United States
Department of
Agriculture

**Soil
Conservation
Service**

Hydrology Training Series

Module 201 - Hydrology and Hydraulics in SCS Programs

Study Guide

Engineering
Hydrology Training Series
Module 201

Hydrology and Hydraulics in SCS Programs

National Employee Development Staff
Soil Conservation Service
United States Department of Agriculture
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Preface

This module consists of a study guide that explains the role of hydrology and hydraulics in designing and planning in the various SCS program activities.

Proceed through this module at your own pace. Be sure you completely understand each section before moving on. If you have questions or need help, please request assistance from your supervisor. If your supervisor cannot clear up your problem, he/she will contact the state-appointed resource person. The resource person is familiar with the material and should be able to answer any questions you may have.

Be sure to write out your answers to the included activities. This will help to reinforce your learning. After completing each activity, compare your answers with the included solution.

Acknowledgement

The design and development of this training module is the result of a concentrated effort by practicing engineers in the Soil Conservation Service. The contributions from many technical and procedural reviews have helped make this module one that will provide needed knowledge of hydrology and hydraulics to SCS employees.

Module Description

Objectives

Upon completion of this module, the participant will be able to:

1. Explain the engineer's role in the hydrologic and hydraulic aspects of major legislated SCS programs and activities.

2. Discuss the area engineer's role in coordinating with state and local water management agencies.

The participant should be able to perform at ASK Level 3 (Perform with Supervision) after completing this module.

Prerequisites

Module 101 – Introduction to Hydrology and the New Employee Orientation course.

Length

Participant should take as long as necessary to complete this module. Training time for the module is approximately one hour.

Who May Take Module

This module is intended for all engineers and others who need to understand the role of hydrology and hydraulics in major SCS programs and activities.

Method of Completion

This module is self-study, but the state or NTC should select a resource person to answer any questions that the participant's supervisor cannot handle.

Content

This module includes brief looks at conservation operations, water resources, the snow survey program, flood plain management studies, and the area engineers role in working with water management agencies. It covers how hydrology and hydraulics interrelate with the programs and agencies.

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Introduction

The purpose of this module is to explain the engineer's role in the hydrologic and hydraulic (H&H) aspects of major SCS programs and activities. The module will not expand on each program, but will try to explain how H&H fits into the overall picture. We will do this by briefly explaining the program and then developing the H&H needs for it.

Legislation and SCS Responsibilities

On August 25, 1933, the Soil Erosion Service was established as a temporary organization in the U.S. Department of the Interior. This action was taken without formal order, but was based on a resolution adopted on July 17, 1933, by a special board of public works. The new agency was to carry out the provisions of the National Industrial Recovery Act of June 16, 1933, relating to soil erosion prevention.

On April 27, 1935, the President approved the Soil Conservation Act of 1935 (Public Law 74-46). It directed the Secretary of Agriculture to establish an agency to be known as the Soil Conservation Service (SCS) to exercise the powers conferred on him by the Act. It further provided that SCS include the activities conducted under the Soil Erosion Service.

By December 31, 1935, SCS, along with its other programs activities, such as demonstration projects, was operating 489 Emergency Conservation Work Camps or Civilian Conservation Corps (CCC). These camps provided the technical assistance, manual labor, and necessary materials to install water related and other erosion control measures on privately owned lands. The measures included terraces, waterways, check dams, gully control structures, stock ponds, wind breaks, tree plantings, grass plantings, wildlife plantings, and assistance with irrigation and drainage.

On June 6, 1937, the Secretary of Agriculture's Committee on Soil Conservation made a recommendation, approved by the Secretary, to the effect: "That on or after July 1, 1937....all erosion-control work on private lands, including new demonstration projects, be undertaken by the Soil Conservation Service only through legally constituted Soil Conservation Associations". Out of this action, Soil Conservation Districts were born. In February 1937, the President submitted to the Governors of all States a standard State Soil Conservation District Law. He suggested that authority be given farmers and ranchers to organize districts specifically for conservation of soil and water resources. On March 3, 1937, the first Soil Conservation Districts Law was enacted in Arkansas. Through these districts and the responsibility of SCS for the technical aspects of the Agricultural Conservation Program (ACP) administered by the Agricultural Stabilization and Conservation Service (ASCS), SCS had technical relationships within almost every county of the nation.

