

# WATER - RESOURCES DEVELOPMENT

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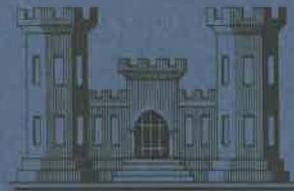
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SOUTH PACIFIC

1 JANUARY 1967

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**WATER-RESOURCES DEVELOPMENT**  
**by**  
**THE U. S. ARMY CORPS OF ENGINEERS**  
**in**  
**ARIZONA**

**1 JANUARY 1967**

**ADDRESS INQUIRIES TO**

**DISTRICT ENGINEER**  
U. S. Army Engineer District  
Los Angeles  
Corps of Engineers  
Federal Building  
300 North Los Angeles Street  
Los Angeles, California 90012

**DIVISION ENGINEER**  
U. S. Army Engineer Division  
South Pacific  
Corps of Engineers  
Appraisers Building  
630 Sansome Street  
San Francisco, California 94111

## *Foreword*

This booklet has been prepared to provide timely, concise information on the water-resources development program of the U.S. Army Corps of Engineers in the State of Arizona — and on the relationship of that program to the Federal program of comprehensive framework studies for the entire Colorado River basin.

The U.S. Army Corps of Engineers, in addition to discharging its military-construction responsibilities, is engaged in a long-range program of civil-works planning and construction to develop the water resources of stream basins in Arizona in accordance with specific directives from Congress. These directives stem from the desires of local interests who have made known their needs to Congress through their elected representatives.

Each stream basin authorized by Congress for investigation is studied as a unit in developing a comprehensive plan for water-resources development in that basin. The studies include not only consideration of flood control but also consideration of water conservation, water supply, hydroelectric power, recreational development, fish and wildlife, navigation, and such other uses of water as can be economically integrated with improvements for flood control.

Close cooperation with local interests, the State, and other Federal agencies is maintained during the investigation and planning. As a result, the desires of local interests and the plans of other agencies receive full consideration, and the project as finally constructed by the U.S. Army Corps of Engineers becomes a unit compatible with the ultimate comprehensive development of the stream basin.

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# Introduction

## GENERAL

The civil-works construction of the U.S. Army Corps of Engineers in Arizona began in 1884, when Congress authorized navigation improvements on the Colorado River. In accordance with the authorization, the Corps during the period 1885-86 widened and deepened the channel of the Colorado River in Arizona by removing tons of rock damming the stream at several locations, constructing small dams in one channel in reaches where the channel was divided to raise the water level of the main channel, and blasting dangerous rocks that menaced navigation. This work was done along the Colorado River in the reach of the river between what is now Lake Mohave and Havasu Lake.

Since that early work on the Colorado River, the work of the Corps in Arizona has been expanded to include constructing flood-control projects and multiple-purpose projects, administering laws pertaining to protection and preservation of navigable waters, fighting floods and making emergency repairs, and conducting investigations and preparing engineering reports on all major streams of the State. These activities, which are carried out in accordance with directives of Congress, are supervised by the Chief of Engineers under the direction of the Secretary of the Army. Work is accomplished in close cooperation with other Federal agencies and with State and local authorities to provide improvements of the type desired by the citizens of the communities and areas most directly concerned.

The Corps of Engineers is directly concerned with all aspects of water-resources development — including conservation for municipal and industrial uses, flood control, navigation, hydroelectric power, recreation, fish and wildlife enhancement, irrigation, and all other related land and water uses.

## WATER-RESOURCES PLANNING

The concept of comprehensive, multiple-purpose, and coordinated planning and development for entire river basins or groups of river basins has been accepted for a long time. Corps of Engineers planning provides for preparation of comprehensive framework plans for major river basins, large blocks of river basins, or regions. These plans serve as guides for more detailed planning that involves determining the economic feasibility of projects or groups of projects. In general, comprehensive framework plans outline the projected water and related land-resource problems and the approaches that appear most appropriate for their solution. Their basic objective is to provide a broad, flexible guide for the best uses of water and land resources to meet the foreseeable short and long-term needs of a region. In achieving this objective, consideration is given to:

- The timely development and management of resources as essential aids to the economic development and growth of each region.
- The preservation of resources to insure they will be available for their best use, as needed.
- The well-being of all of the people.

Preparation of framework plans is a team job. Many Federal, State, and local agencies are involved to insure that plans have proper balance, meet all important needs, and are generally acceptable. Framework planning includes — but is not limited to — consideration of domestic, industrial, and agricultural uses of water; navigation in relation to the national transportation system; hydroelectric power; flood control; water-quality control; watershed protection and management; mineral- and forest-products production; grazing and cropland improvement; recreation; protection and enhancement of fish and wildlife resources; and preservation of unique areas of natural beauty, historical or prehistorical value, or scientific interest.

A basic and essential part of comprehensive water-resources planning is coordination with other governmental agencies (Federal, State, and local) concerned with

## Introduction—Continued

water-resources development. Coordination with other agencies is carried on during all stages of planning for the primary purposes of (a) obtaining and interchanging information pertaining to problems under study to insure that all available useful information is considered and basic research is not unnecessarily repeated, (b) insuring a balanced development among the plans of the other agencies concerned by obtaining and considering all pertinent facts concerning their plans and views, and (c) developing a feasible plan of improvement that will make the best possible use of the natural resources involved.

### NAVIGATION PROJECTS

Navigation improvements are directed by Congress to assist in the development and conduct of waterborne commerce. Such improvements in Arizona would involve shallow-draft navigation for recreation on inland waterways.

### FLOOD-CONTROL PROJECTS

The purpose of flood-control projects is to regulate floodflows and thus prevent flood damages. Regulation is accomplished by constructing flood-control reservoirs and levee and channel improvements, either separately or in combination. In flood-control reservoir projects, floodwaters are stored and later released at nondamaging rates. In levee and channel-improvement projects, sufficient channel capacity to carry peak flows is provided by dredging, clearing, and straightening the waterway; by constructing levees; by building a channel with surfaces to improve flow characteristics; by providing bypasses; or by some combination of these methods.

Upon completion, flood-control reservoirs generally are operated and maintained by the Corps of Engineers unless the protection provided is essentially local in nature. Levee and channel improvements generally are transferred to local authorities for operation and maintenance.



Control tower and outlet works at Painted Rock Reservoir.

## Introduction—Continued

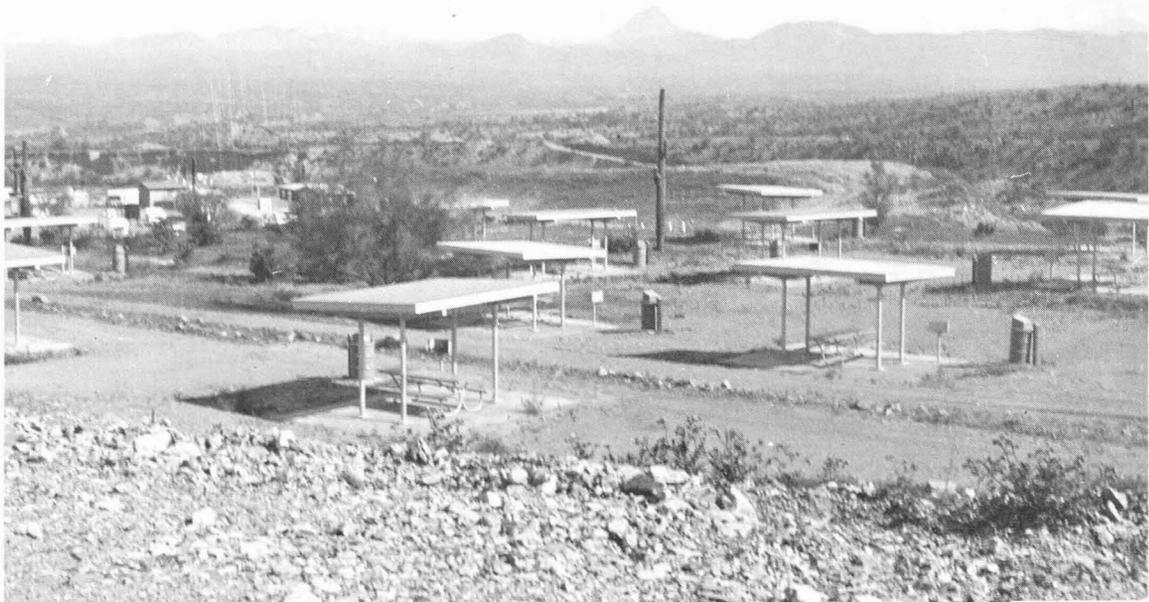
### MULTIPLE-PURPOSE RESERVOIR PROJECTS

The majority of reservoir projects are authorized for multiple purposes, i.e., flood control and other purposes including hydroelectric power, irrigation, navigation, municipal- and industrial-water supplies, water-quality control, recreation, and enhancement of fish and wildlife resources. Some reservoir projects authorized primarily for flood control may also be used incidentally for other purposes — such as recreation or fish and wildlife enhancement — that also are highly significant.

