proportion to the benefits they would receive. This study consists of a proposal for a local cost-sharing plan based on that benefit principle for a specific watershed.

The purpose of experimenting with a cost-sharing plan is to set up procedures and techniques whereby the local sponsoring groups (Soil Conservation District Supervisors and Silver Creek Steering Committee) of a watershed may use these findings as a guide in formulating a workable financial arrangement.

The first watershed in South Dakota to take advantage of the "Watershed Protection and Flood Prevention Act" was Silver Creek. Its tributaries originate in the hills that overlook the town of Dell Rapids. The creek meanders southward mostly on the western side of U.S. Highway 77. As it approaches Sioux Falls, it flows into an old engineering drainage ditch which in turn empties into the Big Sioux River.

Most of the year the creek is dry. However, during the rainy season of June and July, water not only fills the banks, but overflows them onto fields of corn and other crops. The fourteen mile North-South boundaries of the watershed extend from one to two miles on either side of the highway. This basin comprises some 20,600 acres, one-fourth of which is subject to annual flooding. The main crops are corn and small grain, which account for 76 per cent of the total acres in this area subject to flood damage. The average annual damages to crops and pasture amount to \$31,093.¹

¹ Watershed Work Plan For Watershed Protection and Flood Prevention, Silver Creek Watershed, Summary and pp. 1-2.

In Silver Creek the maintenance and operation costs per year have been estimated at approximately \$2,310.² In other watersheds the total could be much more. The operation and maintenance costs will depend on the special characteristics in each watershed, such as size of watershed and amount of structures to be maintained.

Money matters can become a problem very early in the formation of a watershed, in fact, before an organization is formed to solve the operational problems. At a meeting of the Minnehaha Soil Conservation District Supervisors prior to the preparation of this report, the problem arose concerning who would pay the fees for registering the transfer of easements and rights-of-way. While the sum was not too great, \$90 to \$100, it brought up the need for some sort of financial plan to eliminate these problems before they arise.³ Important to a watershed is the timing of a proposed financial plan to be presented to the local people for their approval or revision for their ultimate acceptance. An inkling of the difficulties that will arise in Silver Creek became apparent in the administration costs or fees for these easements. Eventually the \$2,310 annual operation and maintenance cost will aggravate the situation.

A local group may rely on a general levy, but as will be seen in this study, taxes do not always distribute the burden according to benefits. If the upland owners are willing to bear a cost which will not

² Ibid., p. 19.

³ Board of Supervisor's Meeting, January 25, 1957 in Sioux Falls, South Dakota.

benefit them proportionately, there will be no problem. However, it is assumed they will not normally be willing to accept a financial arrangement for financing the watershed development unless this arrangement costs them less than they will benefit from the plan.

Silver Creek does not have the high cost of acquiring the easements and rights-of-way by purchase, since the local sponsoring organization and the local Steering Committee believe that these will be donated. Here again a specific characteristic of this watershed does not necessarily represent the norm. Other watersheds have had trouble with easements. Part of one project was held up and finally severed from the whole when one owner actually refused to give, sell or even trade his land.⁴ Some owners, who donate easements outright at the present, may feel irritated if they later realize an increase in taxes due to the project. In most cases owners of structure sites in Silver Creek receive very little benefit compared with the rest of the watershed.

Income producing features such as sale of water to municipalities are not common and are not included in the Silver Creek plan. This watershed does not anticipate any direct income from water storage.

This reduces to a logical principle. Those who do not benefit at all should not be assessed. Those who benefit the most, should pay the most. Those who realize the least in benefits, should likewise pay the least. This principle, however, applies only where the benefits

⁴ Glen D. Fulcher, The Watershed Protection And Flood Prevention Program In Kentucky, p. 32.

are direct and identifiable but not evenly distributed. It is suggested that this type of plan could be followed as a guide in rendering a service to the local people. At any rate, the specific financial plan should be pertinent to Silver Creek in order to solve their cost-sharing problems, yet flexible in that the techniques and procedures might be used by other watersheds.

Methodology

This writer relied primarily upon data that was collected by the Soil Conservation Service in its process of formulating an economically feasible "Work Plan" under P.L. 566 for Silver Creek Watershed. When completed, this plan was presented to the various agencies and people concerned with the watershed for their final approval.

The S.C.S. Watershed Planning Party divided the Silver Creek flood plain into nine reaches or hydrologic units. The benefits accruing to each reach resulted from prevention of flood damage to crops, pasture, fences, roads, bridges and culverts. Land enhancement was added as a benefit to this total.

The road, bridge and culvert estimates were subtracted from the total benefits, as the County agreed to absorb the cost in this area. The owners would pay for the cost of construction and maintenance of these indirectly through a general county taxation program.

Other possible damages such as Sediment, Scour, Stream Bank Erosion and Swamping were excluded from the special Silver Creek problem because these categories were practically non-existent due to the flatness of the flood plain area. In other watersheds, if they entered into the picture, they would be added to the total benefits.

Because all benefit information was broken down to reaches, only, the individual owner could not know how much of the benefits he would receive. This was one of the main jobs for the financial plan.

In this specific plan any services or land donated by the owners in the watershed would be deducted from their share of the total cost for operation, maintenance, and the necessary and proper costs accumulated by the project.

When the aggregate total of benefits accruing to an owner is determined, this sum is applied to the total benefits in the entire watershed and reduced to a simple ratio. When an assessment is charged to the owners of the land in the watershed, the cost to each individual owner will be apportioned according to the predetermined benefit ratio applied to the total assessment.

CHAPTER II

THE DEVELOPMENT OF PUBLIC LAWS 566 AND 1018

Watershed Characteristics

For purposes of this paper a watershed area may be defined as a small drainage basin that empties into a larger unit such as large creek or river. It may also be a part of a larger entity such as a river basin.

The House Agricultural Committee hearings and conclusions, 1950, revealed the relationship between the development of the big river basins and the small drainage areas with four main points.

First, that our programs for soil and water conservation and for downstream river development and flood protection are closely interrelated and that there is a serious gap in our coordinated attack on this problem.

Second, that gap lies in our approach to the matter of upstream watersheds. The soil conservation and water conservation activities of the Department of Agriculture and the Department of Interior do not reach far enough downstream and the flood-control activities of the Corps of Engineers do not reach far enough up-stream to meet and form a unified program. In between, in the small branches and creeks which form the upstream watersheds, there is a hiatus of authority and a lack of purposeful activity that is to a large extent nullifying both the work being done in major rivers downstream and on agricultural and forest lands above.

Third, it is not necessary to wait until complete plans have been developed for full river valley development before the small watershed work is undertaken. In general, the work which needs to be done to prevent the rapid runoff of water through up-stream creeks, banks and gulleys, will be the same regardless of what the ultimate decision may be as to the development of major streams farther down.

Fourth, since from 25 to 75 percent of all flood damage occurs in these upstream areas, beyond the furthest benefits of the major downstream, structures, the planning and installation of these up-stream programs and projects should be a cooperative matter between the Federal Government, the states, local government agencies, municipalities and private citizens and groups of

citizens. Each should bear, insofar as possible, an equitable proportion of the cost based upon anticipated benefits.⁵

Since there is a correlation between the river basins and watersheds, there is need for combining the interests. A Watershed Association was proposed in 1955 as a possible solution by the National Watershed Congress.

Watershed associations are needed to bring divergent interests together in sane discussion of possible alternative solutions to water problems. From the experience of these groups where the problems are obvious the formation of their groups will follow. Point of origin is not important, but rather that the association be representative of community interests, rather than the tool of some special interest group. The associations could best serve as a coordinating link between all affected civic organizations or associations, not to usurp or replace their functions.⁶

However, Congress and other interested groups had considered the area along other lines before committing themselves to specific legislation that involved the watershed problem. Wisconsin in 1867 and New York in 1872 first showed an interest in the water control programs within the area of forest cover. This culminated in Congress setting aside the first forest reserve in 1891. Then followed the passage of the Reclamation Act of 1902, the formation of the Forest Service in 1905 and the gathering of the White House Conference of Governors on the Conservation of Natural Resources in 1908. The enactment of Weeks Law of 1911 relating to headwater control on navigable streams, the

⁵ "Soil Conservation and Watershed Programs", H.R. Report No. 1140, 83rd Congress, 1950.

⁶ "Report of Committee IV", National Watershed Congress, 1955, p. ii.

Federal Waterpower Act of 1920, the Flood Control Act of 1927 and the McSweeney-McNary Forest Research Act of 1927 also endeavored to control, preserve and manage the wayward habits of water.⁷

The single purposeness of these Acts prior to 1933 and the development of others such as Soil Conservation Service Act of 1935 and the Tennessee Valley Authority of 1933 did not provide an adequate basis for future planning in a small watershed area. The idea of multi-purpose undertaking was forwarded in river developments such as the Missouri, Columbia and Arkansas Basins.⁸ The recognition of the need for a plan to take care of the individual landowners could not be realized by these large projects and the trend towards the small watershed approach came into being.

In 1936 the Flood Control Act authorized the Corps of Engineers to make investigations for controlling and improving the waterways while the Department of Agriculture was to be concerned with soil erosion on watersheds as well as more responsibility in flood control. The lack of sufficient findings in Congressional investigations concerning the feasibility of watersheds led Congress, in 1944, to pass an act authorizing the installation of works of improvement in eleven watersheds to better evaluate the need for small watershed control. The Department of Agriculture was given this responsibility.⁹

⁷ Carl B. Brown and Warren T. Murphy, "Conservation Begins on the Watershed", Yearbook of Agriculture 1955, Water, pp. 161-2.

⁸ Ibid., p. 162.

⁹ Robert Charles Otte, A Small Watershed Program In Wisconsin, pp. 6-7.

Since 1945 almost a thousand non-governmental watershed associations have been organized, according to Brown and Murphy. Emphasis was placed on the ability of the local groups to share participation with and among the various interests whether Federal, State or local.

Congress appropriated \$5,000,000 to initiate pilot projects on small watersheds in 1953. A total of 62 watersheds were chosen to determine what benefits could be realized from conservation measures and flood-retarding structures.¹⁰

Public Law 566

The main interest of these small watersheds is not the production of power but the control and prevention of flood damage with the possibility of additional benefits through irrigation drainage and water storage. This led the 83rd Congress to pass the "Watershed Protection and Flood Prevention Act", Public Law 566 in 1954. For purposes of explanation, the Act will be divided into three phases--Application, the Work Plan, and the Operational Functions.

The initial stage is surrounded by various studies to determine the need for a watershed project. Some local group or organization should initiate the preparation of an application with the help of the Soil Conservation District. This is sent to the Governor of the State in which the watershed lies or some agency designated by the Governor. A second copy is sent to the State Office of the Soil Conservation Service. Field technicians from S.C.S. and other interested agencies

¹⁰ Glen D. Fulcher, The Watershed Protection and Flood Prevention Program In Kentucky, p. 3.

examine the feasibility of this project. The conclusions are reviewed by the State and approved or disapproved. If approved, it is submitted to Washington by the State Conservationist and reviewed by the S.C.S. Administrator. Notice of approval for planning is returned through channels. Then State Conservationist notifies the local organization of the authorization to develop a work plan.