Public Law 76-159 (June 30, 1939), appropriations authority for fiscal year 1940, included language that extended the application of Public Law 74-46 to assistance for farm irrigation, land drainage, establishment and operation of nurseries, and the making of conservation plans and surveys.

Role of hydraulics and hydrology

The Soil Conservation Service has been installing structural measures to control soil erosion since its beginning. Structural measures included check dams, gully control, terraces, waterways, etc. Knowledge of peak discharge, simple pipe flow, and channel hydraulics was needed to design and install each structural measure built. Basic pipe flow and open channel theory could be found in standard textbooks and hydraulics handbooks, such as King's Hydraulics Handbook.

The proportioning of structural measures was based on simple manual hydraulic calculations and simplifying assumptions, such as "the hydraulic grade line is parallel to channel bottom" and "uniform flow conditions". While the simplifying assumptions may not always exist, the impact of hydraulic errors generally was minor. The determination of the discharge or flow was based on regional variations of the Rational equation or rules of thumb, such as assuming one cubic foot per second of flow for every acre of drainage area.

As the agency grew, the number of designs increased. The need to develop standard procedures and working tools also increased. Hydraulic tools, such as Manning's slide rule, began to appear because standard hydraulic equations could be solved in a systematic manner. The growth of hydrologic working tools was hindered because the stream flow data needed to develop and verify any model or working tool was either nonexistent or limited. In the 1930's, Yarnell began to publish rainfall data in a systematic manner for limited locations. The locations were generally major cities.

The combination of a lack of good working tools and simplifying assumptions led to the development of conservative design criteria.

The need to develop working tools and peak flow estimating procedures caused universities to increase their research role. As a result, experimental watersheds were established. As more engineers were hired, more working tools were being developed on a local, as-needed basis.

Water Resources

The Flood Control Act of 1944 authorized the installation of the works of improvement contained in 11 of the survey reports completed by the Secretary of Agriculture under authority of the Flood Control Act of 1936.

As approved by the Congress, these projects consisted mainly of accelerated land treatment measures. They contained no structural measures. However, the Department's watershed reports began to include proposals for structural measures after 1948. Secretary of Agriculture Brannan's 1949 Missouri Basin Agricultural Plan contained proposals for structural measures estimated to cost about $1 billion. The Fiscal Year 1951 USDA Appropriations Act contained language that permitted the authorized projects to include upstream floodwater detention reservoirs, channel improvements, and other structural measures.

Apparently this expanded authorization to include structural measures was anticipated in some sections of the country. When Congress appropriated funds for planning upstream flood prevention work in 1946, planning was started on the Sandstone Creek Subwatershed of the Washita River in Oklahoma. A subwatershed plan designed to reduce erosion and floodwater damages was developed by the soil conservation district supervisors, landowners, interested local organizations, and agencies of the Federal Government. The plan called for conservation treatment of the farmland and ranch land and for such structural measures as floodwater retarding dams, sediment control structures, and channel improvement.

Role of hydraulics and hydrology

Initially, the role of hydraulics and hydrology in the authorized watershed program was limited because accelerated installation of land treatment measures received the major emphasis. As monies were appropriated for construction of structural measures such as floodwater retarding dams, sediment control structures and channel improvement, the need for detailed hydrologic and hydraulic procedures on the larger watersheds became evident. Simple shortcut procedures would no longer work because of structure size and possible serious damage if a structure should fail.

Infiltration studies were initiated to determine losses on a watershed basis. Watershed loss rates and assumed hydrograph shape allowed engineers to develop peak flow estimates for small watersheds and to route hydrographs through floodwater retarding structures.