### RECREATION

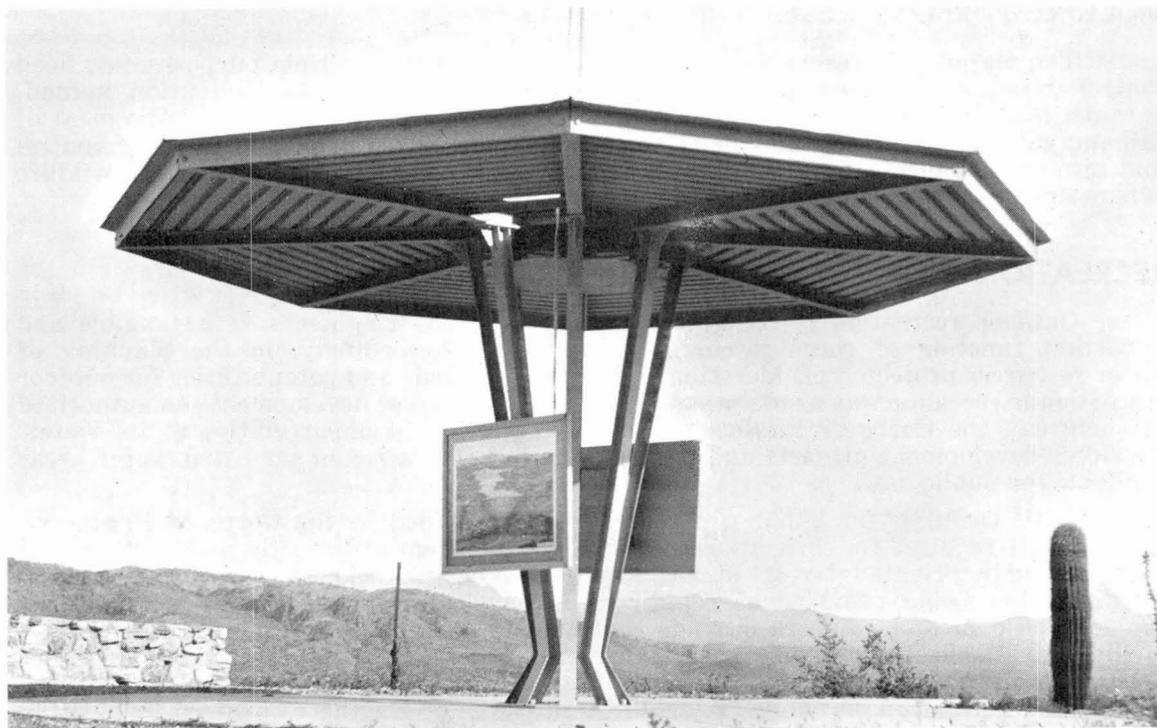
Outdoor recreation is recognized by the Corps of Engineers as a tangible and important function of water-resources development. Accordingly, in the planning of water-resources projects, consideration is given to the needs and potentialities for outdoor recreation in the same way as other aspects of water-resources development. As authorized by Congress, the Corps of Engineers provides recreational opportunities at its water-resources development projects and has made millions of acres of land and water areas available for public use.

Basic facilities for public use generally are provided by the Corps of Engineers, and facilities required for ultimate recreational development are usually provided by local agencies and by private interests on a concessionaire basis. Although facilities for recreational use are being provided as rapidly as is physically and financially possible, the demand at Corps of Engineers projects continues to exceed the capacity of recreational facilities available. Information folders on many projects involving recreational use are available on request from the U.S. Army Engineer District having jurisdiction. Some additional information on public-use facilities at Corps of Engineers projects is given in the following paragraphs.



Ramadas at Alamo Dam, now under construction on the Bill Williams River, offer shaded areas for picnickers and a dramatic view of storied Artillery Peak in the Rawhide Mountains.

## Introduction—Continued



Overlook area at Alamo Dam — where sidewalk supervisors have an unobstructed view of construction operations.

**Reservoir projects.** Public use of land and water areas at Corps of Engineers reservoir projects in the past decade has more than tripled. Facilities provided for public use at reservoirs include access roads, boat-launching ramps, parking areas, observation points, picnic areas, campgrounds, and water-supply and sanitation systems. Provisions are also made for the preservation and enhancement of fish and wildlife resources. Facilities and services such as motels, boatels, restaurants, marina installations, and sporting-goods stores are generally provided on adjacent private lands, although such facilities are sometimes located on Federal lands on a concessionaire basis. Some flood-detention basins, which generally do not have permanent recreation pools, have recreational facilities comprising bridle paths, hiking trails, golf courses, archery ranges, playgrounds, day-camping and picnicking facilities, water-supply and sanitation systems, and parking areas and access roads. The 1965 Land and Water Conservation Fund Act provides for the establishment and collection of entrance and user fees at recreational areas where facilities and services are provided at Federal expense. Under this act, charges will be made for use of recreational areas at certain Corps of Engineers projects. Money collected under this authority will constitute the Land and Water Conservation Fund to be used to acquire and develop needed additional land and water areas and to provide additional recreational facilities. This program and fund will be administered by the U.S. Bureau of Outdoor Recreation.

**Other projects.** The authority for including recreational facilities at Corps of Engineers reservoirs was recently broadened to permit construction of such facilities at other water-resources development projects including levee, channel-improvement, and navigation projects. As a result, consideration will be given to providing basic facilities and to encouraging local interests to provide ultimate recreational facilities at other projects.

## Introduction—Continued

### AUTHORITY FOR PARTICIPATION BY THE CORPS OF ENGINEERS IN CIVIL WORKS

Pertinent information on the authority for participation by the Corps of Engineers in civil-works projects is given in the following paragraphs.

**General.** The basic authority for participation by the Corps of Engineers in the development of water resources is in the "commerce clause" of the Constitution, which gave Congress the power "to regulate commerce with foreign nations, and among the several States, and with the Indian tribes." Under this authority, Congress assigned to the Corps of Engineers during the 1820's the responsibility for projects pertaining to navigation on the Ohio and Mississippi Rivers. This basic authority, which pertained solely to navigation, was subsequently expanded by Congress to include the many related aspects of basin-wide water-resources development. Further information on basic authorities is contained in the following paragraphs.

**Authority for navigation projects.** Beginning with an act approved 24 May 1824, investigations and improvements for navigation and related purposes have been authorized by a series of river-and-harbor acts, from which basic policies and procedures have been established. The 1920 River and Harbor Act expanded the Federal policy regarding navigation improvements and established general requirements for local cooperation where the benefits from such improvements are mainly local in nature. Subsequent acts have further clarified and expanded the Federal policy and have authorized many specific navigation projects. Any special conditions and requirements pertaining to a specific project are included in the authorizing act.

**Authority for flood-control projects.** In the 1880's, the Corps of Engineers was authorized to construct flood-control levees along the Mississippi River; and in 1917, the Corps was assigned the responsibility for flood-control work on the Sacramento River. Since 1936, the Corps has been responsible for the general flood-control program throughout the United States. The 1936 Flood Control Act, as amended by subsequent acts, established Federal policy with regard to flood control by stating that —

\* \* \* flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof; \* \* \*

Each Federal flood-control project, except certain small improvements and emergency work, must be specifically authorized by Congress. The procedures for obtaining authorization and construction of a project are described under a subsequent heading titled "How Corps of Engineers Projects Are Initiated, Authorized, and Constructed."

**Authority for domestic, municipal, and industrial water-supply development.** The Water Supply Act of 1958 (Title III, P.L. 85-500 approved 3 July 1958), as amended, permits the Corps of Engineers to participate and cooperate with States and local interests in developing domestic, municipal, and industrial water supplies in connection with the construction, maintenance, and operation of Federal navigation, flood-control, irrigation, and multiple-purpose projects. Space for storage of municipal and industrial water supplies may be included in Corps of Engineers reservoir projects if local interests agree to pay the percentage of project cost allocated to that function.

**Authority for water-pollution and water-quality control.** Under the 1956 Water Pollution Control Act, as amended by the 1965 Water Quality Act, water-quality control is given full consideration in the planning of water-resources development projects by the Corps of Engineers. In reservoir projects, adequate storage is included for regulation of streamflow to maintain high water quality, but not as a substitute for sewage treatment. The 1965 Water Quality Act established a Federal Water Pollution Control Administration (under the Department of Health, Education, and Welfare) to provide grants for research and development, to increase grants for construction of sewage-treatment works, to require establishment of water-quality criteria, and for other purposes. By executive statement dated 10 May 1966, the President announced the transfer (effective that date)

## Introduction—Continued

of the Water Pollution Control Administration from the Department of Health, Education, and Welfare to the Department of Interior.

**Authority for recreational development.** Under the authority of the 1965 Federal Water Project Recreation Act (P.L. 89-72 approved 9 July 1965), the Corps of Engineers may participate and cooperate with States and local interests in developing the recreational potential of any Federal navigation, flood-control, hydroelectric-power, or multiple-purpose water-resources project. Under this act, the Federal Government assumes responsibility for major recreational development provided that non-Federal public bodies agree in advance to administer project land and water areas for recreation or fish and wildlife enhancement; to bear not less than one-half the separable costs of the project allocated to those purposes; and to bear all the costs of operation, maintenance, and replacement.

**Authority for flood-plain-information studies.** Man's continual encroachment into flood-plain areas periodically needed for passage of floodflows has created a need for information on the flood hazards thus created. This information serves as a guide for use and development of flood plains and for State or municipal regulation of flood plains to avoid or minimize future flood damages. In recognition of this need, section 206 of the 1960 Flood Control Act authorized the Corps of Engineers (under procedures described in the following paragraph) to identify areas subject to periodic inundation by floods of various magnitudes and frequencies, to establish general criteria for guidance in the use of flood plains, to disseminate these data to interested agencies and individuals, and to provide engineering advice for use in planning local programs aimed at reducing flood hazards to life and property.

Flood-plain-information studies must be requested by a State or other responsible governmental agency that will agree to disseminate the information contained in the final report. A pamphlet on the procedure for making application for a flood-plain-information study is available to interested agencies from the Corps of Engineers offices listed on the title sheet.

**Special authorities.** In addition to the regular navigation, flood-control, and other civil-works projects, the Corps of Engineers undertakes small navigation and flood-control projects as well as emergency work under various general congressional authorizations; funds are appropriated annually for these purposes. These special authorities are discussed in following subparagraphs, and work under some of these special authorities in Arizona is discussed under subsequent headings: "Small Flood-Control and Navigation Projects" and "Emergency Work."

**(a) Small navigation projects.** Under the provisions of section 107 of the 1960 River and Harbor Act, as amended, the Corps of Engineers may construct certain small navigation projects without specific authorization by Congress. These projects are subject to the same requirements of feasibility and economic justification as projects requiring congressional authorization and must be coordinated with the local interests concerned. However, the number of small navigation projects is limited by the availability of funds that are provided annually by Congress on a lump-sum, countrywide basis. The total allotment for small navigation projects may not exceed \$10,000,000 for any one year, and not more than \$500,000 may be allotted for the construction of a project at any single locality. Each small navigation project must be complete in itself, and not commit the Federal Government to any additional improvement to insure its successful operation.