The second stage is the formation of the project work plan. A general review of the application is undertaken by the Soil Conservation Service, the sponsoring group, and other interested agencies. The Soil Conservation Service makes a preliminary survey and reviews its findings with the local organization to determine whether to go on with the plan. If a favorable outcome is seen, the Soil Conservation Service plans detailed field studies and carries them out on a cost-benefit analysis in the form of a ratio. The local organization and the participating agencies help by giving out information pertinent to the project. When the tentative plan has been formulated by these various factions, it is sent to the S.C.S. Administrator in Washington for review and recommendation. It is then remitted to the State Conservationist who obtains the final approval of the local group. Once again the plan travels to Washington for the Administrator's final approval. In cases where the project is over twenty-five hundred acre feet in total capacity for one structure, Congressional approval is required. If funds are available, the Administrator will authorize help in building the structures and other improvements. The final notice is given to the local group by the S.C.S.

The third stage consists of direct action within the watershed. The S.C.S. Administrator starts the project by issuing or allocating funds for the watershed project. The local sponsoring group will lead the operation with the help of S.C.S. by securing land easements and rights-of-way. The engineering plans and specifications are furnished by the Soil Conservation Service. Local fund raising for the necessary non-Federal costs is the responsibility of the local sponsoring group. Bids are issued and contracts are let. When construction is completed, the operation and maintenance is carried on solely by the local sponsoring association.

Public Law 1018

The amendments attached to Public Law 566, known as Public Law 1018, broaden its scope considerably. A few amendments are worth mentioning in that they directly involve the financial aspect of the project. Added to authorized works of improvement are nonagricultural phases such as municipal and industrial water supplies. The allocation of costs are specifically stipulated for flood control and nonagricultural uses. The Federal government pays all of the costs for flood control. The Act "Requires local organizations to bear such proportionate share of the costs of installing works of improvement for irrigation, drainage, and other agricultural water management as it is determined by the Secretary to be equitable in consideration of the direct identifiable benefits."¹¹ The local organization is responsible

¹¹ Mimeographed statement sent to the Soil Conservation Service of each State by the U.S. Department of Agriculture.

for all costs of installation that are not attributed to flood prevention and agricultural water management. Local organizations must furnish "...satisfactory plans for repayment of loans or advancements..."¹² The Secretary has the power "...to make loans and advances to local organizations to finance local costs for periods of up to fifty years at the Federal long-term borrowing rate, with provisions that no such loan or advancement shall exceed five million dollars for any one project."¹³ These amendments were passed under Public Law 1018 and approved August 7, 1956.

The general requirements under Public Law 566 and Public Law 1018 to maintain and operate the structures are clearly defined. A local district or organization must have the power to contract, to acquire lands whether by donations or eminent domain, and to have adequate financial powers to levy taxes or assessments and receive money from State or income property.

L. M. Adams of U.S.D.A. pointed out in a speech at Iowa City, Iowa, that a local district must have legal authority but must also have financial ability as well.¹⁴

Elco L. Greenshields summarized the financial needs and functions that Public Law 566 brought out. In the planning stage there should be

¹² Ibid.

¹³ Ibid.

¹⁴ L. M. Adams, "Requirements of the Watershed Protection Act Relating to State and Local Agencies", summary of speech made at the Agricultural Law Center, Iowa City, Iowa, September 28-29, 1955.

a guarantee that funds will eventually be forthcoming. In the completed stage there must be a provision for the perpetual operation and for maintenance costs. Acquiring easements and rights-of-way, providing legal services, facilitating servicing contracts, providing adequate management, authorizing removal or reallocation of public utilities, assuring responsibility for some of the possible damage, and planning an equitable cost-sharing scheme, all become part of the operation of a successful and smooth running organization.¹⁵

One of the problems that could arise would be lack of legal power by a district to collect money. The manner in which to collect may not necessarily take into consideration those who benefit. The district may have to rely on other governmental units for the collection of levies.¹⁶

Some of the suggested research that will be needed was proposed by Greenshields in the following statements. The small districts will have a bigger problem of overhead expenses since their accessibility to funds will be limited to their size. A problem for all watersheds would be the need for funds to meet the costs during the installation period.¹⁷

¹⁵ Elco L. Greenshields, "Discussion of Financial Problems", speech made at the Agricultural Law Center, Iowa City, Iowa, September 28-29, 1955.

¹⁶ Ibid.

¹⁷ Ibid.

CHAPTER III

STATE PROGRESS UNDER PUBLIC LAWS 566 AND 1018

South Dakota

Before the passage of the Watershed Act in the 1957 South Dakota Legislature, there were several districts that were only partially applicable to Public Laws 566 and 1018. A summary of these districts follows:¹⁸

Drainage districts - These organizations could carry out, operate and maintain works of improvement for the specific purpose of drainage. They lacked the expressed right to sue and be sued, to borrow money and to cooperate with the United States Government.

Interstate drainage districts - These organizations could carry out, operate and maintain works of improvement for both drainage and flood prevention. They are applicable only in interstate cases.

Water Resources Commission - This agency has only general supervisory powers and will not be able to do what is necessary and proper to carry out the functions of an organized district. It has judicial rather than legislative powers as related to the financial arrangements that will be set up.

Irrigation districts - They may carry out, operate and maintain works of improvement for irrigation purposes only. This excludes the general watershed district which encompasses flood prevention as well.

¹⁸ United States Department of Agriculture, Soil Conservation Service, "Summary of South Dakota Districts as Applicable to Public Law 566", (mimeographed), June 1956.

Water conservation districts - These may carry out, operate and maintain works of improvement for the conservation, storage, distribution and utilization of water. They are forbidden to raise revenue by levying taxes or assessments.

Soil conservation districts - They may carry out, operate and maintain land treatment measures and works of improvement for flood prevention. They are limited to soil conservation and do not have the power of eminent domain and are not able to raise revenue by levying taxes or assessments.

Effective July 1, 1957 a new law called the "Watershed Act" came into being. By some S.C.S. sources it was considered a tough law because all financial decisions that would increase the assessment would have to be put to a vote. Another difficulty, the requirement "...of 67 per cent of the landowners voting and representing 67 per cent of the land in the District..." in favor to levy a tax, special assessment, bond issue or other financial arrangement or even establish the district is a supporting reason for this opinion.¹⁹

The powers of any newly created district under the Watershed Act are those to be desired for any organization whose purpose and duty is to carry out the required operation and maintenance of structures formed under Public Laws 566 and 1018. The District has the power to sue and be sued; to incur debts, liabilities and obligations; to buy, borrow or rent land through eminent domain; to borrow money; to issue

¹⁹ Watershed Act, Thirty-fifth Session, Legislative Assembly, State of South Dakota.

certificates, warrants and bonds; to provide assessments by a general levy or special assessment; to make contracts; to carry out, operate and maintain works of improvement; and to do anything necessary and proper to carry out the operation of the District. The district also is requested to cooperate "...with any individual, State or subdivision thereof or Federal agency or private or public corporation as authorized under this act..."²⁰

At the present time there are thirteen defined watershed areas entirely within South Dakota applying for assistance.²¹ Only two are advanced to such a stage that a financial arrangement will be needed in the near future. The others are in the planning stage so that very little has been done in this area. The following is a list of projects to date:

Scott Creek This watershed was put into operation as a pilot study by the United States Government. Definite, although small, the costs are forthcoming, and the need for financial arrangements will be apparent when this project is turned over to the local people.²²

²⁰ Ibid.

²¹ "South Dakota Watershed List", (mimeographed), November 1, 1956. (Not included in this list is Scott Creek which is a pilot watershed.)

²² Interview with Norman A. Berg, Ass't. State Conservationist, at South Dakota State College, College Station, South Dakota, April 29, 1957.

Brule Creek Since printing of the "Tentative Work Outline" of January 31, 1957, the Soil Conservation Service has been working on the general work plan. No financial plan has been worked on or suggested except the broad statement, "Local people and sponsors will express their desire to accept (the) plan and their ability to sponsor (the) project. This will include their ability to cost-share if needed and to furnish land easements, rights-of-way, Operation and Maintenance, etc."²³

Battle Creek No financial arrangements are anticipated at present or in the immediate future. Western Farm Management Company bought a good share of the land recently, and R. J. Gibson of the County Extension Service believes they would not look favorably upon any plan.²⁴

Pattee Creek The general plan for structures has not been presented to the people. Because of this, no initial financial plan has been discussed.²⁵

Green Creek and Richland Creek No action was realized in either of these watersheds concerning financial plans. They are still in an early planning stage.²⁶

²³ Soil Conservation Service of Huron, Tentative Work Outline, for Brule Creek Watershed.

²⁴ In a letter from R. J. Gibson, County Extension Agent, Custer, South Dakota, May 7, 1957.

²⁵ In a letter from Kenneth Ostroot, County Extension Agent, Canton, South Dakota, April 27, 1957.

²⁶ In a letter from F. F. Kerr, Assistant County Extension Agent, Elk Point, South Dakota, April 29, 1957.

The following have watershed applications on file but have not been approved, North Deer Creek, Highland Creek and Veblen. Deep Creek and Box Elder Creek were not approved by the State Committee.²⁷

Below is a summary of financial action or anticipated action in Watersheds throughout five other States who are taking or propose to take advantage of Public Law 566.

Montana

Muster Creek was proposed as a "Pilot" watershed in 1953. Final approval of plans were not forthcoming because of the unwillingness of the local people to accept their share of the responsibility. Three reasons were given for this situation. (1) The people's interests lie in irrigation and not flood control. (2) It is difficult for the people to foresee the value of the land and what it is able to produce. (3) The people are too used to having the Federal Government pay the total cost since the resettlement projects of the 1930's.²⁸

These three above statements concerning Muster Creek tended to dominate the general opinion of all succeeding projects even after Public Law 566 was passed. Three applications, although approved for planning, are in the doubtful stage as of September 1956. They are Brown's Gulch, Cottonwood Creek and Ponders Creek.²⁹

²⁷ "South Dakota Watershed List", November 1, 1956.

²⁸ Glen D. Fulcher, The Watershed Protection and Flood Prevention Program In Montana, (Revised), November 1956, pp. 1-2.

²⁹ Ibid., p. 2.

