THE WORK OF THE CORPS OF ENGINEERS

IN NEW MEXICO

By

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The work of the Corps of Engineers in New Mexico involves both Civil and Military installations. For the purpose of this seminar the discussion will be limited to the Civil Works program.

The Civil Works program is primarily concerned with water resources development. It is comprehensive in scope. The principal activities in the State of New Mexico relate to flood and sediment control, major drainage, water conservation for domestic, industrial, and irrigation use, pollution abatement, fish and wildlife conservation, and recreational development of multiple-purose reservoirs constructed for flood control and allied purposes. Navigation is not considered feasible in the State. These functional activities are coordinated with the work of other Federal, State, and local agencies carrying out related programs to avoid any unnecessary duplication of work and to insure that the improvement proposed will satisfy all needs to the fullest extent.

One of the primary responsibilities of the Corps of Engineers is to initiate emergency action before and during floods,whether of a localized nature or of major national concern, especially when local agencies normally responsible are unable to cope with the situation. The Congress, through general and special laws, has authorized the expenditure of certain funds for rescue work, flood fighting, and the repair and restoration of levees and other flood control structures damaged or destroyed by floods. Close cooperation is maintained with local interests by periodic inspection of their levee systems to detect possible future failures, and in addition, maintenance methods are suggested to improve the degree of flood protection.

The water development program of the Corps of Engineers is logically on a watershed basis, and since New Mexico includes portions of several different watersheds there are as many

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development programs in the State. The Continental Divide passes entirely through New Mexico from north to south. About one-sixth of the State is on the western slope of the Divide, in the watershed of the Colorado River. This watershed is under the jurisdiction of the Los Angeles District, which is in the South Pacific Division of the Corps of Engineers. The part of the State east of the Continental Divide is all in the Southwestern Division of the Corps of Engineers. This part is further divided into three districts. The Albuquerque District includes the watersheds of the Canadian River and a very small part of the Purgatoire River, both of which are tributary to the Arkansas River; and the Rio Grande and its major tributary, the Pecos River, which drain the entire central portion of the State. Also included is the small closed basin of the Mimbres River in south central New Mexico. Tributaries of the Arkansas River, including the watersheds of the North Canadian and Cimarron Rivers, lie in the northeast section, and together with tributaries of the Canadian and Red Rivers which rise in New Mexico but which enter the main stems below the New Mexico-Texas State line, comprise that part of New Mexico under the jurisdiction of the Tulsa District. A relatively small part of southeastern New Mexico lies in the watersheds of the Colorado (Texas) and Brazos Rivers. These watersheds are under the jurisdiction of the Fort Worth District.

RIO GRANDE WATERSHED

The Rio Grande drainage area above the New Mexico-Texas State line is about 38,960 square miles, of which about 31,480 square miles lie in New Mexico. The principal tributaries of the Rio Grande, lying wholly within New Mexico, are the Rio Chama, Rio Galisteo, Jemez Creek, Rio Puerco, and Rio Salado. The main stem and tributaries of Rio Grande in New Mexico are either entrenched in deep canyons or are confined to alluvial valleys that vary in width from one-fourth to four miles, and in length from a few miles to more than 100 miles. There are three notable valleys along the main stem: Espanola (upper) Valley, about 30 miles long; Middle Valley, about 165 miles long; and Lower Valley, about 110 miles in length. Within these valleys are some of the State's most densely populated areas, including Albuquerque, Belen, Socorro, Truth or Consequences, and Las Cruces. Industries, transportation and communication facilities, and highly developed agricultural areas are also concentrated along the Rio Grande.

Over the past years, deposition of large quantities of sediment brought down by floods on tributaries has caused a gradual building-up of the Rio Grande channel through the valley reaches. At the present time in Espanola and Middle Valleys the stream bed is as high as, and in many locations, higher than the adjacent valley floor. As a result, the developed areas in the valleys are subject to damage from major floods on Rio Grande. Also the accumulation of sediment in the stream bed has encouraged and promoted the growth of native vegetation which pirates vast quantities of water.

In 1943, the Corps. of Engineers water resources development program was initiated in the Rio Grande watershed in accordance with Section 4 of the Flood Control Act of 1941. After four years of intensive study, in coordination with the Department of the Interior, Department of Agriculture, Federal Power Commission, the Rio Grande Compact Commission, the States of Colorado, New Mexico, and Texas, Middle Rio Grande Conservancy District, and other interested Federal and State agencies, a comprehensive plan was developed for the basin. The plan of development provided generally for flood control and major drainage, sediment control, rehabilitation of the Middle Rio Grande Conservancy District, power development, recreational development, fish and wildlife development, watershed improvement program, improvement of Indian lands, and other collateral improvements.

The flood control phase of the comprehensive plan which was authorized by the Flood Control Act of 1948, provides for flood and sediment control reservoirs on the Rio Chama and Jemez Creek; Rio Grande Floodway through the Espanola and Middle Valleys, including levee rehabilitation and channel rectification in the vicinity of Truth or Consequences; and the Bluewater Floodway.