**(b) Small flood-control projects.** Under the provisions of section 205 of the 1948 Flood Control Act, as amended, the Corps of Engineers may construct certain small flood-control projects without specific authorization by Congress. These projects are subject to the same requirements of feasibility and economic justification as projects requiring congressional authorization and must be coordinated with the local interests concerned. However, the number of small flood-control projects is limited by the availability of funds, which are provided annually by Congress on a lump-sum, countrywide basis. The total allotment for small flood-control projects may not exceed \$25,000,000 for any one year, and not more than \$1,000,000 may be allotted for the construction of a project at any single

## Introduction—Continued

locality. Each small flood-control project must be complete in itself and not commit the Federal Government to additional improvement to insure effective operation.

(c) **Emergency work.** The Corps of Engineers is frequently called upon to perform work of an emergency nature. The authorities and types of work they cover are explained in a subsequent chapter entitled "Emergency Work."

## REGULATORY FUNCTIONS

The Corps of Engineers, in addition to other civil-works activities, is responsible for administering the laws enacted for the preservation and protection of navigable waters. Among other things, these laws pertain to:

(a) Approval of sites and plans for bridges, dams, dikes, or causeways.

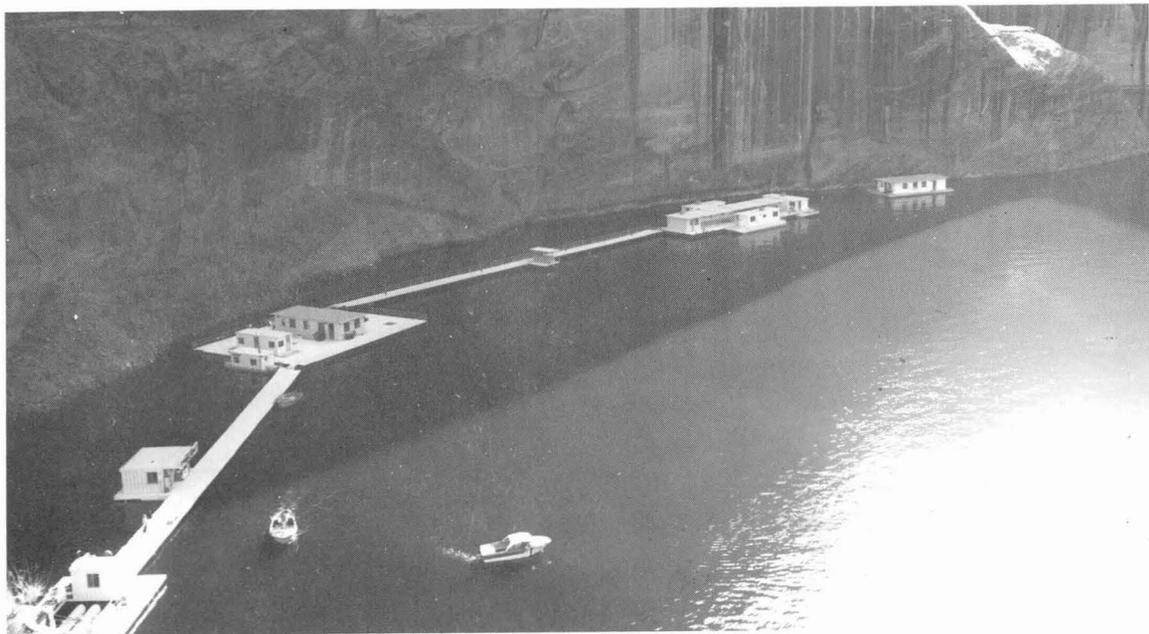
(b) Permits for structures or operations in navigable waters.

(c) Removal of sunken vessels or other obstructions endangering navigation.

(d) Alteration or removal of obstructive bridges. This function was authorized by Public Law 645-76 (Truman-Hobbs Act), which was passed by Congress in June 1940. This law permits the Secretary of the Army to require the alteration or removal of certain bridges if it has been determined that such bridges unreasonably obstruct free navigation of navigable waters.

(e) Regulation of the operation of drawbridges and establishing reasonable toll rates for certain bridges over navigable waters.

(f) Establishment of anchorage grounds, special anchorage areas, danger zones, dumping grounds, restricted areas, and harbor lines. (Under this category, the Corps has established anchorage areas on Lake Mohave behind Davis Dam, Lake Mead behind Hoover Dam, and Lake Powell behind Glen Canyon Dam.)



Sheer sandstone walls form a dramatic backdrop for the Forbidden Canyon anchorage area at Lake Powell—behind Glen Canyon Dam.  
(Picture courtesy of U.S. Bureau of Reclamation)

## **Introduction — Continued**

(g) Discharge of any kind of refuse matter into navigable waters.

(h) Protection of life and property, or of operations of the United States in channel improvements.

## **HOW LOCAL INTERESTS SHARE IN FEDERAL PROJECTS**

The cost of a Federal water-resources project is usually divided between the Federal Government and the local interests directly benefited. The local interests' share of the cost is governed (or determined) by the requirements included in the authorizing act. These requirements are not necessarily the same for each project because each project is separately and specifically authorized. Such requirements may include several of the following items:

(a) Providing lands, easements, rights-of-way, utility relocations, disposal areas, royalty-free rock, miscellaneous harbor and related improvements, supplemental dredging and jetty work, and cash contributions toward new work.

(b) Operating and maintaining the completed improvements, maintaining and preserving certain channel capacities, and preventing any future encroachments on project channels.

(c) Adjusting all water-rights claims resulting from operation of the improvements.

(d) Holding and saving the United States free from damages resulting from construction and operation of the improvements.

(e) Contracting to repay all or part of the costs allocated to irrigation, municipal and industrial water supplies, recreation, and fish and wildlife enhancement.

The best method for meeting the requirements of local cooperation in any project is for local interests to be represented by a legal sponsoring agency. Such an agency should be a local governmental unit or some type of special district with the necessary legal authority and financial ability to meet the local-cooperation requirements specified in the authorizing act.

Whenever a project requiring local cooperation is authorized by Congress, and preferably before the project is authorized, local interests should examine State, county, and local laws to determine whether such a sponsoring agency exists or can be legally formed. If the necessary legal authority does not exist, local interests should take action to obtain the necessary enabling legislation and to organize the sponsoring agency in accordance with the enabling legislation.

## **HOW CORPS OF ENGINEERS PROJECTS ARE INITIATED, AUTHORIZED, AND CONSTRUCTED**

The Corps of Engineers never initiates a project. Actually, local interests initiate, Congress authorizes, and the Corps of Engineers constructs Federal navigation and flood-control projects. The major steps in initiating and processing Corps of Engineers water-development projects are briefly outlined as follows:

## Introduction — Continued



1. Local interests inform their Senator or Representative of a navigation, flood-control, or related water-resource improvement they desire and request that provision of the desired facility be investigated by the Federal Government.

Two courses of action are open to the Senator or Representative. If a previous report has been made for the area, he may request the Senate or House to authorize a review of previous reports to determine whether any modifications in such reports would be advisable.

If a review report is appropriate, the Committee adopts a resolution authorizing the Board of Engineers for Rivers and Harbors to make the review and refers the resolution to the Chief of

Engineers for necessary action. If the Committee is convinced of the need for an original report, the authorization for an investigation will be included in an authorization bill for consideration by Congress. When passed, the bill becomes a directive for the study.

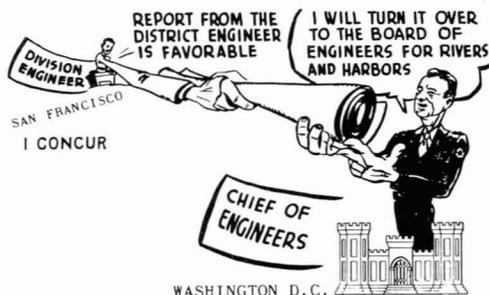
2. When the investigation is authorized, the Chief of Engineers will assign it to an appropriate reporting officer, usually the Division Engineer in whose territory the area is located. The Division Engineer refers it to the proper District Engineer for actual



accomplishment. Following receipt of the directive requesting an investigation and, upon receipt of funds for the studies, the District Engineer, in close cooperation with local authorities and other Federal agencies, begins the necessary engineering and economic investigations. A public hearing is held to ascertain the views and desires of local people as to the extent and character of the improvement desired and on the need for construction. After careful consideration of the views of local people, as expressed during the public hearing or otherwise, and after thorough analysis of data obtained through field and office studies, the District Engineer develops a plan of improvement believed to be best suited to the problems under

consideration and the area in question. Estimates of benefits and costs are prepared and the requirements of local cooperation decided upon. Local interests must state whether they will support the proposed improvement and whether they are willing and able to meet the requirements of local cooperation. All these data, together with the recommendations of the District Engineer as to whether the project should be authorized by Congress, are included in the report on the investigation.

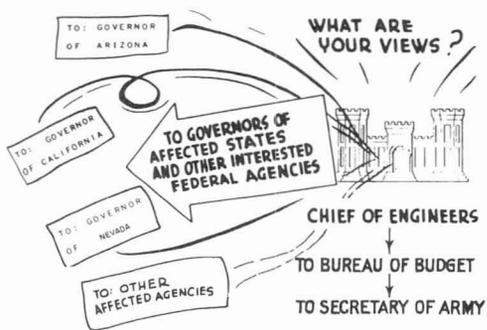
A favorable recommendation by the District Engineer is largely dependent upon acceptance and support of the proposed project by the local people and upon the economic justification of the improvement.



3. The report is submitted to the Division Engineer who reviews and approves the report and transmits it to the Chief of Engineers and the Board of Engineers for Rivers and Harbors for review. All interested parties receive a public notice, which sets forth the findings and recommendations of the District and Division Engineers and informs them that they may present their views on the matter to the Board of Engineers for Rivers and Harbors.