Kentucky

The Watershed Conservancy Districts Law of Kentucky, although on the books as valid legislation, has not been used as of July 30, 1956. The requirements for local sponsorship set down by P.L. 566 seemed to be met within this act with the exception of providing assessments according to a benefit basis. "The act provides that land be taxed at the rate of five mills per dollar of evaluation which they feel is not high enough to become a financial burden to anyone. If additional taxation is needed for bond issues a two-thirds vote of the landowners is required."³⁰

The primary problem in Kentucky can be explained in a single thought, haste. The Soil Conservation Service acted without an intensive educational program to help the people realize their obligations, limitations and the great need of all around cooperation by the various agencies of people concerned with the pilot watersheds.³¹

The results can readily be seen in the following watersheds.

Plum Creek Pilot One member of the Plum Creek Watershed Committee was very doubtful that funds would or could be raised through assessment according to those who benefited the most by flood control.³²

Fulcher revealed an interesting predicament in Plum Creek.

³⁰ Fulcher, The Watershed Protection and Flood Prevention Program In Kentucky, op. cit., p. 21.

³¹ Ibid., p. 30.

³² John Trumbo, Plum-Creek Farmer, interview with Glen D. Fulcher, on his farm, July 13, 1956.

The district supervisors who signed the agreement to meet the cost of maintenance and operation had no idea, and they still do not know, how they will raise the funds for this purpose. They hope, when and if the need arises, to get money from the county fiscal courts and from local organizations. Also, they expect labor contributions from landowners within the watershed. They have no legal authority, however, for raising funds through taxes or assessments and have only faith, but no assurance, that they can meet this financial obligation.³³

Twin Creek This watershed is the most advanced project in Kentucky. It was also approved by Congress.³⁴

The Harrison County Soil Conservation District Board of Supervisors committed themselves in a signed agreement to provide the local construction cost-share and continue with the operation and maintenance when the project was completed. Ben Fritz, a Twin Creek farmer was interviewed on how the board of supervisors would raise the promised finances. He replied,

...they had no idea where the money would come from but that the supervisors were conservationists who were gamblers, opportunists, and speculators where conservation was concerned.³⁵

Minnesota

Minnesota laws have three underlining principles:

- (1) A majority of land owners may use the lands of the minority as a (drainage) outlet.
- (2) The cost of (a drainage) ditch is to be financed by a special assessment based upon benefits received.

³³ Fulcher, The Watershed Protection and Flood Prevention Program In Kentucky, op. cit., p. 36.

³⁴ Ibid., p. 41.

³⁵ Ibid.

- (3) Owners must be compensated for damage to their property.³⁶

However, no applications under P.L. 566, as of December 1, 1956, have been approved. Therefore, there is no need for active financial planning at this time.³⁷

Wisconsin

In most cases where financial support will be needed under P.L. 566, vague promises in equally vague terms constitute the agreements between the local sponsoring organization and the Soil Conservation Service. In the Kickapoo Pilot Project, local government agencies are to furnish the necessary local construction costs.³⁸

There is a general dislike by the Wisconsin Association of County Boards for a special assessment. They favor a general to other special tax assessment. They like the easy manner in which it is set up and collected. "So long as the local public's sense of equity is not violated, this seems to be the most practical method", writes Robert Otte.³⁹

He believes that there are several disadvantages to a special assessment on the basis of benefits. It would introduce a new agency

³⁶ Virgil C. Herrick & Philip M. Raup, "Organizational Problems In Developing the Small Watersheds of Minnesota", pp. 1-2.

³⁷ Ibid., p. 17.

³⁸ Robert Charles Otte, The Small Watershed Program In Wisconsin, op. cit., p. 103.

³⁹ Ibid., p. 104.

among several already established. Because it is untried, he predicts unforeseen difficulties. Because the flood control law states a limit of two annual installments for any special assessment, it would create hardship upon some property owners.⁴⁰

Kickapoo This is one of the pilot projects authorized by Congress in 1953.⁴¹ Since difficulty was encountered in attempting to acquire all of the easements, this project has been held up indefinitely. The only method proposed so far for financial support is by general taxation.⁴²

Mill Creek Financial arrangements were drawn up in a contractual agreement as follows:⁴³

We, the undersigned, members of the Board of the Town of _____, Richland County, Wisconsin, having roads within the boundaries of the Mill Creek Watershed of Richland County, Wisconsin, which roads are subject to flood damage whenever intense storms occur; and being aware that the Mill Creek Watershed is seeking assistance through the "Watershed Protecting and Flood Prevention Act" to obtain flood control plans which when put into affect within the Watershed will control or prevent floods; do hereby indicate our support of this important and vital program by stating:

1. That we believe that it is no more right that the Township of _____ bear its just share of the cost of any flood prevention measures that may be installed in the Mill Creek Watershed in proportion to actual benefits received for _____ township roads that are within the confines of the Watershed.

⁴⁰ Ibid., p. 105.

⁴¹ Ibid., p. 112.

⁴² Ibid., p. 116.

⁴³ Ibid., pp. 120-21.

2. That if and when the State of Wisconsin enables townships to appropriate township funds for the purpose of flood prevention works, while this same Board is in office, we will be favorable to receiving a request from the Watershed for financial participation on the basis of benefits received.

3. That should any of the proposed flood control works involve changes in the township roads, we will be favorable toward reasonable changes.

4. And that we hereby make known to future town Boards of the Town of _____ this resolution and advise that they also adopt the same position on this matter. This resolution adopted unanimously by the Board of the Town of _____ at a regularly called meeting of the Board on _____.
(date)

Signed by members of the Town Board

Lost Creek This project is still in the planning stage although it was returned to the local group without approval because there was not a sufficient amount of evidence of how the local organization would finance the project.⁴⁴

The conclusion of Robert Charles Otte is very pessimistic concerning use of the benefit principle for financing watersheds in the State of Wisconsin.

The only method now readily available for raising the local share of costs is from the general tax funds of the counties, towns, cities and villages. It appears that this will be Wisconsin's method unless there is a change in the general attitude. Of the people interviewed in connection with this study - agency personnel, farmers, local officials - no one had any faith in the workability of assessments on the basis of benefits. The Secretary of the Wisconsin County Board's Association stated that that organization favored financing from general tax funds as against special assessments. The rationale usually given is that such expenditures tend to be evened out. A parallel is often drawn to highways and bridge construction.⁴⁵

⁴⁴ Ibid., p. 128.

⁴⁵ Ibid., p. 136.

Nebraska

The Plattsmouth Watershed in Cass County, Nebraska, fifty per cent of which lies within the city of Plattsmouth, is unique in that it has solved its financial problems on a benefit-based assessment. Local contributions met the cost of some terracing several years ago and led the city officials to believe that other costs to complete the project could be raised in the same manner. The \$30,000 needed, it was feared, would not carry in a local referendum.

Paul Fauquet, a lawyer and civic leader, formulated a financial plan with some help from others in the community. The general pattern of this plan was to determine the various factors such as the exposure rate of property to flood damage, the total front footage of this property, and the amount of real and personal property each owner had within the flood area. By discovering the extent that these various factors would be involved in any flood that might come upon the watershed area, the community would be able to assess each owner according to the amount of benefits he would receive to the total benefits realized in the community.⁴⁶

⁴⁶ Loyd Glover, The Small Watershed Program In Nebraska, (unpublished manuscript), Revised, January 1957, pp. 21-26.

CHAPTER IV

IRRIGATION DISTRICT PROBLEMS

Irrigation and watershed districts have similar problems such as organization, management and financing, the main difference being in the ultimate goals. Irrigation districts are constructed primarily for better utilization of the water resources by controlled diversion of water onto parched lands. Watershed districts have the multiple purposes of flood protection as well as better utilization of the waters. Both must be self-supporting. Therefore, some insight on financing watershed districts might be gained by investigating the financial problems of irrigation districts.

In 1931 Wells A. Hutchins prepared a bulletin that summarized methods of financing irrigation districts of the Western states. He discovered that Idaho, Nebraska, Nevada, North Dakota, South Dakota, Washington and Wyoming apportioned their assessments primarily by the benefit principle. California, Oregon and Texas had benefit assessment as one of the alternatives for raising funds to meet the costs of a district. Utah had provision for a water allotment assessment based on the benefit principle.⁴⁷

In a later bulletin Hutchins revealed the following:

The successful irrigation districts are those in which, in addition to securing and distributing water effectively, annual income is derived from the soil year after year in amounts sufficient to pay interest and maintenance and operation charges promptly, and to retire the principal of the bonds at

⁴⁷ Wells A. Hutchins, "Summary of Irrigation - District Statutes of Western States", pp. 55-59.

maturity...(and allowed)...for a wide margin of safety, or permissible cost, above the charge determined upon as reasonable, which the lands must be able to bear if the project is to be considered feasible.⁴⁸

In courts the difference between "tax" and "assessment" is made clear. "This distinction is important in that assessments for local improvements, which the district changes are usually held to be, are not subject to constitutional provisions that taxation shall be equal and uniform."⁴⁹

The South Dakota Code provides for assessment and procedures for carrying out the assessment. Any lands that are excluded from an irrigation district shall receive a refund of any assessment upon them so long as the assessment does not take into consideration any benefits received by the land owner. If some benefits are realized, this amount shall be deducted from the total to be refunded.⁵⁰ Benefits accruing to the individual land owner from an irrigation district shall be recorded and confirmed by the court. This is the basis for apportioning the cost of an irrigation district.⁵¹

Watershed districts should learn from what has been found to be the difficulties in irrigation developments.

⁴⁸ Wells A. Hutchins, "Irrigation Districts, Their Organization, Operation and Financing", p. 8.

⁴⁹ Ibid., p. 20.

⁵⁰ South Dakota Code 1939, Chapter 61.08.

⁵¹ Ibid., Chapter 61.09.

Opposition to irrigation development in a certain area may or may not be well-founded. Too often, the farm and ranch operators in an area proposed for irrigation have not had adequate information on which to base an intelligent decision. The cost-factor-operation, maintenance, and construction charges - obviously is a major item influencing the reactions of farmers and ranchers in an area proposed for irrigation. It seems to be a characteristic of federal development that definite figures on costs are slow in becoming available to the people most concerned. Part of this is probably unavoidable due to shifts in the price level between the time a project is first planned and completion of the final construction phases. Changes in design of various structures and changes in general plans as a whole also make it difficult to predict costs. Every effort should be made, however, to settle on definite cost figures at the earliest possible stage in the planning for new irrigation projects.⁵²

⁵² Roy Huffman, Irrigation Development and Public Water Policy, p. 76.

CHAPTER V

PROCEDURE

Before formulating the specific procedure to be followed in a cost-sharing plan for Silver Creek, some preliminary explanations concerning the responsibilities of the local group, the breakdown of non-Federal costs, and the type of benefits used as a guide for the plan, are needed.