Simple manual backwater calculations were used to design channel improvements and emergency spillways.

The same manual calculations were used to estimate the area flooded at selected downstream locations.

Regionalization of limited stream flow data was used to estimate peak flow at selected locations in a watershed. The reduction in peak flow at selected downstream locations because of floodwater retarding structures was assumed to be equal to the percent of the drainage area controlled.

More and more engineers became involved in the planning and design phase of the authorized watersheds. These engineers and those associated with the experimental watershed efforts began to develop detailed hydraulic and hydrologic procedures.

Watershed Protection

The Watershed Protection and Flood Prevention Act (Public Law 83-566) was approved by the President on August 4, 1954. The Act authorized the Secretary of Agriculture to help local organizations plan and carry out works of improvement for flood prevention and agricultural aspects of water use and conservation on watersheds that did not exceed 250,000 acres. The assistance included conducting investigations and surveys, developing a watershed protection plan and an engineering plan for needed structural measures, and determining the economic feasibility of the proposed plan. The basic authorities included in this Act were not new in the sense that they already existed in the 11 Authorized Flood Prevention Watersheds. However, these were restricted to specific watersheds.

The 1956 amendments were contained in Public Law 84-1018. They provided the following:

1. Required the Federal government to pay 100 percent of the construction costs allocated to flood prevention.

2. Added agriculture water management (irrigation and drainage) as eligible purposes.

3. Increased the maximum size of dams and reservoirs for upstream protection from 5,000 to 25,000 acre-feet, provided that not more than 5,000 acre-feet were devoted to flood protection.

4. Authorized the Secretary to make loans up to $5 million to local organizations to finance their share of the costs.

5. Extended the program to include Hawaii, Alaska, Puerto Rico, and the Virgin Islands.

Watershed project planning is a coordinated analysis of watershed problems and potential solutions by a team of technicians representing various disciplines. The principal disciplines are economics, hydrology, geology, engineering, soil science, and plant science. These may be supplemented by biologists, recreation specialists, foresters, and water quality engineers as needed. There is no defined line between the areas of responsibility of each of these disciplines. The actions and decisions of each is dependent upon and interrelated with the others. Plan formulation requires that the alternative systems of improvements are feasible and compatible with the economic and social conditions of the watershed.

Role of hydraulics and hydrology

With the Watershed Protection and Flood Prevention Act (PL-566), SCS began development of the National Engineering Handbook, Section 4 - Hydrology (NEH-4) and other standard nationwide hydraulic procedures. The concepts of runoff curve numbers (CN) to estimate runoff were developed. Information from experimental watersheds was used to develop a good portion of the present Chapters 7, 8, 9, and 10 of NEH-4. Specific criteria for the design of floodwater retarding structures was developed.

PL-566 led to the development of the hydrologic procedures presently used by SCS in all programs. Standard hydrologic design procedures are used to proportion earth dams. Channel diversion structures determine acres flooded and depth of flooding information. Techniques were developed to evaluate the downstream impacts of proposed structural measures. Detailed reservoir water budget studies on a monthly basis were made to size reservoirs if beneficial storage was involved.

PL-566 led to the development of the three big computer programs, TR-20, WSP2, and DAMS2. The TR-20 computer program is used to develop peak flow estimates at selected locations. It uses standard hydrologic techniques to make these peak flow estimates and to determine the impact of floodwater retarding structures on the peak flow estimates. The WSP2 computer program is being used for detailed backwater calculations, area flooded, and depths of inundation. The DAMS2 computer program is being used to proportion earth dams using detailed standard hydraulic techniques.

Because of these activities, SCS has been able to develop a unique procedure to estimate peak flow from small, ungaged, rural watersheds. This procedure uses relatively easily obtainable watershed characteristics. CN and the hydrograph generation techniques in TR-20 were used to develop Chapter 2, Estimating Runoff and Peak Discharge, in the Engineering Field Manual, which is used extensively in the Conservation Operations program.