## Introduction — Continued

4. The Board reviews the reports of the District and Division Engineers and carefully considers any additional information received from interested parties. Finally, the



Board prepares its report, including its recommendations, and transmits it to the Chief of Engineers. The Chief of Engineers reviews the reports and all other data and then prepares the report he will submit to Congress. The report is sent to the Governors of the States affected and to other interested Federal agencies in order to obtain their views and recommendations on the improvements discussed in the report. After full consideration of the comments received, the Chief of Engineers then submits the report to the Secretary of the Army. The Secretary of the Army obtains the views of the Bureau of the Budget and transmits the report to Congress.

5. The Committees on Public Works of the House and Senate may hold hearings on the report with a view towards formulating a bill including authorization of projects recommended. If the project is included in an authorization bill, enactment of this bill constitutes authorization of the project.

**CONSTRUCTION CONTRACT IS AWARDED AFTER DESIGNS ARE COMPLETED & FUNDS APPROPRIATED.**



Funds for undertaking authorized projects are not usually provided by the authorizing act, but are supplied by a later appropriation. After authorization, projects are designed and built in accordance with the authorizing acts and such other general laws as may be applicable, at a rate determined by appropriation of funds.

# *Water-Resources Development in Arizona*

## **HISTORY**

The water-resources development program of the Corps of Engineers in Arizona began in 1884, when Congress authorized navigation improvements on the Colorado River. Since that time, the program has been expanded to include numerous projects designed to utilize and develop the water resources of the State by protecting lands and improvements against flood damages and by conserving available water for beneficial uses whenever economically justified.

## **STATUS OF PROJECTS**

For convenience in designating the status of existing projects, they are classified as completed, under construction, or authorized but not started. A summary of projects according to these classifications is tabulated below, their locations are shown on the map bound at the end of this pamphlet, and brief descriptions of individual projects are presented in the text. Detailed information on individual projects may be found in the Annual Report of the Chief of Engineers on civil-works activities.

	<b>Multiple- purpose reservoirs</b>	<b>Flood- control projects</b>	<b>Total</b>
Completed .....	1	4	5
Under construction .....	1	0	1
Authorized but not started .....	1	8	9
Total .....	3	12	15

## **NAVIGATION PROGRAM**

The navigation program of the Corps of Engineers in Arizona provides for participation in maintenance of navigable streams, removal of snags or shoals, and development of marinas for recreational purposes.

## **FLOOD-CONTROL PROGRAM**

The flood-control program of the Corps of Engineers in Arizona will provide for the most urgent needs of urban, suburban, and agricultural areas. Of the 15 flood-control and multiple-purpose projects now authorized for Arizona, 5 projects (1 multiple-purpose reservoir project, 1 flood-control reservoir project, 1 detention-reservoir and channel project, and 2 levee and channel projects) have been completed. These flood-control works have functioned to provide effective flood protection to the project areas. It is estimated that the total accumulated flood damages that have been prevented to date throughout the State of Arizona by Corps of Engineers projects presently completed and in operation are more than \$18,350,000. However, many streams still remain uncontrolled or only partly controlled, and many areas are entirely unprotected or inadequately protected by existing flood-control projects. Although urban centers generally have better protection than rural areas, they are still potentially liable to serious damages from large floods. Comprehensive planning and construction programs must be continued in order to check periodic floods, which not only cause destruction and damage, but also waste to the Gulf of California vast amounts of water that should be conserved for the benefit of the people, agriculture, and industry of Arizona.

## Water-Resources Development in Arizona—Continued

### COOPERATION WITH OTHER AGENCIES IN THEIR PROJECTS

The U.S. Army Corps of Engineers cooperates with other Federal agencies and with State and local agencies in any of their programs related to Corps of Engineers responsibilities. For example, the 1944 Flood Control Act assigned to the U.S. Army Corps of Engineers the responsibility of formulating rules and regulations for the use of space allocated to flood control at all reservoirs constructed wholly or in part with Federal funds. Brief descriptions of Corps cooperation with other agencies' projects in Arizona are given later in the text of this pamphlet.

### INVESTIGATIONS AND REPORTS

(a) **General.** As indicated in the introduction to this pamphlet, detailed investigation of potential water-resources development projects is an essential part of their authorization for construction. Congress has directed that the Corps of Engineers make investigations and prepare reports on numerous proposed improvements in Arizona. Many of these investigations and reports have been completed and submitted to Congress. Others are in progress and, as funds are made available, the remainder will be completed and submitted to Congress for its decision on authorization. In addition, many special investigations and reports are required as bases for authorization of small flood-control and navigation projects and in connection with research-and-development projects.

(b) **Coordination with other agencies.** Water-resource development planning requires a high degree of complex coordination with numerous other agencies. For this purpose, a number of inter-agency committees have been established. For coordination on a regional basis, the Pacific Southwest Inter-Agency Committee on Water Resources is composed of representatives from six Federal agencies and nine Southwestern States. At meetings held about every 3 months, each member agency briefs the others on what it has done and what it proposes to do.

(c) **Status of investigations and reports.** For convenience in designating the status of investigations and reports, they are classified as completed, under preparation, or authorized (inactive or not started). A summary of investigations and reports is tabulated below, and brief descriptions of individual investigations are presented in the text.

	Type of investigation		Total
	Flood control*	Framework	
Completed but not yet—			
Submitted to Congress .....	0	0	0
Acted on by Congress .....	0	0	0
Under preparation .....	3	0	3
Authorized (inactive or not started) .....	4	2	6
Total .....	7	2	9

\*And related purposes.

### COMPREHENSIVE FRAMEWORK STUDIES

The overall purpose of the comprehensive framework studies will be to assess and project the total needs of the State of Arizona against the total resources of the State, plus such resources now available from outside the State as may have been established by decision of the U.S. Supreme Court. The comprehensive framework studies planned for the upper Colorado River basin and the lower Colorado River basin will provide economic projections of economic development, translation of such projections into demands for

## **Water-Resources Development in Arizona—Continued**

water and related land-resource uses, hydrologic projections of water availability both as to quantity and quality, and projections of related land-resource availability, so as to outline the characteristics of projected water and related land-resources problems and the general approaches that appear appropriate for their solution. It is expected that the framework studies will provide general guides to future water-resource development. The studies will be accomplished through the coordinated efforts of Federal and State agencies.

### **FLOOD-PLAIN-INFORMATION STUDIES**

In Arizona, flood-plain-information studies are under way for streams in Maricopa County. Brief descriptions of these studies are presented later in the text of this pamphlet.

### **EMERGENCY WORK**

Emergency work consists principally of flood-fighting activities, repair of structures damaged by floods, and snagging and clearing operations. About \$245,000 has been spent on emergency work by the Corps of Engineers in Arizona. Unlike authorization for new construction, continuing congressional authorization permits immediate undertaking of this work as required by emergency situations that have developed or to prevent predicted emergency situations from arising.

The Corps of Engineers also repairs and restores flood-damaged facilities at the request of the Office of Emergency Planning, which — acting under powers delegated by the President — coordinates all disaster-relief functions of Federal agencies during major disasters.

Brief descriptions of emergency work in Arizona are presented later in the text of this pamphlet.

### **MAINTENANCE AND OPERATION OF COMPLETED PROJECTS**

Along with the State of Arizona and other local interests, the Corps of Engineers performs maintenance and operation of completed projects. Local interests generally assume responsibility for maintenance and operation of levee and channel-improvement projects. Navigation projects and reservoirs are generally the responsibility of the Corps of Engineers for operation and routine repairs and replacement. The Federal cost of this activity for completed projects in Arizona was about \$42,000 in fiscal year 1966.

# Completed Multiple-Purpose Reservoir Project

## PAINTED ROCK RESERVOIR

The Painted Rock Reservoir, which was authorized by the Flood Control Act of 17 May 1950, was completed in December 1959.

The reservoir is formed by a dam on the Gila River at river mile 126 (about 20 miles northwest of Gila Bend).

Physical data on the improvements are:

Dam (earthfill):		
Height.....	feet.....	181
Crest length .....	feet.....	4,796
Reservoir:		
Gross capacity .....	acre-feet.....	2,491,700
Design peak flow:		
Inflow, maximum .....	cubic feet per second.....	300,000
Outflow, maximum .....	cubic feet per second.....	22,500



**View of Painted Rock Dam during a topnotch performance—when water impounded by dam in January 1966 flood formed a lake 7 miles long, 3 to 4 miles wide, and 54 feet deep at dam.**

## Completed Multiple-Purpose Reservoir Project—Continued

The reservoir provides protection from floods originating above the reservoir site to about 360,000 acres in the downstream overflow area along the Gila River from the damsite to the Colorado River, along the Colorado River from Laguna Dam to Mexico, and in the Imperial Valley, Calif. About 200,000 acres of intensively developed irrigated land are in the overflow area. In addition, about 100,000 acres of intensively developed irrigated land outside the overflow area are protected from damage caused by the irrigation-service disruption that would occur if the Gila and the All-American canals were damaged by floods originating upstream from the reservoir.

In addition to those benefits that have been evaluated in monetary terms, Painted Rock Reservoir will produce other large benefits by reducing the sediment load that enters the Colorado River from the Gila River. Completion of Painted Rock Reservoir was assumed in the design of the levees along the lower Colorado River by the U.S. Bureau of Reclamation and the International Boundary and Water Commission — with resultant reduction in height and cost of these levees.

Painted Rock Reservoir is being developed as a recreational and game-management area by the Arizona Game and Fish Department, as follows: (a) under license by the Secretary of the Army for lands owned in fee by the U.S. Department of the Army and (b) under withdrawal agreements with the U.S. Bureau of Land Management for public-domain land on which the U.S. Department of the Army has only flowage rights and with the State of Arizona for State-owned land on which the U.S. Department of the Army has only flowage easements.

The Federal first cost of the project was about \$19,189,000 (1966). No local contribution was required for construction of the project.