The cost-sharing statement set down in the Interim Watershed Protection Handbook relates that

...it is the policy that local organizations will be expected to assume that part of the cost of installing works of improvement, exclusive of Federal costs of technical services such as planning, design, supervision and economic analysis, which is equal to the ratio of local benefits to total benefits and all construction costs for water distribution and other facilities for purposes other than flood prevention and features related thereto. In addition, to such costs as accrue to the Federal Government under the above provisions, the Federal Government may share a portion of the costs otherwise accruing to the local organization when justified in the work plan and the reasons for so doing are set out in detail.⁵³

Other costs that must be furnished by the local group are acquiring easements and rights-of-way, operating and maintaining the flood retarding structures and channel improvements, and furnishing other necessary and proper non-Federal costs.

The land treatment measures in Silver Creek total \$47,925 but are not included in the overall cost to be apportioned to each land owner. Land easements and rights-of-way amount to \$68,425 in the watershed.

⁵³ U.S.D.A., Soil Conservation Service, Interim Watershed Protection Handbook, Sec. 28, p. 4.

This is hoped to be donated by the local people. The administration costs for contracts are estimated at \$6,500. The grand total non-Federal cost is \$122,850.⁵⁴ (For a complete Federal and non-Federal breakdown see Table 1 of Appendix.) The average annual non-Federal cost in Silver Creek Watershed was estimated at \$2,310.⁵⁵

Excluded from the total non-Federal cost to the owners in the watershed is the price for acquiring land easements and rights-of-way because the local people stated this part will be contributed to the project.⁵⁶

This study is based primarily on the principle that the local cost-sharing should be apportioned according to the amount of benefits each land owner will realize by the Work Plan project. The first step in determining what benefits can be realized is to define the term benefit and its subdivisions thereof.

Benefits - are all identifiable increases or gains in assets or values, whether in goods, services, or intangibles, whether primary or secondary, and whether measurable in monetary or non-monetary terms which taking account of conditions with and without the project, are properly creditable to that project, and which are net of all costs other than project costs.

⁵⁴ Watershed Work Plan For Watershed Protection and Flood Prevention, op. cit., supporting tables.

⁵⁵ Ibid., p. 13.

⁵⁶ Last general meeting of Silver Creek Watershed in Sioux Falls, South Dakota, January 17, 1957. (Statement by Justin Mortvedt, Chairman of Steering Committee, Silver Creek Watershed.)

Primary Benefits - are the value of the immediate products or services resulting from the measures for which project costs and associated cost were incurred.

Secondary Benefits - are the values added over and above the value of the immediate products or services of the project as a result of activities stemming from or induced by the project.⁵⁷

Of these benefits, the Soil Conservation Service Work Plan Party utilized the "primary" for purposes of determining the economic feasibility of the plan.

S.C.S. divided their computations into six general areas: Crop, Pasture, Other Agricultural, Indirect, Enhancement, and Road-Bridge Culvert. The following is a discussion of the methodology used in each case.

Cropland Benefit Computations

In the Operations Handbook of Economic Studies the general procedure for computing the crop damage is outlined.⁵⁸ The handbook relied primarily on the Synthetic Storm - Discharge Chart in tabulating the damages and for computing the average annual benefits within a reach. The purpose of this chart was to serve as a tool in computing the damages from various plans and subtracting the most economically feasible plan from the situation without structures, in order to obtain the average annual benefits in this area due to the reduction of flood damages to crops. The results obtained, however, did not break down

⁵⁷ Subcommittee on Benefit and Costs, Proposed Practices for Economic Analysis of River Basin Projects, p. 8-9.

⁵⁸ Operation Hand Book, Economic Studies, an unpublished hand book used by the Soil Conservation Service watershed planning parties.

the benefits to the individual owner. This process is stated later along with a detailed explanation of what is involved in the Synthetic Storm - Discharge Chart.⁵⁹

In collecting data to determine the economic feasibility of the Silver Creek Watershed, the Soil Conservation Service Work Plan Party prepared a Synthetic Storm - Discharge Chart (Table 1) to estimate the reduced damage in a hydrological drainage area known as a "reach".

The extreme left column on this chart lists the Storm Frequencies from one year to one hundred years, and should be thought of as reciprocals of the per cent chance of the occurrence of storms of this magnitude or greater. The Storm Frequencies below 10.0 total 90 storm years and are grouped and averaged to make computations easier to handle. Corresponding columns related to the storm frequencies in groups of threes state the (1) discharge rate of water in cubic feet per second (c.f.s.) flow line or "Q", (2) area in acres flooded at this discharge rate, and (3) dollar damage in this area.

⁵⁹ See appendix for complete explanation of this table, p. 71.

TABLE 1 - SYNTHETIC STORM-DISCHARGE CHART

Silver Creek Watershed							Reach No. VII		
Storm Freq.	Present			Conservation			Plan G		
	Q	Area	\$Dam.	Q	Area	\$Dam.	Q	Area	\$Dam.
100	6300	211	2575	5620	210	2480	1990	186	1420
50	5200	209	2400	4700	208	2315	1630	172	1240
33.3	4550	208	2290	4150	207	2200	1450	162	1120
25.0	4120	207	2200	3800	206	2125	1310	152	1010
20.0	3810	206	2125	3500	205	2050	1215	143	910
16.7	3600	205	2075	3300	205	2000	1160	136	820
14.3	3400	205	2025	3140	204	1950	1095	127	700
12.5	3220	204	1975	2990	203	1900	1040	118	580
11.1	3100	204	1940	2830	203	1860	1000	109	480
10.0	2970	203	1900	2720	203	1825	960	101	410
6.72	2520	2020	17600	2330	2010	15650	815	620	2600
3.98	2000	1930	15600	1840	1880	14900	635	220	1000
2.84	1710	1830	14400	1550	1770	13500	550	90	400
2.20	1490	1730	13100	1360	1680	12500			
1.81	1330	1660	12250	1220	1610	11600			
1.53	1210	1610	11600	1110	1550	10750			
1.33	1130	1550	11000	1040	1500	10200			
1.17	1020	1490	10150	945	1440	9550			
1.038	950	1440	9600	880	1390	8950			
Av. Ann. Damage			<u>1368.05</u>			<u>1283.05</u>			<u>126.90</u>
Av. Ann. Benefits						<u>85.00</u>			<u>1156.15</u>
Per cent Reduction						<u>6%</u>			<u>90%</u>

The Work Plan Party estimated several situations that were to be compared one against the other. The first encompassed the "Present" condition of the reach in the absence of projects to improve the value and productivity of the land. The second improved the "Present" status with "Conservation" practices such as contouring and terracing to retard the destructive aspects of heavy rains and flooding as well as to replenish the soil moisture. Several other circumstances were estimated with various combinations of dams and channel improvements to determine the best cost-benefit ratio. "Plan G" with six flood retarding structures and 13.3 miles of new and improved channel was found to be the most feasible.

In computing the average annual benefits or reduced damage, the watershed planning party economist selected the "Conservation" plan and "Plan G" for computation. Conservation measures practiced by the owners of the bottomlands were judged by S.C.S. to provide direct benefits and costs to the individual owner and would have little direct effect upon his neighbor's situation. If the "Present" situation were used to compare with "Plan G", the resultant error would be on the average 4 per cent for all computations. For this reason the "Conservation" plan was selected to eliminate the error.

The computation of these two plans can be seen by referring to Table 2. For example, the 100 year "Storm Frequency" has a corresponding flood area in the reach of 210 acres and \$2,480 damage under the "Conservation" plan. By dividing \$2,480 by 210 acres, the resultant, \$11.81, is the dollar damage per acre with conservation. In "Plan G", by dividing the total damage of \$1,420 by 210 acres, the resultant, \$6.76, is the dollar damage per acre in that situation. The difference between \$11.81 and \$6.76 or \$5.05 is the reduced damage or benefits per acre at the 100 year storm frequency. In multiplying the total acres (210) by the benefits per acre (\$5.05) and dividing this product by 100, the figure is reduced to the average annual benefits at 5,620 c.f.s. discharge rate or 100 year storm frequency. A summation of all the storm frequency benefits is the average annual benefits in the reach due to reduced cropland damage.

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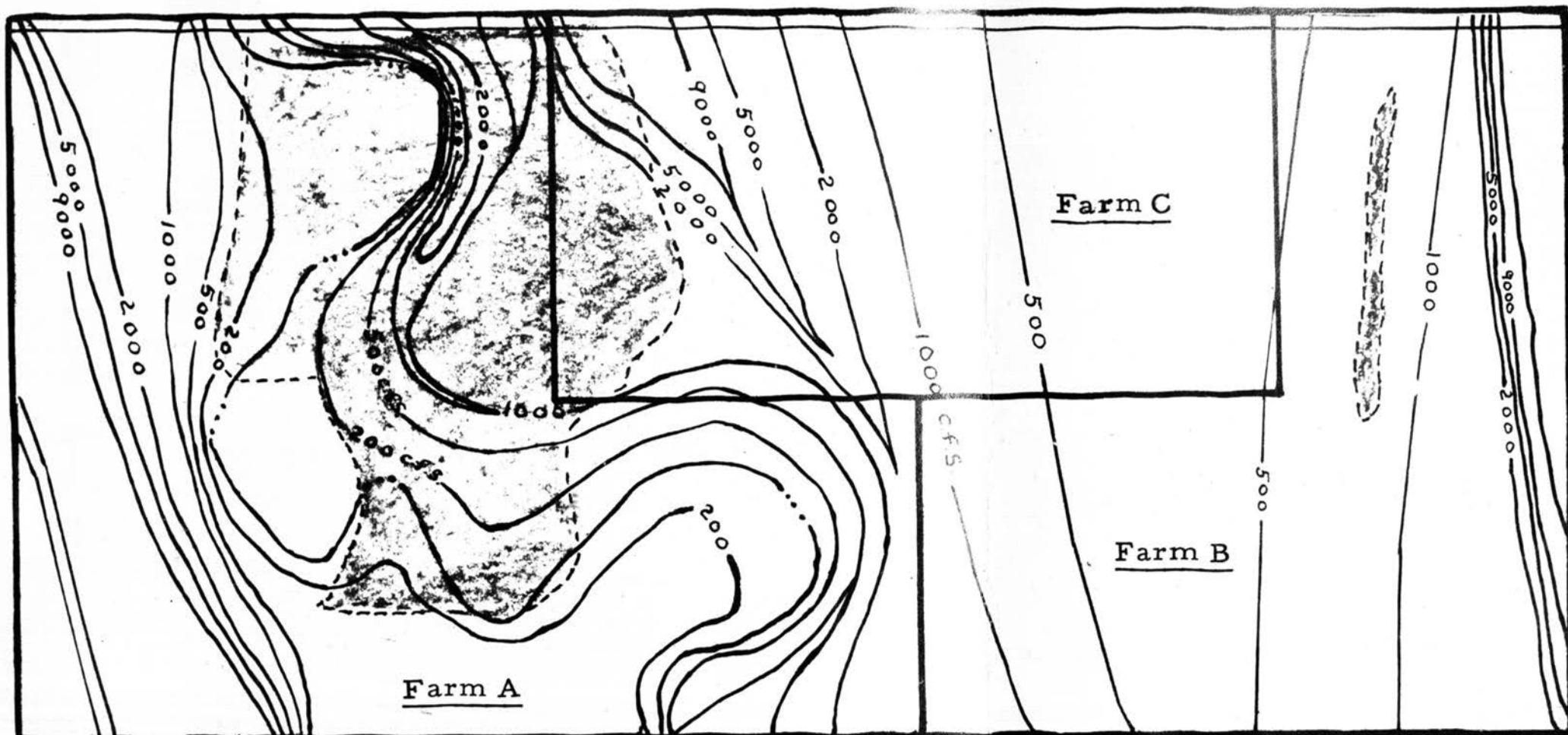
TABLE 2 - CROPLAND BENEFITS BY STORM FREQUENCIES