The following is a brief description of the individual projects, their present status, and relationship to the comprehensive plan of development.

Project Completed

THE JEMEZ CANYON DAM AND RESERVOIR is the first unit to be completed of the flood control phase of the comprehensive plan for the Rio Grande basin in New Mexico, which was authorized by the Flood Control Act of 1948. The dam is located on Jemez Creek about 2 miles above its confluence with the

Rio Grande, near the town of Bernalillo in Sandoval County. Bernalillo is 17 miles north of Albuquerque. The structure is an earthfill dam, 780 feet long, rising to a height of 136 feet above the stream bed. Flood releases are regulated by a gate-controlled conduit, 13 feet in diameter. The dam is protected against overtopping by an uncontrolled off-channel spillway 400 feet long, located about a mile to the south of the dam. An earthen levee about 2,900 feet long prevents backwater from entering the Santa Ana Indian Pueblo which is near the upstream end of the reservoir area. The primary purpose of the project is to provide a reservoir to trap sediment and for the detention and regulation of floods on Jemez Creek, thereby aiding in the prevention of flood damages and aggradation in the Middle and Lower Valleys of the Rio Grande. The reservoir controls the runoff from an area of about 1,034 square miles. The storage capacity at spillway crest is about 120,000 acre-feet, 73,000 of which is reserved for flood control use and 47,000 for deposition of sediment.

Construction was initiated in May 1950, and completed in October 1953. The cost of the project was $4,055,627, which is about $2,800,000 less than the original estimate. The flood control and other benefits which will accrue to the flood control phase of the comprehensive plan, of which the Jemez Canyon Dam and Reservoir is an integral part, are estimated at $5,200,000 annually.

Jemez Canyon Reservoir will be emptied as soon as practicable after each flood and as it will be dry 70 percent of the time, it will afford no opportunity for water-associated recreational activity. However, an overlook shelter, and other public use facilities including picnic tables, barbecue pits, and comfort stations have been provided.

Project Under Way

THE RIO GRANDE FLOODWAY authorized by the Flood Control Act of 1948 will be located along three separate reaches of the Rio Grande. In downstream order, the first reach will extend through the Espanola Valley, the second reach through the Middle Valley from Cochiti to the upstream end of Elephant Butte Reservoir, and the third reach will be between Elephant Butte Dam and the upstream end of Caballo Reservoir.

The project will include rehabilitation and enlargement

of existing levees and construction of supplemental levees where necessary. Also, it will include the construction of levee protection works and channel dredging. The ultimate objective is a deeper, stabilized channel that will safely pass floods that cannot be controlled by upstream reservoirs and provide a solution to the problem created by the rising water table throughout the valley.

In accordance with an agreement reached between the Secretary of the Army and the Secretary of the Interior in 1947, it is the responsibility of the Corps of Engineers to construct and rehabilitate levees and provide the necessary bank and levee protection works. Channel rectification, dredging, and the rehabilitation of existing drainage and irrigation facilities is the responsibility of the Bureau of Reclamation.

About 30 miles of the channelization program under the direction of the Bureau of Reclamation has been completed in the San Marcial area and planning and some construction is under way for the remainder.

Construction of the first phase of the Rio Grande Floodway, consisting of a system of levees to protect the city of Albuquerque and its environs, was initiated in May 1954 by the Corps of Engineers. This levee system when completed will afford protection to the city from floods up to 42,000 cubic feet per second on Rio Grande. The levee will have a total length of about 27 miles, of which about 18 miles will be built along the east bank of the river to protect the principal business and industrial sections of the city as well as a large segment of the residential district. Another 9 miles will be constructed along the west bank of the river to protect an urban and suburban area located on the west side. The levee will have an average height of 10 feet, a crown width of 12 feet, and 1 on 2.5 side slopes. Flexible-type levee protection works will be provided in the critical areas that are vulnerable to scour and cutting during floods. This phase will be substantially complete by July 1956.

The estimated cost of construction of the levees protecting Albuquerque (first phase of the floodway) is $3,529,000. The average annual benefits expected to accrue to the Albuquerque Unit are included in the benefits of $5,200,000 which are expected to accrue annually to the entire flood control phase of the comprehensive plan.

Authorized Projects

THE CHAMITA RESERVOIR PROJECT (ABIQUIU AND LOW CHAMITA DAMS) was authorized by the Flood Control Act of 1948 as a unit in the flood control phase of the comprehensive plan for the Rio Grande basin in New Mexico. The authorized plan originally provided for a high dam on Rio Chama in Rio Arriba County, 5 miles upstream from its confluence with the Rio Grande and about 6 miles northwest of Espanola. However, as a result of additional studies a more economical plan which will effect a savings of $8,800,000 has been substituted for the authorized plan. The adopted plan consists of Low Chamita Dam and Abiquiu Dam. Low Chamita Dam will be located at the site of the authorized high Chamita Dam and Abiquiu Dam, a high structure, will be located near the town of Abiquiu on Rio Chama about 25 miles upstream from the Chamita site. Together these reservoirs will control 3,126 square miles of drainage area and will have a total controlled storage of 700,000 acre-feet, as contemplated in the authorizing legislation. Since the Abiquiu project is the upstream dam, it will be constructed first in order to provide the greatest initial benefit from the substitute plan.