If a project design flood should occur, Painted Rock Reservoir would prevent damages estimated at \$74,000,000 (1966). Since its construction, the project has prevented damages estimated at \$17,500,000 (1966). This project is an important unit under the overall flood-control plan for the lower Colorado River. The plan was formulated as a result of studies that were authorized by the Mexican Water Treaty of 1944.

# Completed Flood-Control Projects

## HOLBROOK LEVEE

The Holbrook levee, which was authorized by the Flood Control Act of 22 December 1944, was completed in December 1948.

The levee, along the north bank of the Little Colorado River at Holbrook, protects about 95 percent of the city of Holbrook from floods.

Physical data on the improvements are:

Drainage area above levee.....square miles.....	11,400
Length of levee.....feet.....	6,200
Design capacity.....cubic feet per second.....	60,000

The total Federal first cost of the project was about \$335,000. The costs of meeting requirements of local cooperation for construction of the project amounted to \$8,000.

Flood damages prevented by the project since its construction are estimated at \$150,000 (1966). The project would prevent damages estimated at \$1,010,000 (1966) if a project design flood should occur.

## TRILBY WASH DETENTION BASIN (McMICKEN DAM) AND OUTLET CHANNEL

The Trilby Wash detention-basin and outlet-channel project, which was authorized for construction by the Secretary of the Air Force by Public Law 209, Eighty-third Congress, 1st session, approved 7 August 1953, was completed by the U.S. Army Corps of Engineers in July 1956. In November 1956, the dam was dedicated as McMicken Dam.



A summer's view of outlet works of Trilby Wash detention basin—where winter's turbulent floodwaters are calmed in the stilling basin and released through the outlet channel.

## Completed Flood-Control Projects—Continued

The project includes a detention basin on Trilby Wash about 20 miles west of Phoenix, Ariz., and a leveed outlet channel to convey flood releases from Trilby Wash detention basin toward the Agua Fria River.

The project provides complete protection from floods originating upstream from the detention basin to the Luke Air Force Base, the Litchfield Park Naval Air Facility, the Goodyear Aircraft Co. plant, and the towns of Goodyear, Litchfield Park, and Avondale, and to about 50,000 cultivated acres of intensively developed agricultural land.

Physical data on the improvements are:

Dam (earthfill):		
Maximum height .....	feet.....	34
Crest length .....	feet.....	50,200
Detention basin:		
Gross capacity (1956).....	acre-feet.....	19,300
Channel:		
Levee height (average).....	feet.....	8.5
Length .....	miles.....	5.8

The total Federal first cost of the project was about \$1,822,000. The costs of meeting requirements of local cooperation for construction of the project amounted to \$241,000.

Flood damages prevented by the project since its construction are estimated at \$600,000 (1966). The project would prevent damages estimated at \$5,900,000 (1966) if a project design flood should occur.

### TUCSON DIVERSION CHANNEL

The Tucson diversion channel, which was authorized by the Flood Control Act of 30 June 1948, was completed in April 1966. The project, which is a diversion-channel improvement to intercept flows from the upstream part of the Tucson Arroyo drainage area (including the upstream part of the Railroad Wash drainage area) and divert those flows around the southern edge of Tucson to Julian Wash and thence to the Santa Cruz River, includes (a) a modified existing detention basin to reduce those peak discharges of Tucson Arroyo and Railroad Wash flows that are being diverted into Julian Wash and (b) levee and channel improvements.

Physical data on the project are:

Channel improvements:		
Interceptor levees .....	miles.....	2.3
Diversion channel .....	miles.....	5.1
Inlet channel .....	feet.....	1,500
Design capacity:		
Interceptor levee .....	cubic feet per second.....	3,500- 9,900
Diversion channel to detention basin .....	cubic feet per second.....	9,900-15,300
Channel (basin to Julian Wash) .....	cubic feet per second.....	9,300
Channel (at Julian Wash and downstream) .....	cubic feet per second.....	17,600-17,800

The improvement would provide protection for (a) intensively developed areas in the downstream part of the Tucson Arroyo drainage area from standard project floods originating upstream from the diversion channel and (b) intensively developed areas

## Completed Flood-Control Projects—Continued

along Julian Wash from diverted floodflows as well as from standard project floods on Julian Wash.

The latest (1965) estimate of Federal first cost for the project is \$5,900,000. The latest (1965) estimate of the non-Federal first cost for this work is \$2,940,000.

The completed project will prevent damages estimated at about \$12,900,000 (1966) if a project design flood should occur.

### WHITLOW RANCH RESERVOIR

The Whitlow Ranch Reservoir, which was authorized by the Flood Control Act of 24 July 1946, was completed in November 1960.

The reservoir is formed by a dam on Queen Creek at stream mile 43, approximately 40 miles southeast of Phoenix.

The project provides flood protection to an area of 142,000 acres, of which 92,000 acres are highly developed irrigated lands in the Queen Creek irrigation district, the Roosevelt water-conservation district, the Salt River project, and the San Carlos project.



Whitlow Ranch Dam flings out broad arms to hold back floodflows on Queen Creek.

### Completed Flood-Control Projects — *Continued*

Physical data on the improvements are:

Drainage area above dam.....	square miles.....	143
Dam (earthfill):		
Maximum height .....	feet.....	149
Crest length .....	feet.....	837
Reservoir:		
Gross capacity.....	acre-feet.....	35,890
Design peak flow:		
Inflow .....	cubic feet per second.....	110,000
Outflow .....	cubic feet per second.....	1,000

The reservoir is operated primarily for flood control. However, retardation of flood-flows permits the percolation of all runoff from most floods into the underground storage basins along the channel. Furthermore, consideration is being given to development of Whitlow Ranch Reservoir as a recreational area.

The Federal first cost of the project was about \$1,867,000. No local cooperation was required for construction of the project. The project would prevent damages estimated at about \$10,200,000 (1966) if a project design flood should occur. Since its completion, the project has prevented flood damages estimated at about \$1,000,000 (1966).

# *Multiple-Purpose Reservoir Project* *Under Construction*

## **ALAMO RESERVOIR**

Alamo Reservoir was authorized by the Flood Control Act of 22 December 1944.

The project is under construction on the Bill Williams River, about 39 miles upstream from the junction of the Bill Williams and Colorado Rivers.

Physical data on the improvements are:

Drainage area above dam.....	square miles.....	4,770
Dam (earthfill) :		
Height .....	feet.....	283
Crest length .....	feet.....	952
Reservoir:		
Gross capacity .....	acre-feet.....	1,043,000
Design peak flow:		
Inflow .....	cubic feet per second.....	317,000
Outflow .....	cubic feet per second.....	7,000

The principal benefits from the construction of Alamo Reservoir would result from the protection of life and property along the lower Colorado River from floods on the Bill Williams River. In addition, substantial irrigation benefits would result from water-conservation storage to be provided in the reservoir, and substantial public-access benefits would result from recreational facilities to be provided at the reservoir site. Intangible benefits would result from the reduction of sediment inflow into Lake Havasu. The project would provide protection against floods to an overflow area comprising about 230,000 acres of land along the Colorado River from Parker Dam to the international boundary.



**Massive construction equipment assumes antlike proportions in the vast  
expanse required for the task of constructing Alamo Dam.**

**Note intake structure in left foreground.**

**Multiple-Purpose Reservoir Project Under Construction—Continued**



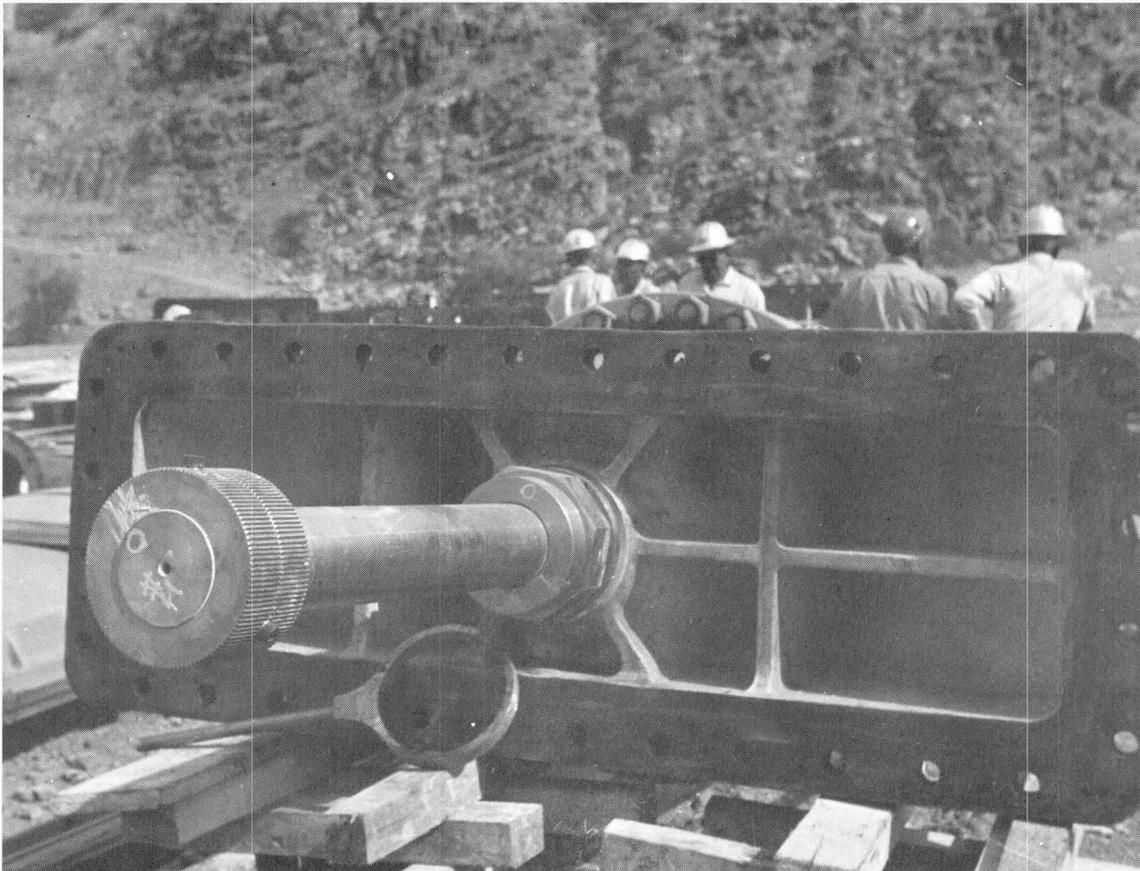
**The monolithic proportions of the Alamo Reservoir intake structure at this stage in construction remind the viewer of ancient monuments whose history lies buried in antiquity.**

## Multiple-Purpose Reservoir Project Under Construction — *Continued*

Completion of Alamo Reservoir was assumed in the design of the improvements along the lower Colorado River by the U.S. Bureau of Reclamation and the International Boundary and Water Commission—with resultant reduction in cost of those improvements.