Silver Creek Watershed			Reach No. VII					
No. of Storm Years	Storm Freq.	Acres	Damages-W/Conser.		Damages-Plan G		Benefits	Av. Ann.
			Total	Per Acre	Total	Per Acre	Per Acre	Benefits
1	100	210	2480	11.81	1420	6.76	5.05	10.60
1	50	208	2315	11.13	1240	5.96	5.17	10.75
1	33.3	207	2200	10.63	1120	5.41	5.22	10.81
1	25.0	206	2125	10.32	1010	4.90	5.42	11.17
1	20.0	205	2050	10.00	910	4.44	5.56	11.40
1	16.7	205	2000	9.76	820	4.00	5.76	11.81
1	14.3	204	1950	9.56	700	3.43	6.13	12.50
1	12.5	203	1900	9.36	580	2.86	6.50	13.20
1	11.1	203	1860	9.16	480	2.36	6.80	13.80
1	10.0	203	1825	8.99	410	2.02	6.97	14.15
10	6.72	2010	15650	7.79	2600	1.29	6.50	130.65
10	3.98	1880	14900	7.93	1000	.53	7.40	139.12
10	2.84	1770	13500	7.63	400	.23	7.40	130.98
10	2.20	1680	12500	7.44			7.44	124.99
10	1.81	1610	11600	7.20			7.20	115.92
10	1.53	1550	10750	6.94			6.94	107.57
10	1.33	1500	10200	6.80			6.80	102.00
10	1.17	1440	9550	6.63			6.63	95.47
10	1.038	1390	8950	6.44			6.44	89.52
100		16884	128305	7.60	12690	.75	6.85	1156.42

The Work Plan Party prepared a "Plan Profile" map of each reach which contains c.f.s. discharge rates or flow lines. Reach VII (see Figure 1) has the following flow lines: 9,000 c.f.s.; 5,000 c.f.s.; 2,000 c.f.s.; 1,000 c.f.s.; 500 c.f.s.; and 200 c.f.s. Additional information in the form of ownership boundaries was traced upon the map and labeled with capital letters to correspond with the owner of the land. The area between these flow lines within each farm from 1,000 c.f.s. to 5,000 c.f.s. was computed, and the areas between 880 c.f.s. to 1,000 c.f.s. and 5,000 c.f.s. to 5,620 c.f.s. were interpolated for each farm in the reach (Table 3). The summation of these figures was balanced so that they would coincide with the difference on the "Conservation" plan (Table 1) between the 100 year frequency storm of 210 acres and the one year frequency storm of 139 acres or a difference of 71 acres.

TABLE 3 - DISCHARGE AREA BREAKDOWN

Silver Creek Watershed		Reach No. VII	
	C.F.S.		Area
	From	To	
Farm A:	5000	- 5620	0
	2000	- 5000	4
	1000	- 2000	14
	880	- 1000	2
Farm B:	5000	- 5620	0
	2000	- 5000	2
	1000	- 2000	20
	880	- 1000	4
Farm C:	5000	- 5620	2
	2000	- 5000	10
	1000	- 2000	11
	880	- 1000	2



FLOW PLAN MAP
Silver Creek Watershed

Reach No. VII

Scale: 0' 320' 640'

Legend





- Farm Boundary 
- Flow Lines  1000 c.f.s.
- Stream Channel 
- Pasture 

Figure No. 1

TABLE 4 - CROP FARM BENEFIT BREAKDOWN

Silver Creek Watershed								Reach No. VII	
Q*	Average Annual Benefit	Acres	Dollar Factor**	Farm A		Farm B		Farm C	
				Acres	Benefit	Acres	Benefit	Acres	Benefit
5620	10.60	71	0.149	20	2.98	26	3.87	25	3.72
4700	10.75	69	0.156	20	3.12	26	4.06	23	3.59
4150	10.81	68	0.159	20	3.18	26	4.13	22	3.50
3800	11.17	67	0.167	20	3.34	26	4.34	21	3.51
3500	11.40	66	0.173	20	3.46	26	4.50	20	3.46
3300	11.81	66	0.179	20	3.58	26	4.65	20	3.58
3140	12.51	65	0.192	20	3.84	26	4.99	19	3.65
2990	13.20	64	0.206	20	4.12	26	5.36	18	3.71
2830	13.80	64	0.216	20	4.32	26	5.62	18	3.89
2720	14.15	64	0.221	20	4.42	26	5.75	18	3.98
2330	130.65	62	2.107	20	42.14	26	54.78	16	33.71
1840	139.12	49	2.839	16	45.42	20	56.78	13	36.91
1550	130.98	38	3.447	13	44.81	15	51.71	10	34.47
1360	124.99	29	4.310	10	43.10	11	47.41	8	34.48
1220	115.92	22	5.269	8	42.15	8	42.15	6	31.61
1110	107.57	16	6.723	6	40.33	5	33.62	5	33.62
1040	102.00	11	9.273	4	37.09	3	27.82	4	37.09
945	95.47	5	19.094	1	19.09	3	57.28	1	19.09
880	<u>89.52</u>	3	29.840	1	<u>29.84</u>	1	<u>29.84</u>	1	<u>29.84</u>
	1156.42				380.33		448.66		327.41

Farm A = 380.33
 Farm B = 448.66
 Farm C = 327.41
1156.40

* C.F.S. under "Conservation Plan".

** Average Annual Benefit per acre flooded.

In Table 4 the average annual benefits were broken down to the individual farm owners. The "Q" column represents the discharge rate in c.f.s. The "Average Annual Benefits" correspond to the annual benefits obtained in Table 2. The "Acres" were computed as explained in the preceding paragraph. By dividing, for example, \$10.60 by 71 acres, the resultant would be the "Dollar Factor" for each acre at the 5,620 c.f.s. rate or 100 year frequency storm. In this case, the "Dollar Factor" was 0.149. The "Acres" column under farms A, B and C represents the area that each farm will have at the various discharge rates. The summation of each row of acres in A, B and C farms will correspond to the total acres in the third column of the table labeled as "Acres". In using the 5,620 discharge rate row, farm A has 20 acres, farm B has 26 acres and farm C has 25 acres that will be affected. This totals to 71 acres. The "Benefit" column is the product of the "Dollar Factor" and the "Acres" under each farm. Multiplying 0.149 by 20 acres will result in \$2.98 or the amount of annual benefits gained by farmer A at the 5,620 discharge rate. A summation of these benefits will be recorded in "Reach Benefit Chart" under "Crop", see Table 10.

Pasture Benefit Computations

Very little damage could be realized on pasture land in Silver Creek Watershed. The Soil Conservation Service Economist computed the average annual pasture benefits to be gained in "Plan G" within each reach.

The area of pasture land was computed in the shaded area on the Flow Plan Map (Figure 1), and recorded for each farm in Table 5. The per cent of the total pasture was estimated for each farm and applied

to the total benefits of the reach. In Reach VII, farm A had 47 acres of pasture land and 78.4 per cent of the total \$35.00 average annual benefits or \$27.44.

TABLE 5 - PASTURE BENEFIT

Silver Creek Watershed				June, 1957		Reach No. VII	
Code	Town- ship	Range	Section	Owner	Pasture Acres	Per Cent Total	Av. Ann. Dollar Benefit
A	103	49	28	Bert Klopstad	47	78.4	27.44
B	103	49	28	Julius Endahl	2	3.3	1.16
C	103	49	28	M. B. Brekkee	11	18.3	6.40
Totals					60	100.0	35.00

Other Agricultural Benefit Computations

Other Agricultural damages would encompass farm structures such as buildings and fences as well as loss to livestock or anything to do with the physical aspects of the farm excluding crop destruction. The Soil Conservation Service used a percentage in the same manner as was used in floodwater damage to crops. This was found to be a very small part of the total benefits.

Indirect Benefit Computations

Indirect damages are of a nature that is difficult to place a dollar value on. One example of this would be the increased travel from farm to market because certain shorter routes are flooded to the extent that they must be circumvented. A straight 10 per cent of the direct damages was judged by S.C.S. to be the best estimate in this area for their computations.

With the aid of the Flow Plan Map (see Figure 1), the total acres subject to flooding for each owner in a reach was computed. After being balanced (by subtracting the excess acres due to planimentering errors) to correspond with the data in Table 7 under "Crop", the total acres were recorded in Other Agricultural and Indirect Benefit Chart (see Table 6). For example, the summation of the "Total Acres" column (215) in Table 5 would correspond to the "Crop" acreage in Reach VII of Table 7. The 44.20 (Table 6) on A's farm represents the per cent that 95 is of the total (215). This per cent is applied to the total "Other Agricultural" benefits (9.00) of Reach VII in Table 11 to obtain 3.98 or the average annual dollar benefit realized in farm A by this category. The summation of the three farms, A, B and C, in "Other Agricultural" benefits of Table 5 will now correspond to the total in the same category in Table 11.

The same procedure as above is to be followed with the "Indirect" benefit computation, noting that the totals for "Indirect" are to be used in place of "Other Agricultural".

TABLE 6 - OTHER AGRICULTURAL AND INDIRECT BENEFITS CHART

Silver Creek Watershed					Reach No. VII	
Code	Owner	Legal Description	Total Acres	Per Cent	Average Annual Dollar Benefit	
					Other Ag.	Indirect
A	Bert Klopstad	Part W $\frac{1}{2}$ SW $\frac{1}{4}$ Sec. 27 and E $\frac{1}{2}$ SE $\frac{1}{4}$ and NW $\frac{1}{2}$ SE $\frac{1}{4}$ Sec. 28 -103-49.	95	44.20	3.98	57.02
B	Julius Endahl	NE $\frac{1}{4}$ SW $\frac{1}{4}$ and part W $\frac{1}{2}$ SW $\frac{1}{4}$ Sec. 28 -103-49.	66	30.72	2.76	39.63
C	M. B. Brekke	SE $\frac{1}{4}$ SW $\frac{1}{4}$ and SW $\frac{1}{2}$ SE $\frac{1}{4}$ Sec. 28-103-49.	54	25.08	2.26	32.35
Totals			215	100.00	9.00	129.00

TABLE 7 - PLANNED PROFILE MEASUREMENTS-CROP AND PASTURE

Silver Creek Flood Plain Lands (Acreages subject to flooding in acres as estimated by S.C.S.)			
Reach	Crop	Pasture	Totals
IV	741	195	936
V	328	64	392
VI	840	55	895
VII	215	60	275
VIII	1203	115	1318
IX	305	95	400
X	445	25	470
XI	465	23	488
XII	439	58	497
Totals	4981	690	5671

Enhancement Benefit Computations

The increased value of land due to better use of that land through improved crop production is one definition of enhancement. In Reach VII, 24 of the total 60 pasture acres were subject to enhancement. This was determined by S.C.S. from information gathered through questionnaires concerning what the future use of land would be when a reduction of

flooding would be realized. This was compared with the known physical data of the land and its capabilities. This resulted in the best S.C.S. estimate according to their standards.