River Basins

Section 6 of PL-566 authorized the Secretary of Agriculture, in cooperation with other federal, state and local agencies, to make investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs. In the Secretary's Memorandum 1325, April 1, 1953, the Secretary of Agriculture had assigned the responsibility for administration of USDA water resource programs to SCS.

Role of hydraulics and hydrology

Hydrologic studies in the river basin program have been generally limited to inventory information or to the development of region-wide shortcut procedures. Quite often, these region-wide shortcut procedures were developed from information determined by watershed studies. Generally, information that was developed included relationships between ratio of maximum area flooded to average annual area flooded versus percent chance of beginning damage. This type of information was used to identify potential PL-566 watersheds. Other regionalized information included average volume of required storage in watershed inches, and peak rates of discharge per unit area for selected frequencies.

Resource Conservation and Development Program

Resource conservation and development (RC&D) projects help people take better care of their natural resources and improve their community's economy. These projects are locally initiated, sponsored, and directed. They provide a base for people to come together to plan and carry out actions that will make their project area a better place in which to live, work, and play.

USDA provides technical and financial assistance to the sponsoring local groups. It also helps them seek funds and services from other federal, state, and local sources. USDA assistance is provided under the following authorities: the Soil Conservation Act of 1935 (PL 74-46), the Food and Agriculture Act of 1962 (PL 87-703, 76 Stat. 607), and further amended by Public Law 89-796, 80 Stat. 1478. SCS has leadership for USDA in the RC&D Program.

Role of hydraulics and hydrology

RC&D measures or projects, in general, have been described either as small watershed projects or large size farm measures. As such, they have involved previously developed standard hydrologic and hydraulic techniques outlined in National Engineering Handbooks.

Snow Survey Program

As a result of the unprecedented western drought of 1934, agricultural interests expressed to USDA a desire for general and specific information on water supplies that could be expected to be available during the ensuing growing season. Both the Weather Bureau and the Forest Service were considered as the USDA agency to conduct and coordinate the snow survey program. Both agencies objected, and Congress selected the Bureau of Agricultural Engineering to operate the program. The Appropriation Act of 1935 included $36,000 for the Bureau to initiate this activity. On July 1, 1939, the Division of Irrigation of the Bureau of Agricultural Engineering was transferred to SCS and continued to conduct these surveys until June 30, 1953. On July 1, 1953, the research work of SCS was transferred to the ARS, but the Snow Survey Program remained with SCS. Section 8 of Reorganization Plan 4 specifically authorized USDA to continue to make snow surveys. Based on Public Law 74-46 and the above described authorities, SCS has provided the leadership and participated in the operation and direction of the cooperative snow survey activity in the Western States since 1935.

The first known snow survey in the United States was reported in 1834. The first known survey with a documented measurement method was reported in 1900. The first western snow surveys were made on Mt. Rose in the Sierra Nevada Mountains in 1906. The State University of Nevada began snow surveys in 1910; the Bureau of Reclamation started some in Washington in 1915 and in Wyoming in 1919. Some of the other western states followed, and by 1935 at least nine independent snow survey networks were operating in the West.

Priority is given to providing program data suited to the needs of agricultural water users, particularly those served by the soil and water conservation districts. In the states served, there are 1,200 snow courses, 200 aerial snow-depth markers, 200 soil moisture installations and 300 precipitation gages.

Data collected include depth and water content of snow, soil moisture, precipitation, and soil and air temperatures. Data are collected manually by both SCS personnel and cooperators.

To meet more sophisticated needs, SCS has installed an automatic telemetry system (Snow Telemetry, SNOTEL) to replace a portion of the manual system of collecting snow data. The telemetry system consists of approximately 500 data-collection sites, two central stations, a base station computer/controller in Portland, Oregon, and terminals in the SCS state offices of the 11 Western States. The data collected can either be transmitted on a fixed interval or on an "as requested" basis. The SNOTEL system uses an ionized meteor trail to transmit the data from the remote site to the base station. On an average, about 95% of the polled sites respond within an hour.