The latest (1966) approved estimate of Federal first cost for the project is \$14,500,000. No local cooperation is required for the construction of the project. However, except for initial public-access facilities to be constructed by the Corps, recreational improvements would be constructed by local interests. Consideration is being given to development of Alamo Reservoir as a recreational and game-management area by the Arizona Game and Fish Department under a lease by the Secretary of the Army.

The project would prevent damages estimated at about \$26,400,000 (1966) if a project design flood should occur.



Like an artillery piece with its steel-helmeted crew behind it, this massive hydraulic cylinder awaits emplacement in the Alamo Dam control structures. The cylinder, designed specifically for the dam, will lift 400 tons. Six cylinders are built into the dam works—each cylinder operates a water-control gate.

# *Authorized Multiple-Purpose Reservoir Project Not Started*

## SANTA ROSA WASH, ARIZ. (TAT MOMOLIKOT RESERVOIR)

Tat Momolikot Reservoir is part of the Santa Rosa Wash project, which was authorized by the Flood Control Act of 27 October 1965. The project plan provides for (a) a multiple-purpose reservoir on Santa Rosa Wash at the Tat Momolikot site (stream mile 43.4) and about 6½ miles upstream from the Indian village of Vaiva Vo and (b) the development of 1,640 acres of cultivated land in the Vaiva Vo irrigation project on the Papago Reservation downstream from the dam.

The water-supply distribution system under the project plan would consist of (a) a main supply canal that would receive water from the dam and would deliver water to laterals in the area proposed for irrigation development; (b) 13 wells and pumps along the laterals and the main canal to utilize the ground-water supplies; and (c) ponds at the upper end of the main canal to increase the ground-water recharge. These ponds would also be used as fish ponds. Recreation and hunting facilities would be located in the reservoir area and in the area of the fish ponds.

Physical data on Tat Momolikot Reservoir are:

Drainage area above dam.....	square miles.....	1,750
Dam (earthfill):		
Height .....	feet.....	66
Crest length .....	miles.....	3
Reservoir:		
Gross capacity .....	acre-feet.....	181,000
Design peak flow:		
Inflow .....	cubic feet per second.....	55,000
Outflow .....	cubic feet per second.....	4,600

The principal benefits from construction of the Santa Rosa Wash project including Tat Momolikot Reservoir would result from (a) the prevention of flood damage to about 46,000 acres of cultivated land and to irrigation systems, the towns of Stanfield and Maricopa, and several Indian villages by controlling a stream that constitutes one of the major flood threats in the lower Santa Cruz River basin; (b) the full development of the water-supply potential of Santa Rosa Wash within the Papago Indian Reservation; (c) the area redevelopment in the Papago Indian Reservation, where underemployment currently exists; and (d) the development of the recreational and fish-and-wildlife potentialities of the area.

The latest (1966) approved estimate of Federal first cost for the project is \$7,760,000 including a first cost of \$1,250,000 for irrigation, recreational, and fish-and-wildlife improvements by the Bureau of Indian Affairs. No local contribution is required for construction of the project.

The project would prevent damages estimated at about \$7,400,000 (1966) if a project design flood should occur.

# *Authorized Flood-Control Projects Not Started*

## **CAMELSBACK RESERVOIR**

The Camelsback Reservoir was authorized by the Flood Control Act of 23 October 1962.

The plan of improvement provides for the construction of a flood-control dam on the Gila River at the Camelsback site in Graham County, about 8 miles upstream from the head of Safford Valley and about 8 miles downstream from the mouth of the San Francisco River.

Physical data on the project are:

Drainage area above dam.....square miles.....	7,500
Dam (earth and rockfill) :	
Height .....feet.....	284
Crest length .....feet.....	1,140
Reservoir :	
Gross capacity .....acre-feet.....	283,000
Design peak flow :	
Inflow .....cubic feet per second.....	175,000
Outflow .....cubic feet per second.....	120,000
60 percent of design flood :	
Inflow .....cubic feet per second.....	105,000
Outflow .....cubic feet per second.....	15,800

The project would provide a high degree of protection against floods to Safford Valley: The average annual flood damages over a 50-year period in Safford Valley would be reduced by about 75 percent. This protection is in addition to that provided by the authorized middle Gila River channel improvements (clearing), which are discussed in subsequent paragraphs. With completion of the reservoir and the channel improvements, significant flooding in Safford Valley would be unlikely to occur more often than on an average of once in about 14 years. Construction of the reservoir would not be initiated until construction of the channel improvements is assured.

The latest (1966) approved estimate of Federal first cost for the project is \$13,000,000. No local cooperation is required for construction of the project.

The project would prevent damages estimated at \$2,750,000 (1966) if a project design flood should occur.

## **GILA AND SALT RIVERS LEVEE AND CHANNEL IMPROVEMENTS**

The Gila and Salt Rivers levee and channel improvements were authorized by the Flood Control Act of 14 July 1960. Advance planning on the project has been suspended pending final resolution of local interests' financial capability to participate in the project.

The plan of improvement provides for (a) a levee along the left bank of the Salt River near Tempe, Ariz.; (b) a levee along the right bank of the Salt River at Phoenix, Ariz.; (c) a floodway cleared of phreatophytes along the Salt and Gila Rivers from Granite Reef Dam to Gillespie Dam; and (d) two low-flow channels.

The improvement would provide complete protection against the standard project flood (290,000 c.f.s. at McDowell damsite and 350,000 c.f.s. at Gillespie Dam) for most of the city of Tempe and part of the city of Phoenix and partial protection for additional

## Authorized Flood-Control Projects Not Started—Continued

areas in Phoenix, for adjacent developed areas, and for other areas along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam. Because of the clearing of phreatophytic growth from the floodway, the improvement would also result in a net annual increase of 16,000 acre-feet of water available for agriculture.

Physical data on the project are:

Channel improvements (Salt River):		
Levee (downstream of Tempe Butte).....	feet.....	2,000
Levee (upstream of 40th St., Phoenix).....	feet.....	16,700
2,000-foot-wide floodway (Granite Reef Dam to Gila River).....	miles.....	43
Low-flow channel (near Tempe).....	miles.....	1.7
Channel improvements (Gila River):		
2,000-foot-wide floodway (Salt River to Gillespie Dam).....	miles.....	34
Low-flow channel (upstream of Gillespie Dam).....	miles.....	28

The latest (1964) approved estimate of Federal first cost is \$2,348,000. The cost of meeting requirements of local cooperation on construction of the project amounts to \$1,512,000.

The project would prevent damages estimated at about \$7,000,000 (1966) if the standard project flood should occur. In addition, the average annual benefits accruing from the removal of phreatophytic growth and the resultant increase in water available for agriculture are estimated at \$156,000 (1966).

### INDIAN BEND WASH

The Indian Bend Wash project was authorized by the Flood Control Act of 27 October 1965. The plan of improvement provides for a concrete-lined channel along Indian Bend Wash from the Arizona canal to the Salt River; two levees upstream from the canal to divert and direct flows into the channel; a siphon system to carry canal flow under the channel; and a gated wasteway to divert canal flow into the channel.

Physical data on the project are:

Drainage area above improvements.....	square miles.....	224
Channel (concrete trapezoidal):		
Length.....	miles.....	7
Capacity.....	cubic feet per second.....	40,000

The project would provide complete protection against floods up to the size of the design flood (40,000 cubic feet per second) to an intensely developed residential area along Indian Bend Wash in and adjacent to Scottsdale. A flood of the magnitude of the design flood—although only about 56 percent of the magnitude of the standard project flood—is more than 2½ times larger than any known flood of record in the area.

The latest (1966) approved estimate of Federal first cost for the project is \$8,440,000. The cost of meeting requirements of local cooperation for construction of the project amounts to \$2,060,000 (1966).

The project would prevent damages estimated at about \$4,150,000 (1966) if the project design flood should occur.

## Authorized Flood-Control Projects Not Started—Continued

### LOWER GILA RIVER LEVEE AND CHANNEL IMPROVEMENTS, DOWNSTREAM FROM PAINTED ROCK RESERVOIR

The lower Gila River levee and channel-improvements project was authorized by the Flood Control Act of 23 October 1962. The downstream end of the project would be about 10 miles east of Yuma. Advance planning on the project has been suspended pending final resolution of local interests' financial capability to participate in the project.

The tentative plan of improvement provides for the construction of levee and channel improvements along the Gila River from Texas Hill to the Gila siphon.

Physical data on the project are:

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Levees (compacted-earthfill) :		
Right bank .....	miles.....	49
Left bank .....	miles.....	50
Channel (trapezoidal) :		
Base width, total .....	feet.....	750
Base width, cleared floodway.....	feet.....	500
Design flood (at Dome, Ariz.).....	cubic feet per second.....	50,000

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The proposed improvements would be part of a coordinated plan that includes (a) the flood-control improvements authorized for construction by the Bureau of Reclamation downstream from the Gila siphon and (b) the protective works already constructed by the Bureau of Reclamation along the tributaries of the Gila River.

The latest (1965) approved estimate of Federal first cost is \$20,900,000, and the latest (1965) approved estimate of non-Federal first cost is \$860,000.

The project would prevent damages estimated at \$21,800,000 (1966) if a project design flood should occur.