The existing pasture land was inked on the Flow Plan Map (see Figure 1) by the Soil Conservation Service. The ownership boundaries had already been transferred on the plan in the crop benefit computation. The pasture land was planimetered to determine the total acreage for each owner. This information was transferred to the Enhancement Benefit Chart, (Table 9). Some land was omitted because it was too near the creek and would remain in its present pasture status.

The total enhancement acres for Reach VII (24) was divided by the total pasture in the reach (60) to compute the per cent to be applied to the total pasture of each owner in order to obtain the figures for enhancement land. The \$15.53 increased value of enhancement land, as determined by S.C.S., was multiplied by the enhancement acres of each farmer to ascertain the average annual dollar benefit for that farmer. In farm A, 19 acres of enhancement was multiplied by \$15.53 to obtain \$295.07 of benefits.

TABLE 8 - ENHANCEMENT* ACRES

Silver Creek Watershed			(May 1956-S.C.S. figures)	
Reach	Acres		Value/acre	Totals
IV	65	x	\$15.53	\$1009
V	25	x	"	388
VI	20	x	"	311
VII	24	x	"	373
VIII	45	x	"	699
IX	30	x	"	466
X	5	x	"	78
XI	5	x	"	78
XII	10	x	"	155
Totals	229			\$3557

* Enhancement - The change from pasture or poor crop production to greater crop production due to increased potential of land through the construction of floodways and dams to minimize flood damage.

TABLE 9 - ENHANCEMENT BENEFIT CHART

Silver Creek Watershed					Reach No. VII		
Code	Owner	Description			Acres		Av. Ann. Dollar Benefit
		Twnsp.	Range	Sec.	Pasture	Enhance.	
A	Bert Klopstad	103	49	28	47	19	295.07
B	Julius Endahl	103	49	28	2	1	15.53
C	M. B. Brekke	103	49	28	11	4	62.12
Totals					60	24	372.72

Enhancement value per acre: \$15.53.

Road, Bridge, Culvert Benefits

These average annual benefits pertain directly to government agencies. This figure was subtracted from the total average annual benefits as the farmer will not have to bear this cost except indirectly through taxation. The government agencies agreed to furnish the necessary funds for these improvements.

Sediment, Scour, Stream Bank Erosion and Swamping

Little or no benefits were realized within these categories in Silver Creek, therefore, these fields were not included in the general plan.

TABLE 10 - BENEFIT BREAKDOWN ACCORDING TO OWNER

Silver Creek Watershed						Reach No. VII
Code	Owner	Crop & Pasture	Other Ag.	Indirect	Enhancement	Av. Ann. Total Benefit
A	Bert Klopstad	380.33	3.98	57.02	295.07	736.40
B	Julius Endahl	448.66	2.76	39.63	15.53	506.58
C	M. B. Brekke	372.41	2.26	32.35	62.12	469.14
Totals		1156.42	9.00	129.00	372.72	1712.12

TABLE 11 - SILVER CREEK REACH: BENEFIT CHART

	Reach or Unit Designator									
	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
Crop	5654	1831	3077	1186	5779	1261	1977	3750	1622	26137
Pasture	157	39	27	35	68	43	17	33	32	451
Other Ag.	22	9	13	9	25	17	16	11	12	134
Road-Br-Culvert	134	45	129	60	134	79	99	86	234	1000
Sediment										
Scour										
St. Bank Erosion										
Swamping										
Enhancement	1009	388	311	373	699	466	78	78	155	3557
Indirect	597	192	325	129	601	140	211	388	190	2773
TOTALS	7573	2504	3882	1792	7306	2006	2398	4346	2245	34052

Ratio Assessment

A complete breakdown of average annual benefits to each owner in Reach VII can be seen in Table 10. From these benefit figures a ratio can be obtained for computing future special assessments by dividing the

individual owner's total benefits by the aggregate sum of benefits in the watershed. In Reach VII, owner A has a total of \$736.40 in benefits. In computing what part farmer A would be assessed of the total assessment, the ratio would be \$34,052 (average annual total benefits in all reaches) to \$736 (average annual benefits realized by farmer A) or 4.6 per cent of the total assessment needs. Farmer B would have an assessment of 6.7 per cent of the total cost and farmer C, 7.3 per cent. The average annual operation and maintenance costs were estimated at \$2,310. This would mean an assessment to farmer A of \$49.96, farmer B of \$34.36, and farmer C of \$31.83. According to S.C.S., the farmers should gain in benefits more than two and one-half times their respective assessment. This is computed by setting up a ratio of the amount of benefits realized to the total cost of realizing these benefits.

Appraisal of Site

Some of the beneficiaries of this project are being asked to donate easements and rights-of-way for dam sites and channel improvement. These cases require special consideration.

There are several ways to handle this matter. In Silver Creek, donation of easements are anticipated. In other watersheds, compensation might be required to obtain them. If they are donated, credit against future assessments should be given. There are two approaches to the problem and either one may be used, depending upon the preferences of the local group.

Before stating the procedure to follow, the difference between the permanent pool and the flood pool behind flood retention dams needs an explanation. The permanent pool will be lost to the farmer as any

use other than storage of water. The flood pool will vary in area according to the severity of the flooding. At times crops may be entirely recoverable in this area while at others, partial or total destruction is possible.

The first method of obtaining easements would be the purchase of the easement for dam site, flood pool, and permanent pool outright. This would require an appraisal of the lost land in the dam site and the permanent pool, and the damages that would be realized over an extended period in the flood pool, this latter capitalized into present value or damages.

The alternative would be to pay nothing for the flood pool easement, but agree to pay for the damages as they occur at the end of the year. The procedure followed in the crop computations could be used as a guide in this analysis, or a third party could appraise the damages.

This latter method might lead to farmers deliberately planting corn each year within the flood pool in order to collect the damages. Purchase of an easement for the flood pool area might lead to better land use and would avoid yearly appraisals of damage.

If the site is donated, one of these methods of appraisal should be recorded so that if any future assessment is placed upon the owner of the land, he could deduct this appraisal from his total assessment.

Maintenance Agreements

Over a fifty year period the Soil Conservation Service estimated that the operation and maintenance cost would amount to \$49,624.⁶⁰

The cost of operating and maintaining the flood retarding structures and channel could be paid out directly to those contracted for the specific job or credit against future assessment could be given to the farmer who contributed his services for the necessary maintenance. These costs could involve annual routine maintenance such as clearing of willows in the main channel, and also nonroutine maintenance which could relate to repairing part of a dam that was destroyed in an unusually severe storm.

Adjustment and Negotiation of Plan

This plan is by no means a rigid, nonamendable scheme. In fact, it is hoped that new suggestions for simplifying it could be formulated through experience with this plan. Those involved in the watershed should be consulted for the adjustment of this project to fit their own concept of an ideal financial plan based on the benefit principle. Then too, the division of benefits may not be satisfactory to everyone concerned. Men selected by the local sponsoring organization will have to negotiate with those who object to their suggested share, and a satisfactory solution will have to be spelled out through compromise.

⁶⁰ Watershed Work Plan For Watershed Protection and Flood Prevention, op. cit., p. 21

Aggregate Roll Review

A final roll of all benefits and contributions realized by each farm owner should be formulated. Provision should also be made for a review of the data when it is so warranted, and the method of computing this data should also be open for revision when more accurate estimates are possible.

CHAPTER VI

CONCLUSIONS

The crop computations, when broken down within each reach, revealed definite patterns. In Reach VII, the differences in the benefits realized among the three land owners was not great. This was due to the fact that the farms were fairly well distributed over the entire reach. Although farm A had more acres within the limits of the reach, farm B had a greater spread between the 500 and 2000 c.f.s. lines. Within these lower c.f.s. numbers, a greater share of reduced damage was estimated. This results in farm A receiving only \$380.33 in benefits while farm B will enjoy \$448.66 in benefits. The smaller size of farm C is compensated for by the large proportion of its acreage between the 500 and 2000 c.f.s. lines.

The land enhancement benefits were in direct proportion to the total pasture land. Farm A had 78.4 per cent of the total pasture land and would gain \$27.44 in benefits. Farm C with 18.3 per cent or \$6.40 in benefits and farm B with only 3.3 per cent or \$1.16 in benefits followed in that order. Reach VII was comparatively moderate in pasture benefits as compared with the other reaches. It ranked fifth among all the reaches and could be considered a little below the average.

S.C.S. estimated the degree of enhancement value per acre for pastureland at \$15.53. This category is difficult to appraise. The data received from the farmer on the acres of pasture land he intends to convert into a more intensive use, would be speculative intention up to the time he does act. Then too, the farmer may not be able to convert his land, although he would like to do so. A high water table on his

present pasture acreage may prevent him from the conversion. His limited information may not reveal this fact to him until a survey is made. The author disregarded pastureland close to the main channel of the creek because this would likely remain in its present status. Table 9 represents the enhancement breakdown according to the amount of enhancement land that was estimated for each farmer.

The method of Other Agricultural and Indirect computations was similar to the pasture computation. A proportion of individual ownership of cropland to the total cropland within the reach was used to obtain the individual benefits. For a detailed outline of the breakdown of other agricultural and indirect benefits, see Table 6. S.C.S. ascertained Other Agricultural benefits to each reach by a detailed survey of the farmers in the area, while for Indirect Benefits they used approximately 10 per cent of the direct benefits because of the difficulty in assigning a dollar value to this category.

Road, bridge and culvert damages did not enter into the benefit part of the financial plan in Silver Creek. The county agreed to bear these costs.

Sediment, scour, stream bank erosion and swamping were excluded from the total financial plan of Silver Creek. In other watersheds a methodology would have to be formulated to break down S.C.S. data if these categories of damage were found.