The manual measurements are made three to six times, or more frequently, during the winter months, beginning as early as December 1 and continuing until May or June 1, depending upon elevation and latitude.

Role of hydraulics and hydrology

The collected data are used in multiple regressions to predict the seasonal runoff volume for selected locations. The National Weather Service has the responsibility of making peak flow or flood forecasts.

As part of the SNOTEL system, SCS has automated a good portion of the seasonal volume forecasts, developed and maintained meteorological data bases, and analyzed the regression equations, making adjustments in the information used as justified.

Flood Plain Management Studies

The basic responsibility for flood hazard information studies, at the federal level, is assigned to the Corps of Engineers. An interagency Task Force on Flood Control Policy prepared a report entitled "A Unified National Program for Managing Flood Losses", published in August 1966 as House Document 465, 89th Congress. Recommendation 9(c), "Regulation of Land Use", recommends that USDA prepare preliminary flood hazard reports "for guidance in areas where assistance is needed before a full flood hazard information report can be prepared or where a full report is not scheduled". Executive Order 11296 (August 10, 1966) placed constraints on the use of Federal funds for construction and for the disposal of federal lands where flood hazards exist. USDA Secretary's Memorandum 1606, dated November 7, 1966, assigned the responsibility to SCS to represent the Department under Executive Order 11296. Executive Order 11988 (May 1977) also directs federal agencies to determine flood hazards and to avoid developing or modifying the flood plain wherever possible.

The legislative authority for SCS to participate in and to fund flood hazard studies is provided by Section 6, PL-566. These studies are carried out as cooperative efforts with state and local governments. A description of this program is covered in Subpart C of Part 621, 40 FR, 12474, March 19, 1975. This program was initiated in Fiscal Year 1968 under the direction of the Director, River Basins Division, SCS.

Four specific phases involved in a flood hazard analysis are: (1) establishing eligibility, (2) initiating the study, (3) carrying out investigations and preparing the report, and (4) assisting the local government in the use of the study findings.

Flood plain management study-reports contain descriptive and historical data pertaining to floods and flood frequencies, maps of flood plain reaches showing flood frequency lines, and water surface profiles showing relative elevations of the flood frequency lines at specific valley cross sections. The data are presented in such a way as to be readily interpreted and effectively used.

Role of hydraulics and hydrology

The information developed is also used to determine the eligibility of the watershed to participate in the watershed protection program and to identify measures that local sponsors can carry out without federal assistance. The flood plain management study has been a program where SCS can provide the sponsor with useful information within a short time period.

SCS uses the same standard hydraulic and hydrologic techniques in the flood plain management studies as are used in the Watershed Protection Program. These techniques include TR-20 and WSP2 computer programs. Basically, there is no difference between these two programs, since watershed analysis is involved in both.

Activity 1

At this time, complete Activity 1 in your Study Guide to review the material, just covered. After finishing the Activity, compare your answers with the solution provided. When you are satisfied that you understand the material, continue with the Study Guide text.

Activity 1

1. Starting with August, 1933, place, in chronological order, the significant events leading up to the SCS as it existed in July, 1939.

2. What impact did the creation of SCS have on hydrology and hydraulics?

3. What did the Flood Control Act of 1944 do?

4. What were the provisional changes to Public Law 566 made on August 6, 1956?

5. How does the Resource Conservation and Development Program (RC&D) work?

6. When was the first known snow survey completed?

7. What is the purpose of a snow survey?

8. What are the four specific phases involved in a flood hazard analysis?

Activity 1 – Solution

1. Starting with August, 1933, place, in chronological order, the significant events leading up to the SCS as it existed in July, 1939.

   a. August 25, 1933 - Soil Erosion Service established.

   b. April 28, 1935 - Public Law 74-46 (Soil Conservation Act of 1935) established the Soil Conservation Service. SCS was to direct all activities related to soil erosion.

   c. February, 1937 - Soil Conservation Districts were born. First was established in Arkansas, March 3, 1937.

   d. June 30, 1939 - Application of Public Law 74-46 extended assistance to farm irrigation, land-drainage and operation of nurseries, and making of conservation plans and surveys.