### MIDDLE GILA RIVER CHANNEL IMPROVEMENTS, UPPER END OF SAFFORD VALLEY TO BUTTES RESERVOIR SITE

This project was authorized by the Flood Control Act of 3 July 1958 as one of the units under a comprehensive plan for the development of the Gila River upstream from the Salt River. Other units include Camelsback Reservoir, which was authorized by the Flood Control Act of 23 October 1962, and Buttes Reservoir, which is subject to further detailed study and specific authorization. Advance planning on the middle Gila River channel improvements has been completed. However, work on the project is now suspended pending finalization of assurances from local interests.

The plan of improvement provides for a cleared floodway extending along the middle Gila River from the upper end of Safford Valley to Buttes Reservoir site.

Physical data on the project are:

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Floodway:		
Clearing along middle Gila River.....	miles.....	94
Area cleared of phreatophytic growth.....	acres.....	14,200
Maximum width .....	feet.....	4,000
Average width .....	feet.....	1,300

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## Authorized Flood-Control Projects Not Started—Continued

The improvement would provide partial protection from floods to areas in the Safford Valley and, because of the removal of phreatophytic growth, would result in a net annual increase of 19,800 acre-feet of water available for agriculture.

The latest (1966) approved estimate of Federal first cost is \$1,350,000. The latest (1966) approved estimate of non-Federal first cost is \$290,000.

Although the project is designed to operate independently of any other flood-control improvement, it is also designed to operate even more effectively in conjunction with Camelsback Reservoir, one of the improvements under the comprehensive plan now under study for development of the Gila River upstream from the Salt River. However, even when operating independently, the project would still prevent (a) average annual damages estimated at \$111,000 (1966) and (b) damages estimated at \$465,000 (1966) if a project design flood should occur. In addition, the average annual benefits accruing from the removal of phreatophytic growth and the resultant increase in water available for agriculture are estimated at \$1,002,000 (1966).

### PHOENIX AND VICINITY (INCLUDING NEW RIVER)

The Phoenix and vicinity (including New River) project was authorized by the Flood Control Act of 27 October 1965. The project plan provides for (a) detention basins on Cave Creek, on an unnamed tributary of Skunk Creek, on the New River, and on Dreamy Draw; (b) the Union Hills diversion channel, the Arizona canal diversion channel, and a diversion channel to divert floods on Skunk Creek to the Adobe detention basin on the unnamed tributary of Skunk Creek; and (c) channel improvements on Cave Creek, on Dreamy Draw, on Skunk Creek, on the New River, and on the Agua Fria River.



Street scene in Phoenix after heavy rains in October 1966. Evidently, the garage owner was farsighted in naming his business.

## Authorized Flood-Control Projects Not Started—Continued

The plan of improvement provides for controlling as much of the floodflow as possible in the drainage area involved, for diverting residual flows in Deer Valley and Cave Creek to Skunk Creek, and for improving Skunk Creek, the New River, and the Agua Fria River to accommodate those residual flows.

Physical data on the project are:

Drainage area .....	square miles.....	2,730
Detention basins (earthfill) :		
Number .....		4
Capacity .....	acre-feet.....	450-39,500
Design flood:		
Peak inflow .....	cubic feet per second.....	2,180-79,000
Outflow .....	cubic feet per second.....	100- 5,400
Diversion channels:		
Number .....		3
Length:		
Concrete .....	miles.....	11.8
Earth .....	miles.....	12.5
Design capacity .....	cubic feet per second.....	1,500-18,500
Channels:		
Number .....		5
Length:		
Concrete .....	miles.....	13.6
Earth .....	miles.....	15.5
Design capacity .....	cubic feet per second.....	100-74,000



A flood seems like fun in this street scene after heavy rains in August 1963 drenched the Phoenix metropolitan area—but this storm caused about \$3,000,000 damage. (Picture courtesy of The Arizona Republic)

## Authorized Flood-Control Projects Not Started—Continued

The project would provide a high degree of protection against floods to about 41,000 acres of mostly urban and agricultural property within the Phoenix metropolitan area.

The latest (1966) approved estimate of Federal first cost for the project is \$64,300,000. The cost of meeting the requirements of local cooperation for construction of the project is estimated at \$13,800,000.

The project would prevent damages estimated at about \$76,500,000 (1966) if the project design flood should occur.

### PINAL CREEK CHANNEL IMPROVEMENTS

The Pinal Creek channel-improvements project was authorized by the Flood Control Act of 23 October 1962. The project is in and near the town of Globe.

The plan of improvement provides for construction of a channel along Pinal Creek at Globe.

Physical data on the project are:

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Channel improvement:	
Inlet wing levees.....	2
Concrete-lined trapezoidal channel..... feet.....	4,100
Concrete-lined rectangular channel..... feet.....	4,600
Transition section and outlet structure..... feet.....	400
Design flood (near McMillen Wash) ..... cubic feet per second.....	16,000

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The design flood — although only about 50 percent of the standard project flood — would be about  $2\frac{1}{3}$  times as large as the 1954 flood, which was one of the largest floods of record along Pinal Creek.

The latest (1966) approved estimate of Federal first cost is \$2,000,000 and the latest (1966) approved estimate of non-Federal first cost is \$340,000.

The project would prevent damages estimated at about \$2,500,000 (1966) if the project design flood should occur. However, although the project will provide protection against floods much greater than the maximum observed in recent years, experience on similar streams in the region indicates that a flood potential exists on Pinal Creek substantially greater than the project design flow. Therefore, local people should consider taking further steps in developing flood-plain regulations as well as flood-warning and emergency measures.

### WINSLOW (LITTLE COLORADO RIVER)

The Winslow (Little Colorado River) project was authorized by the Flood Control Act of 27 October 1965. The project plan provides for two units of improvement.

The first unit of the project would be the Ruby Wash diversion levee, which would be a rock and earth levee extending generally eastward from high ground near the southwest corner of the airport to the Little Colorado River south of the Atchison, Topeka and Santa Fe railroad bridge. Flows in Ruby Wash and in other streams crossing the alinement of the levee would be diverted to the Little Colorado River.

**Authorized Flood-Control Projects Not Started—Continued**

**Summer and sudden thunderstorms often arrive together at Winslow.  
(Pictures courtesy of J. P. Scott, Winslow)**



**Floodwaters endanger homes along Mahoney Street during flood of August 1959.**

**The butcher, the baker, the candlestick maker, and other citizens join forces as flood-fighters along Ice House Wash during flood of August 1959.**



The second unit of the project would be the Ice House Wash channel improvement, which would be partly a rectangular reinforced-concrete channel, partly a leveed trapezoidal channel, and partly an excavated pilot channel. The improved channel would extend generally northward through the city of Winslow from the Atchison, Topeka and Santa Fe railroad tracks to a point near the northern city limits.

Physical data on the project are:

Drainage area above improvements.....square miles.....	26
Ruby Wash diversion levee:	
Length .....miles.....	5.5
Design capacity .....cubic feet per second.....	8,500-23,000
Ice House Wash channel improvement:	
Length .....miles.....	2
Design capacity .....cubic feet per second.....	2,200

## Authorized Flood-Control Projects Not Started—Continued

The project would provide a high degree of protection against floods to residential, commercial, and public property in and adjacent to the city of Winslow. The project would prevent 81 percent of the total damages that otherwise would be expected to occur in the area. The project would also permit local interests to develop an adequate storm-drain system designed to accommodate flows originating downstream from the Ruby Wash diversion levee.

The latest (1966) approved estimate of Federal first cost for the project is \$3,470,000. The costs of meeting the requirements of local cooperation for construction of the project are estimated at \$210,000 (1966).

The project would prevent damages estimated at \$2,730,000 (1966) if a project design flood should occur.

# *Small Flood-Control and Navigation Projects*

Under the provisions of section 205 of the 1948 Flood Control Act (as amended by section 212 of the 1950 Flood Control Act; Public Law 685, 84th Congress, 2d session; and section 205 of the 1962 Flood Control Act), the Corps of Engineers may construct certain small flood-control projects not specifically authorized by Congress when, in the opinion of the Chief of Engineers, such work is advisable. Small flood-control projects are based upon favorable reconnaissance-type investigations and subsequent detailed project reports, which serve as bases for authorization of projects and preparation of project plans and specifications. A favorable reconnaissance-type investigation of flood problems at Willcox, Ariz., and vicinity has been completed. However, further investigation has been suspended pending receipt of local interests' assurances that they will participate in the project.

Under the provisions of section 107 of the 1960 River and Harbor Act (as amended by section 310 of the 1965 River and Harbor Act), the Corps of Engineers may construct certain small navigation projects not specifically authorized by Congress when, in the opinion of the Chief of Engineers, such work is advisable. Small navigation projects are based upon favorable reconnaissance-type investigations and subsequent detailed project reports, which serve as bases for authorization of projects and preparation of plans and specifications. No small navigation investigations have been authorized in Arizona.

Each small flood-control project may not exceed \$1,000,000 in Federal cost, and each small navigation project may not exceed \$500,000 in Federal cost.

Each small project must constitute a complete solution to the problem involved and not commit the Federal Government to additional improvements to insure effective operation. These projects, which are subject to the same requirements of feasibility and economic justification as projects requiring specific congressional authorization, must be coordinated with the State or local agencies concerned. The number of small flood-control and navigation projects is limited by the availability of funds, which are provided annually by Congress on a lump-sum nationwide basis.

No small flood-control or navigation projects have as yet been authorized for Arizona.



**Floods have plagued Willcox for over half a century. Left — Railroad Avenue after 1905 flood. Right — State Route 86 at Jessie Street after 1958 flood.**

## *Cooperation With Other Agencies In Their Projects*

The 1944 Flood Control Act assigned to the U.S. Army Corps of Engineers the responsibility of formulating rules and regulations for the use of space allocated to flood control at all reservoirs constructed wholly or in part with Federal funds. In carrying out that responsibility, the Corps of Engineers — in cooperation with the U.S. Bureau of Reclamation and the U.S. Bureau of Land Management — evaluates the flood-control aspects of reservoirs proposed by those agencies as a basis for determining whether flood-control storage space should be allocated in those reservoirs.