In Reach VII the easements and rights-of-way will have to be secured on a small piece of land where straightening of the channel is planned on farm A. However, the price should take into consideration that the old channel is also on farm A, thus balancing the loss of one

area by the gain of a larger one. The old channel winds around a bend and covers more territory than the new, straightened channel. Even if farmer A donates the land, which is expected according to the opinion of the local Steering Committee, due credit should be given to him so that future assessments can take into account his contribution. Some who have land only in the uplands probably will derive little benefit from site donations, since they will receive very little indirect benefits and practically no direct benefits. Since this is true, no assessment, according to this plan, is possible for them. This is the reason for believing that donations of easements and rights-of-way must be considered outright gifts to the lowland farmers unless a damage schedule or purchase of these lands is provided. As long as the upland farmer's sense of equity is not disturbed, a donation scheme is possible. The situation now stands that way in Silver Creek. Only the future can foretell if this sense of equity will remain.

There will be a definite maintenance cost of clearing the channel of various debris such as willows and repairing washouts. Depending upon the agreement, a specially hired company or the farmer through whose land the channel runs, may be responsible for the maintenance work. When services are donated by a farmer, his tax levy for the watershed should receive a comparable reduction. This is, of course, presupposing that no compensation was given to him beforehand, and that all benefits to him from the watershed project were considered in computing assessments.

The following paragraphs attempt to evaluate the usefulness of this local cost-sharing plan. At the present time, it is not possible

to test this financial arrangement in the field. Silver Creek does not have an organization that can legally carry out the operation of the plan.

The status of the data used may be explained by analyzing these pertinent questions: (1) Is the S.C.S. data adequate for computing individual farm benefits? (2) Could a watershed district afford to pay the labor cost required to compute special benefit assessments by the method outlined in this thesis, or, as an alternative, could S.C.S. make these computations?

In considering these questions, one must first recognize the limitations faced by the Soil Conservation Service in time and money. Members of the S.C.S. work party expressed the opinion that breaking down the crop damage computations to the individual owner would involve a prohibitive amount of time and expense.

Since the Soil Conservation Service can help only by producing generalizations in the form of reach benefits, the watershed districts, with help from sources other than S.C.S., will have to undertake the computation of individual farm benefits. Two members of the S.C.S. work party, in a cooperative effort, formulated a plan to break down the crop damages to the individual owner. They discovered that their method to compute a simulated reach with four farms would take at least one month.

One purpose of this paper was to attempt to simplify the procedure sufficiently to make it less time consuming and thus less expensive.

The time required to compute Reach VII of the Silver Creek Watershed in all categories - crop, pasture, other agricultural, indirect and enhancement, was estimated at nearly one day. This does not include the time taken to develop, test and become familiar with the procedure. The smallest reach (VII) in Silver Creek was used as an example. Other reaches have from one and a half to three times as many individual owners. Considering these additions, two weeks is an estimate of the time which would be required for a technician to complete the plan.

After the individual farm benefits are computed, the watershed district board will need to negotiate all special cases, add benefits not included by S.C.S., and hold hearings on the proposed benefit assessments. Whether the cost of this type of financial plan is acceptable to the local organization is a value judgement to be made by that group.

The computed benefits can be no more precise than the S.C.S. data used as a source. The divisions within each reach were planimetered to determine their area, and thus additional precision was lost. Hence, the benefits computed for the three farms are probably stated more precisely than is warranted.

While the data presented in the Synthetic Storm - Discharge Chart was easily converted for this plan, some difficulty was encountered when an attempt was made to estimate the areas on the Flow Plan Map. In most cases, the flow lines drawn by the hydrologist were limited to a few c.f.s. lines such as 9,000; 5,000; 2,000 etc. If the damages were proportionate to these flow lines, it would be a simple matter to draw the flow lines between these selected few. This is not the case. If a flow line of 7,000 c.f.s. were drawn halfway between 9,000 c.f.s. and 5,000

c.f.s. one could not be certain that the damages would be one-half the difference of the damages between these Qs (5,000 and 9,000) plus the damages to the 5,000 Q.

Another problem is the fact that the Flow Plan Map is on a scale too small for accurate computation. A mistake of a few acres could be possible by using a dull pencil instead of a sharp one.

One possible solution would be for S.C.S. to draw up a new map based on storm frequencies of a larger scale with more c.f.s. flow lines. This method would be more satisfactory providing corresponding data were found in the Synthetic Storm - Discharge Chart to make these additional lines useful.

If a scheme could be devised to break down the S.C.S. benefits by zones, it would prove a more satisfactory plan. In the present plan, the damage stated in each area is an average of that area. For example, in Table 4, the "Dollar Factor" represents the average annual benefit per acre that is flooded. Using the dollar factor, 0.149, would mean that any benefits realized from the river channel or zero c.f.s. line to the 5620 c.f.s. line would on the average realize 0.149 cents benefit per acre whether the area is located near the channel or on higher ground. This is true only on the average. More reduced damage will usually result nearer the channel than on the edges of the flood plain.

The zone system would work as follows: Instead of computing the damage and benefits for each area from zero c.f.s. to each other c.f.s. limit that is given, an average benefit per acre between c.f.s. lines would be computed. For example, the average annual benefit per acre could be computed between 5000 and the next c.f.s. line (2000) that was

drawn on the Flow Plan Map. This same average benefit between 2000 c.f.s. and 1000 c.f.s. could also be computed, etc. In this manner, the average error introduced would be much less than if it covered the whole area of the reach. That is one problem for the economists to follow up from where this plan leaves off. A final suggestion is given to those who work on a zoning system. The preparation of the financial plan should follow the S.C.S. data as much as possible since private or independent investigations would be too costly to be undertaken by the local organization.

Enhancement land was judged by S.C.S. to include only pasture land, but according to the definition of enhancement, (more intensive use of land), this could also include cropland as well. Some independent investigation should be made into² this subject for possible additional benefits.

Other types of benefits may also be present but temporarily overlooked. If the farmers on whose lands the flood retarding structures will be constructed desire a high-water dam instead of the present request for a minimum permanent flood pool, fish and wild life benefits could be realized. Watering of livestock could also be a benefit. The people of the watershed may even have ideas on benefits that have been overlooked in this paper. They also should be added to the total picture.

Cooperation by the various peoples and agencies is the key to a successful and workable plan. This whole scheme is based upon that principle. The renters and owners of the land in the watershed, the general public, and the sum total of the various agencies and organizations

involved, cannot possibly succeed in solving the financing problem unless there is a united effort to make a new idea work.

It is doubtful whether any plan will be accepted or reviewed by the people of Silver Creek until the need for such a plan is so great that the very watershed project itself is threatened. These watershed people are hesitant to go into any legally binding organization until they are forced to that situation.

The author's purpose and interest in this project was to set up procedures and techniques that might be followed in watersheds that reach a particular stage of development. This plan is to be used as a guide only and does not necessarily constitute the best or final approach to the problem. It should be understood and emphasized that any plan presented does not obligate the people of the watershed to accept the conclusions reached herein. This plan should be submitted to the farmers of Silver Creek with the hope of stirring the necessary criticism and suggestions that will eventually develop a workable scheme that will be satisfactory to them. This is their project and should reflect their thoughts and desires. It will be up to the farmers, or more specifically the land owners in the Silver Creek Watershed, to decide what type of plan they prefer. Part of the financial plan will be determined when the negotiation stage has passed and as has been suggested before, this may take a long time. This does not, however, restrict other watersheds from following these principles as much as is applicable in their respective areas.

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APPENDIX A

SCS-207
RevisedTABLE 1 - U.S.D.A.-S.C.S.
Watershed Cost Data (P.L. 566)

Silver Creek Watershed

For Total Project

(Watershed Name or Summary Identification)

	Federal	Non-Federal	Total
<u>LAND TREATMENT</u>			
<u>FOR WATERSHED PROTECTION: I</u>			
1. Land Treatment SCS	25,704	47,925	73,629
2. Land Treatment FS			
3.			
4. Subtotal Land Treatment I	25,704	47,925	73,629
<u>FOR FLOOD PREVENTION: II</u>			
5. Land Treatment SCS			
6. Land Treatment FS			
7.			
8. Subtotal Land Treatment II			
9. Total Land Treatment	25,704	47,925	73,629
<u>STRUCTURAL MEASURES</u>			
10. SCS Subtotal	180,819		180,819
11. FS Subtotal			
12.			
13. Total Structural Measures	180,819		180,819
14. Total Construction Cost	180,819		180,819
<u>INSTALLATION SERVICES</u>			
15. Engineering Services-SCS	27,125		27,125
16. Other - SCS	27,121		27,121
17. Total - SCS	54,246		54,246
18. Total - FS			
19.			
20. Total Installation Services	54,246		54,246
<u>OTHER COSTS</u>			
21. Land, Easements & Rights-of-Way		68,425	68,425
22. Administration of Contracts		6,500	6,500
23. Water Rights			
24. Total Other Costs		74,925	74,925
25. Total Installation Structures	235,065	74,925	309,990
26. Grand Total	260,769	122,850	383,619
<u>SUMMARY</u>			
27. Total SCS	260,769	122,850	383,619
28. Total FS			
29.			
30. Total	260,769	122,850	383,619

Date December, 1956

TABLE 2 - BENEFIT COST ANALYSIS

Silver Creek Watershed, South Dakota

Measures	1956 Price Base					
	Average Annual Benefits				Average Annual Cost	Benefit-Cost Ratio
	Flood-water	Indirect	More In- tensive Use of Land	Total		
Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	
<u>STRUCTURAL MEASURES FOR FLOOD PREVENTION</u>						
Waterflow Control						
Retarding Structure No. 1	1,904	191	244	2,339	506	4.6:1
Retarding Structure No. 2	3,169	317	407	3,893	1,246	3.1:1
Retarding Structure No. 3	3,700	370	475	4,545	1,050	4.3:1
Retarding Structure No. 4	1,877	188	241	2,306	682	3.4:1
Retarding Structure No. 5	2,176	218	279	2,673	784	3.4:1
Retarding Structure No. 6	2,218	221	285	2,724	1,055	2.6:1
Channel Improvement	12,678	1,268	1,626	15,572	8,237	1.9:1
GRAND TOTAL	27,722	2,773	3,557	34,052	13,560	2.5:1

Date December, 1956

TABLE 3 - COST-SHARING SUMMARY

Silver Creek Watershed, South Dakota

Type of Cost	1956 Price Base					
	Federal Cost		Non-Fed. Cost		Total Cost	
	Dollars	Pct.	Dollars	Pct.	Dollars	Pct.
Land Treatment						
Non-Federal Land <u>A/</u>	25,704	35	47,925	65	73,629	17
Structural Measures						
Flood Prevention	235,065	76	74,925	24	309,990	72
Total Installation Costs	260,769	68	122,850	32	383,619	89
Operation & Maintenance <u>B/</u>	-	-	49,624	100	49,624	11
TOTAL PROJECT COSTS	260,769	60	172,474	40	433,243	100

A/ This cost is exclusive of reimbursement from ACF or other Federal funds.