2. What impact did the creation of the SCS have on hydrology and hydraulics?

   For the first time, serious impact was made to stop or reduce soil erosion. Personnel was hired to design structures, plan improvements, and recommend vegetative practices. Runoff data, structure design, channel, and waterway improvement designs - all needed engineers to gather and use. Universities hired more engineers for research to assist in the effort. For the first time, engineers were made available in all phases of agriculturally related work to help control soil and water erosion.

3. What did the Flood Control Act of 1944 do?

   The Flood Control Act of 1944 authorized the installation of the works of improvement contained in 11 of the survey reports completed by the Secretary of Agriculture under the authority of the Flood Control Act of 1936. These projects consisted mainly of accelerated land treatment measures and practices. They contained no structural measures. Structural measures were not included until after 1948.

4. What were the provisional changes to Public Law 566, August 6, 1956?

   1. Required the Federal government to pay 100 percent of the construction costs allocated to flood prevention.

   2. Added agriculture water management (irrigation and drainage) as eligible purposes.

   3. Increased the maximum size of dams and reservoirs for up-stream protection from 5,000 to 25,000 acre-feet, provided that not more than 5,000 acre-feet were devoted to flood protection.

   4. Authorized the Secretary to make loans up to $5 million to local organizations to finance their share of the costs.

   5. Extended the program to include Hawaii, Alaska, Puerto Rico and the Virgin Islands.

5. How does the Resource Conservation and Development Program (RC&D) work?

   Resource conservation and development (RC&D) projects help people take better care of their natural resources and improve their community's economy. These projects are locally initiated, sponsored, and directed. They provide a base for people to come together to plan and carry out actions that will make their project area a better place in which to live, work, and play.

   USDA provides technical and financial assistance to the sponsoring local groups. It also helps them seek funds and services from other federal, state and local sources. USDA assistance is provided under the following authorities: the Soil Conservation Act of 1935 (PL 74-46), the Food and Agriculture Act of 1962 (PL 87-703, 76 Stat. 607), and further amended by Public Law 89-76, 80 Stat. 1478. SCS has leadership for USDA in the RC&D Program.

6. When was the first known snow survey completed?

   1834

7. What is the purpose of a snow survey?

   It provides specific information that can be used to predict expected water supplies during the ensuing growing season. This is of major concern to western states that depend on snow melt for irrigation, municipal, and industrial use.

8. What are the four specific phases involved in a flood hazard analysis?

   a. Establishing eligibility

   b. Initiating the study

   c. Carrying out investigations and preparing the report

   d. Assisting the local government in the use of the study findings

SCS Engineer's Role

The hydraulic engineer is an engineer who understands the science of hydrology and uses this understanding, together with an understanding of engineering principles, in technical studies associated with planning, design, and operation of water resources development. Engineers in SCS need to become proficient in hydrology and hydraulics to assume this role.

Selection of alternatives and structures is a public responsibility. The alternatives must be developed in such a way that they will not set up unreasonable demands. The engineer is on the team that collects and reviews components in public meetings. The engineer must be acquainted with the various public agencies that should be involved in water resource developments.

Local government agencies involved in water resources include the following:

1. Planning Office
2. Park and Recreation Department
3. Emergency Management
4. Development Department
5. Health Department

County government agencies involved in water resources including the following:

1. Agricultural Extension Service
2. 4–H Department
3. Civil Defense Department
4. County Commissioners
5. Planning Department

State government agencies involved in water resources including the following:

1. Environmental Improvement Agency
2. Office of General Council
3. State Planning Office
4. State Engineer's Office
5. State Parks and Recreation
6. State Historic Preservation Office

7. State Land Office

8. State Highway Commission

Area engineers must work closely with other disciplines and specialists on the planning, design, and construction of various resource developments. They will be required to coordinate with these disciplines and be familiar with the type of hydrologic data needed by each discipline.