Also, in carrying out the responsibilities assigned by the 1944 Flood Control Act, the Corps of Engineers — in cooperation with the Bureau of Reclamation — has developed rules and regulations for operating flood-control storage at Hoover Dam. Although the Corps of Engineers did not recommend provisions for flood-control storage space in Glen Canyon Reservoir (Lake Powell), upstream from Lake Mead — the reservoir behind Hoover Dam, a study is now being made to determine whether revisions should be made in the rules and regulations for operating flood-control storage at Hoover Dam to reflect a transfer of storage between those reservoirs.

At the request of the Bureau of Reclamation, the Corps of Engineers has completed an evaluation of the flood-control aspects and has recommended flood-control storage for (a) the proposed Buttes Dam, at or near the Buttes site on the Gila River; and (b) the proposed Maxwell (Orme) Dam, at the McDowell site on the Salt River.

# Emergency Work

Emergency work of the U.S. Army Corps of Engineers in Arizona is accomplished under several general congressional authorizations, as well as under Public Law 875, 81st Congress. Emergency work is generally of small scope and usually consists of remedial measures to protect threatened flood-control or navigation structures. Pertinent information on emergency work is given in following paragraphs.

**Emergency flood-control work under general congressional authorizations.** The U.S. Army Corps of Engineers undertakes certain emergency flood-control work under general congressional authorizations and with general funds appropriated annually. Although emergency flood-control projects to which these general authorizations are applicable do not have to be individually authorized, they are subject to the same principles of economic feasibility as are used for specifically authorized projects.

These general congressional authorizations and the emergency work authorized under them fall into three general types, as follows:

**(a) Emergency bank protection.** Under section 14 of Public Law 526, 79th Congress, the U.S. Army Corps of Engineers is authorized (within the limits of available funds) to spend not more than \$50,000 for any one locality during any one fiscal year for the construction of emergency bank-protection works to prevent flood damage to public works, such as highways, bridge approaches, and other essential public works that are endangered by bank erosion. Public works within the meaning of the authorization are considered to be those facilities that serve the general public and that are owned and operated by Federal, State, or local governments.

**(b) Snagging and clearing.** Under section 208 of Public Law 780, 83d Congress, the U.S. Army Corps of Engineers is authorized (within the limits of available funds) to spend not more than \$100,000 for any single tributary during any one fiscal year for the removal of accumulated snags and other debris and for the clearing and straightening of the channels in navigable streams and tributaries thereof when, in the opinion of the Chief of Engineers, such work is advisable in the interest of flood control.

**(c) Flood fighting and repair and rescue work.** Under Public Law 99, 84th Congress, and antecedent legislation, the U.S. Army Corps of Engineers is authorized (within the limits of available funds) to engage in flood fighting and rescue operations and to repair or restore any flood-control works threatened or destroyed by flood, including the strengthening, raising, extending, or other minor modification thereof as may be necessary in the discretion of the Chief of Engineers for the adequate functioning of the work for flood control.



Family transportation became a difficult — though not insurmountable — problem during September 1966 flood in Maryvale.  
(Picture courtesy of U.S. Soil Conservation Service)

## Emergency Work—Continued

Pertinent information on emergency flood-control work already accomplished in Arizona under these general congressional authorizations is given in the following table:

*Emergency flood-control work of the U.S. Army Corps of Engineers in Arizona, under general congressional authorizations*

Location	Type of work	Estimated costs to 30 June 1966
Jerome.....	Clearing of interceptor channel and outlet.	\$16,000
Eloy.....	Repairing levees, revetting levee side slopes, and removing sediment — all on Greens canal.	173,500
Clifton.....	Snagging and clearing on San Francisco River.	11,500
Tucson.....	Emergency bank-protection work:	
	Valencia Road bridge.....	25,000
	City Well No. 12.....	19,000
	Total .....	245,000

**Emergency flood-control (rehabilitation) work under Public Law 875.** In addition to the emergency work just described, the U.S. Army Corps of Engineers performs rehabilitation of flood-damaged facilities at the request of the Office of Emergency Planning. The OEP, acting under powers delegated by the President, coordinates the disaster-relief



The Tempe area resembles an inland sea after flood of January 1966.  
(Picture courtesy of Don Keller, Phoenix)

## **Emergency Work—Continued**

functions of all Federal agencies during major disasters. During such periods, the OEP may request the Corps of Engineers to rehabilitate flood-damaged facilities or perform other disaster-recovery activities.

During the floods of 1965 and 1966, the OEP requested the Corps of Engineers to act in a guidance and advisory capacity for rehabilitation work performed under Public Law 875. In general, the function of the Corps of Engineers was to prepare evaluation reports on requests to OEP for repayment of costs incurred by local interests for rehabilitation work. After the floods of 1965 and 1966, the Corps prepared evaluation reports recommending repayment of about \$823,000 for emergency restoration work done by local interests in the following Arizona counties: Graham County, Greenlee County, Maricopa County, and Pima County.

**Emergency navigation work under general congressional authorizations.** The U.S. Army Corps of Engineers undertakes certain emergency navigation work under general congressional authorizations and with general funds appropriated annually. Pertinent information on these general congressional authorizations and the emergency work authorized under them fall into two general types as follows:

**(a) Removal of wrecks and obstructions.** Under Public Law 189, 55th Congress, the Corps of Engineers is authorized (within the limit of available funds) to investigate wrecked vessels and other obstructions to navigation and to insure removal at the expense of the owner or, under certain specific conditions, at the expense of the Federal Government.

**(b) Snagging and clearing.** Under section 3 of Public Law 14 (1945 River and Harbor Act) and within the limit of available funds, the Corps of Engineers is authorized to remove accumulated snags and other debris and to protect, clear, and straighten channels in navigable harbors and navigable streams and tributaries thereof when, in the opinion of the Chief of Engineers, such work is advisable in the interest of navigation.

No emergency navigation work has been authorized for Arizona.

# *Flood-Plain-Information Studies*

The Flood Control District of Maricopa County has requested that flood-plain-information studies be made of flood-hazard areas in various parts of Maricopa County. Because of the large overall scope of the proposed investigations, the flood-hazard areas to be studied are divided into individual study areas. A separate report will be submitted on each area.

Pertinent information on the reports to be submitted on the flood-plain-information study areas in Maricopa County is given in the following table:

*Pertinent information on reports for flood-plain-information study areas  
in Maricopa County, Arizona*

Priority of report	Study area under consideration	Approximate completion date
1.....	Indian Bend Wash .....	(*)
2.....	Cave Creek .....	(*)
3.....	Skunk Creek .....	(*)
4.....	Wickenburg .....	(*)
5.....	New River .....	1967
6.....	Agua Fria River .....	1967
7.....	Sand Tank Wash .....	1968
8.....	Hassayampa River .....	1970
9.....	Centennial Wash .....	1971
10.....	Waterman Wash .....	1971

\*Report has been completed, and copies of the report have been supplied to the Flood Control District of Maricopa County for its guidance.

# *Investigations and Reports*

## *For Navigation, Flood Control and Related Purposes, Comprehensive Framework Studies, and Special Investigations*

Investigations and reports on potential projects are the foundation of the civil-works program of the Corps of Engineers. As briefly described in the introduction to this pamphlet, such investigations must usually be authorized by Congress. They consist primarily of engineering and economic studies leading to conclusions and recommendations upon which Congress can base action on authorization of Federal water-resources development projects. The processing of authorized investigations is controlled by policies and procedures established for guidance of the Corps of Engineers.

Congress has directed that investigations and reports for flood control and drainage include consideration of allied water-use problems. Thus, in addition to the study of flood damages and means for their reduction, careful consideration is given to the possibility of developing projects that will provide water for irrigation, domestic and industrial use, and generation of hydroelectric power; improve conditions affecting navigation and fish and wildlife; prevent saltwater intrusion; develop recreational resources; enhance land values; or improve other conditions related to the control and use of water. Consequently, multiple-purpose projects are developed that not only provide a high degree of flood protection, but also serve one or more of the other purposes mentioned above. Normally, the cost of multiple-purpose projects is significantly less than the total cost of separate, single-purpose projects that would provide comparable benefits. Costs allocated to purposes other than flood control are borne by the interests desiring inclusion of those additional features in the project plans unless such purpose is of national significance.

Information pertaining to authorized investigations for locations in Arizona is given in the following tabulation. Many of the investigations have indefinite completion dates because such work is dependent upon future allocation of funds.

### **PLANNING FOR FLOOD CONTROL AND RELATED PURPOSES**

Pertinent information on authorized investigations for flood control and related purposes in Arizona is given in the following table:

Area under investigation	Purpose	Approx. completion date
Colorado River and tributaries above Lee Ferry (mostly in States other than Arizona)	To determine the advisability of improvements for flood control and related purposes.	Indefinite
Gila River and tributaries	To determine the advisability of improvements for flood control and related purposes. A series of interim reports is planned.	Indefinite
Glendale-Maryvale and South Phoenix, Gila River basin	To determine the advisability of channel and detention-basin improvements. Review report.	1967
Salt River, Gila River basin	To determine the advisability of flood-control storage in the proposed Maxwell (Orme) Reservoir and channel improvements on Salt River. Review report.	1967

## Investigations and Reports—Continued

Santa Cruz River, Gila River basin	To determine the advisability of improvements for flood control and related purposes. Interim report in cooperation with U.S. Bureau of Reclamation, which is conducting a feasibility study of the San Pedro and Santa Cruz Rivers.	1970
Upper Gila River, Gila River basin	To determine the advisability of improvements for flood control and related purposes. Review report.	Indefinite
Virgin River and tributaries (mostly in States other than Arizona)	To determine the advisability of improvements for flood control and related purposes.	Indefinite

### COMPREHENSIVE FRAMEWORK STUDIES

A comprehensive framework study has been authorized for the upper Colorado River basin and for the lower Colorado River basin. The studies are scheduled for initiation in fiscal year 1967.

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