B/ Capitalized at the estimated borrowing rate of organization(s) guaranteeing operation and maintenance.

Date December, 1956

APPENDIX B

ECONOMIC APPENDIX

Silver Creek Watershed
May - 1956

Flood Damages and Methods of Evaluation

High intensity storms, large number of excessive rainfall occurrences (from hydrologist), and moderately steep slopes with loess capped soils are conducive to rapid runoff of soil and water under prevailing conditions of use and management of lands in Silver Creek Watershed. The precipitation is usually heaviest and storms most frequent during the season when cultivated lands are highly susceptible to erosion. This combination of factors results in serious loss of both soil and moisture and causes extensive damages due to flooding waters. Without the recommended watershed treatment program in effect, flooding will increase in frequency of occurrence, and in magnitude and severity of damages. This will result from the deterioration of soil and plant cover; from increase runoff and erosion, and from sedimentation deposits on the floodplains. Yields will become smaller on both uplands and floodplain lands plus the direct damages from the increase of floodwaters with which they will have to cope. Another future damage that is insignificant at the present time, is the deposit of infertile (sub-soil) sediments. At the present, the sediment deposits are the fertile, loess derived, topsoils of the adjacent upland farms; but the future will be a different story unless protective measures are applied.

The recommended watershed program for Silver Creek is divided into two separate categories, land treatment measures and structural

measures. Land treatment measures were not evaluated as to damages and benefits expected within the life of the program because it is felt that they have proven themselves in the past years. A detailed evaluation of land treatment measures was made on the pilot watersheds, and in all cases, the benefits greatly exceeded the costs, therefore, this step has not been calculated for Silver Creek. The recommended conservation measures needed and the cost of same has been determined and can be found in the tables of the work plan. A discussion of methodology used for both land treatment measures and structural measures follows:

LAND TREATMENT MEASURES

In Table I of the work plan is shown the amount of conservation measures to be applied during each specific year as listed. In Table II of the work plan is shown the amount of conservation measures already on the land, plus the amount to be applied after the project years. The cost figures are also listed in these two tables. The conservation measures in Table I are only those that will be applied during the project years and does include the minimum amount (75%) of those land treatment measures required above structures where the lack of such measures would adversely affect the design, operation, and maintenance of proposed structures. Also included are the kinds and amounts of land treatment measures for the balance of the watershed which in the judgment of the Area Conservationist, Work Unit Conservationist, Steering Committee, etc., that the people will be willing and able to install during the project years.

In July, 1955, a physical inventory of the watershed was completed by Skalland's work unit personnel. On this inventory they delineated

on 8" photos the specific present land use such as corn, oats, hay, pasture, etc., location and kind of conservation practices now on the land, and the condition of cover (good, fair, or poor) found at the present time. Lorne Nestrud, Area Soils Scientist, prepared a complete land capability map of the watershed and combined this information, with the above physical inventory information, on one composite map for measurement and tabulation purposes. This composite map was then divided into hydrologic units before any measurements were tabulated. These hydrologic units or segments were determined by the work plan party hydrologist and shall be referred to as "reaches" hereafter. Nestrud and myself then compiled the necessary information needed from this composite map. Measurement and tabulation was done by planimetry and the Grid (dot) system. The charts, tables, and data compiled from this study is found in the folder of this appendix labeled land-use and capability - Silver Creek.

The first use made of this data was to supply the hydrologist with cover index figures for the watershed under present existing conditions. The future cover index figures for the watershed, with the complete recommended conservation program on the land, were furnished to the hydrologist after the conservation needs study was completed and agreed upon.

This measurement and tabulation data compiled on the proper forms was then used for the conservation needs study. In August, 1955, a group of technicians including Brahm, Ellis, Rozendal, Skalland, Nestrud, Huxtable, Geiger, and Parker met in Sioux Falls and completed this study. The conservation needs which includes the total needs,

amount yet to be applied, and the amount to be applied during the project years, was presented to the Steering Committee, who in turn approved the results of this study. Technical standards of the Minnehaha Soil Conservation District were also used for this conservation needs study.

Work sheets, charts, etc., for this study can be seen in folder of this Appendix labeled Land Treatment Practices and Conservation Need Studies. One change was made since the meeting of this group of individuals in August. After studies by the hydrologist and engineer of the work plan party were sufficiently far enough along, it was decided to exclude Reach XIII (everything south of Highway 38A) from the watershed. This decision necessitated some small changes in the final figures presented in the original conservation needs study.

In March, 1956, a review of the needs study by McVicker and Hermanson resulted in adjustments as to the amount of terraces to be applied during the project years. The figure for terraces was raised to meet the 75% minimum. State Office, Area and Work Unit personnel have all concurred in this change.

With the needs of the watershed established, the next step was to determine the cost of each of the various practices concerned with in this watershed. Mr. Rozendal prepared a summary of the complete total costs of each separate practice and Mr. Skalland, with the help of the local ASC, determined the amount of cost-sharing furnished by the ACP payments. All maintenance costs are private and are not considered in the costs or in any tables of the work plan. All installation costs shown in the work plan for land treatment measures are less any ACP

payments received and are based on 1955 price levels. A table of these costs can be found in this appendix.

Since this original cost estimate was completed, we have made some changes for most of the practices. More firm and detailed analysis of these costs were desired for the development of the work plan. At the present time, these costs are in the process of study and review and are subject to slight changes.*

* This report was written by the Watershed Work Plan Party headed by Party Leader Ray Huxtable from the Huron Office of the State Soil Conservation Service.

APPENDIX C

SOUTH DAKOTA CODE 1939

Chapter 61.08

61.0840 - Refunding assessments to owners of lands excluded. In case of the exclusion of any lands under the provisions of this chapter, there shall be refunded, to any and all persons who have paid any assessment or assessments to such district for any lands so excluded any sum or sums so paid. Such payments shall be made in the same manner as other claims against such district, and from such fund or funds as the board of directors may designate; but where such parties have realized benefits from the organization and operation of the district, the value of such benefits shall be deducted from the assessments paid in by such person and the balance if any refunded.

Chapter 61.09

61.0904 - Act of Congress August 11, 1916, entitled An Act to Promote the Irrigation of Arid Lands, and shall determine the benefits which will accrue to each of such tracts or subdivisions on account of the construction or acquisition of such irrigation works, and the amount so apportioned or distributed to each of such tracts or subdivisions as finally equalized or confirmed by the court, as the case may be, shall be and remain the basis for fixing the annual assessments levied against such tracts or subdivisions in carrying out the purposes of this chapter. Such assessor shall make or cause to be made a list of such apportionment or distribution; which list shall contain a complete description of each subdivision or tract of land of such district with the amount and rate per acre of such apportionment or distribution of

cost and the name of the owners thereof: or he may prepare a map on a convenient scale showing each of such subdivisions or tracts with the rate per acre of such apportionment entered thereon. Where all lands on any map or section of a map are assessed at the same rate, a general statement to that effect shall be sufficient...Whenever any assessment is made in this in lieu of bonds, or in any annual levy for raising the interest on bonds, or any portion of the principal or the expenses of maintaining the property of the district or any special assessment voted by the electors, it shall be spread upon the lands in proportion to the benefits received, and the whole of the assessment of benefits shall equal the amount of bonds or other obligations authorized at the election last above mentioned...

APPENDIX D

STORM-SERIES

by Wm. Corcorah, Hydrologist
Soil Conservation Service
Huron, South Dakota

In order to evaluate discharge and damages on an annual or yearly basis, a storm-series is prepared. This is based on the logical assumption that in an average 100-year period, there would be one storm that would equal or exceed the 100-year frequency storm, or would have a 1% chance of occurring every year. There would be four storms that would equal or exceed the 25-year frequency storm, or this storm would have a 4% chance of occurring every year.

The annual storm peaks are then tabulated in descending order (see right-hand side of Table 4) tabulate the plotting position, F_a , obtained usually from a Table or from the following equation:

$$F_a = \frac{100 (2n-1)}{2y}$$

Where F_a is the plotting position, n is the rank, and y is the number of years of record.

On Hazen paper, Figure I, plot the flood peaks versus their F_a position. The paper shown is No. 3128, logarithmic normal which is obtained from the Codex Book Company, Inc., Norwood, Massachusetts. No. 31376, logarithmic normal by the same manufacturer is also used. Draw a line through the plotted points. When data are a good sample, they will plot in straight line on Hazen paper. Consistent errors and biased data will produce curved lines on the paper.

The percent scale of Figure I is called the percent chance scale. For example, at the 50% chance line we have a discharge of about 1410 cfs. The probability is 50% that a storm of this size would be equalled or exceeded in any year. At the 1% line there is a discharge of about 5200 cfs. There is a probability that a peak discharge of this size will be equalled or exceeded in any year. The 1% chance discharge is often referred to as the 100-year frequency flood. To obtain the so-called frequencies, merely divide 100 by the percent chance. These values are tabulated (see Table 5) in the synthetic series, which goes to the economist.

TABLE 4 - U.S. DEPT. OF AGRICULTURE
SOIL CONSERVATION SERVICE

WATERSHED AND HYDROLOGIC STUDIES
Reach XII Silver Creek Watershed

Date	Q	q	#	q	F _a
54	.28	520	1	4315	2.0
53	.93	1635	2	3045	6.0
52	.19	355	3	2955	10.0
51	1.01	1770	4	2875	14.0
50	.80	1425	5	2380	18.0
49	.36	650	6	2280	22.0
48	.99	1760	7	1770	26.0
47	1.73	3045	8	1760	30.0
46	1.69	2955	9	1725	34.0
45	.38	775	10	1710	38.0
44	.73	1400	11	1635	42.0
43	.37	660	12	1505	46.0
42	1.65	2875	13	1425	50.0
41	.85	1505	14	1425	54.0
40	.97	1710	15	1400	58.0
39	.45	800	16	1362	62.0
38	.77	1362	17	960	66.0
37	.98	1725	18	940	70.0
36	2.49	4315	19	800	74.0
35	.80	1425	20	775	78.0
34	1.30	2280	21	775	82.0
33	.54	960	22	660	86.0
32	1.37	2380	23	650	90.0
31	.38	775	24	520	94.0
30	.52	940	25	355	98.0

TABLE 5 - SYNTHETIC STORM-DISCHARGE CHART

Reach No. XII

Storm Freq.	Present			With Conservation			With Conservation & Dams		
	Disch. cfs	Area Ac.	Damage \$	Disch. cfs	Area Ac.	Damage \$	Disch. cfs	Area Ac.	Damage \$
100				5800					
50				4900					
33.3				4400					
25.0				4050					
20.0				3800					
16.7				3600					
14.3				3410					
12.5				3300					
11.1				3160					
10.0				3050					

6.72

3.98

2.84

2.20

1.81

1.53

1.33

1.17

1.038

Each of these represent
10 Storms that will occur
in 100 years.