Hydrologic investigations are essential for determining the location, timing, and availability of water resources in the planning and design of water related structures and projects. Hydrologic investigations rely on the availability of hydrologic data and watershed characteristics.

Procedures in the Engineering Field Manual for Conservation Practices, Chapter 2, are the preferred methods for hydrologic analysis for on-farm conservation practices. They are to be used unless another method is specified by the approving engineer.

Procedures in NEH-4, Section 4, and those contained in Technical Releases, Hydrology Notes, and designated references are to be used for hydrologic analysis of soil and water conservation practices to the maximum extent practicable.

Hydrologic criteria established in standards and directives are to be used for designing conservation practices and water control structures. Exceptions to using national criteria are to be obtained from the Director of Engineering. Requests for such action are to include the recommendation of the head of an NTC Engineering Staff.

The two primary references for criteria are National Handbook of Conservation Practices and Technical Release 60 - Earth Dams and Reservoirs.

Activity 2

At this time, complete Activity 4 in your Study Guide to review the material just covered. After finishing the Activity, compare your answers with the solution provided. When you are satisfied that you understand the material, continue with the Study Guide text.

Activity 2

1. What are the hydrologic/hydraulic responsibilities of an engineer when working with local, county, and state agencies?

2. List the reasons why hydrology and hydraulics are important to the SCS engineer.

Activity 4 – Solution

1. What are the hydrologic/hydraulic responsibilities of an engineer when working with local, county, and state agencies?

    The engineer must assure that alternative selection is kept within the realm of reason. The engineer must be familiar with the various public agencies involved in water development. The engineer must work closely with other disciplines and specialists in the planning, design and construction of various resource developments, and understand the types of hydraulic data needed.

2. List the reasons why hydrology and hydraulics are important to the SCS engineer.

    Hydrologic and hydraulic data are essential for water resource planning and design of water related structures and projects. Hydrologic and hydraulic criteria established in standards and directives are required to be used for designing conservation practices.

Summary

Soil and water conservation is the planned management of soil and water resources to prevent deterioration or destruction. Various SCS programs have been legislated to assist farmers, ranchers and local agencies with planning, designing, construction, and mandatory conservation measures and plans.

These programs include:

1. Conservation operations
2. The Flood Control Act of 1944
3. The Watershed Protection and Flood Prevention Act
4. River basins program
5. Resource Conservation and Development Program
6. Snow Survey Program
7. Flood Plain Management Studies

The SCS engineer uses an understanding of hydrology together with an understanding of engineering principles in technical studies to assist in the planning, design, and operation of water resource development. Basically, all disciplines depend upon hydrology and hydraulics data. The engineer must be familiar with this data need. The engineer exerts significant influence on conservation planning because of his close coordination with the planning team.

Retain this Study Guide as a reference until you are satisfied that you have successfully mastered all the methods covered. It will provide an easy review at any time if you should encounter a problem.

If you have had problems understanding the module or if you would like to take additional, related modules, contact your supervisor.

When you are satisfied that you have completed this module, remove the Certification of Completion sheet (last page of the Study Guide), fill it out, and give it to your supervisor to submit, through channels, to your State or NTC Training Officer.

Hydrology Training Series
Module 201
Hydrology and Hydraulics in SCS Programs

CERTIFICATION OF COMPLETION

This is to certify that

____

completed Hydrology Training Series
Module 201
Hydrology and Hydraulics in
SCS Programs

on __________________ and should be credited with 1 hour of training.
Date

Signed ____________________________ ____________________________
Supervisor/Trainer Participant

Completion of Hydrology Training Series Module 201 – Hydrology and Hydraulics in SCS Programs, is acknowledged and documented in the above-named employee's record.

Signed _________________________ ____________________________
Training Officer Date