The Abiquiu Dam will control 2,147 square miles of drainage area or about two-thirds of the total project drainage area. It will be an earthfill structure about 1,500 feet long which will rise 325 feet above stream bed. It will be the fourth highest earth dam in the world and the second highest earth dam to be built by the Corps of Engineers. Two outlets, one gated at stream bed level and one ungated at a higher elevation, will be provided in the stucture for regulation of discharges from the reservoir. The initial controlled storage below the ungated outlet will be 562,000 acre-feet; however, upon completion of Low Chamita Dam, which is scheduled for construction after the completion of Abiquiu Dam, the entrance to the ungated outlet works of the Abiquiu Dam will be lowered, thereby reducing the controlled storage from 562,000 acre-feet to 449,000 acre-feet, so that the total controlled storage in the two reservoirs will not exceed 700,000 acre -feet. The uncontrolled storage capacity made available by the modification of the outlet works of Abiquiu Dam, after the construction of Low Chamita Dam, will be utilized for temporary detention of floodwaters which will be automatically released through the uncontrolled outlet. The estimated cost of Abiquiu Dam is $13,290,000.

The Low Chamita Dam, with a capacity of 251,000 acre-feet, also will be an earth-fill structure. It will be about 5,700 feet long and rise 153 feet above stream bed. It will be operated in conjunction with the Abiquiu Dam for flood and sediment control during flood periods. The estimated cost of Low Chamita Dam is $14,700,000.

The total estimated cost of the two dams is $27,990,000. Benefits from the two dams will be realized on Rio Chama and on Rio Grande throughout the Espanola, Middle, and Lower Valleys. By far, the greatest benefit will accrue in the Middle Valley, particularly in the vicinity of Albuquerque, where high value property subject to flood damage is concentrated. Although damage from spills from Elephant Butte Reservoir will be eliminated, only a very small percentage of the total benefits will accrue to the valley downstream from Elephant Butte Dam. The flood control and other benefits which will accrue to the flood control phase of the comprehensive plan, of which Chamita Reservoir Project (Abiquiu and Low Chamita Dams) is an integral part, are estimated at $5,200,000 annually. Construction of the Abiquiu Dam will be initiated during Fiscal Year 1956.

THE BLUEWATER FLOODWAY would be located on Bluewater Creek in Valencia County, about 2 miles north of the town of Bluewater. This authorized improvement is an element of the comprehensive plan of development for the Rio Grande and tributaries in New Mexico.

Floods on Bluewater Creek inundate large areas of valuable agricultural land in the Bluewater-Toltec Irrigation District, causing considerable damage to rich farmland used for commercial truck farming. During major floods many acres of land have been totally destroyed by bank cuttings.

Flood protection would be provided by the construction of a small earth-fill dam about 8 feet high, which would divert flood flows through an excavated channel about 8,300 feet long, and discharge them into adjacent lava beds north of the irrigation district. A concrete box culvert would be provided for passing flows under U. S. Highway 66 and the Atchison, Topeka and Santa Fe Railway.

The estimated cost of the project is $323,300, of which about $75,000 would be the amount required from local interests toward construction of the concrete culvert under

the highway and railroad, and for rights-of-way and relocation of public utilities. The average annual benefits that would be derived from the prevention of flood damages by the construction of the project are estimated to be about $38,100.

THE ALBUQUERQUE DIVERSION CHANNELS PROJECT was authorized by the 1954 Flood Control Act to alleviate the flood condition at Albuquerque. Severe flooding has been experienced frequently in urban and suburban Albuquerque as a result of flash floods in the numerous intermittent streams and arroyos which originate near or on the steep slopes of the Sandia Mountains east of the city and flow westward across the highly developed residential and business districts to the Rio Grande. The problem is becoming more acute because of rapid expansion of the city and the extension of subdivisions into the tributary flood plains.

The plan of improvement would provide for the construction of two large diversion or collection channels and appurtenant works to be located on high ground east of and, in general, parallel to Rio Grande. One channel would run north, with a capacity increasing from 5,300 cubic feet per second to 42,000 cubic feet per second, intercept flows from the numerous arroyos which enter Rio Grande north of U. S. Highway 66, and divert them into Rio Grande through a drop structure to be located near Alameda. The other channel would intercept flows from the arroyos which enter Rio Grande south of U. S. Highway 66 and divert them into Rio Grande through a drop stucture and outfall channel to be located a short distance from Tijeras Canyon. The flows from Tijeras Canyon would be diverted into the latter outfall by means of a short diversion dike and channel. The capacity of the south diversion channel would increase from 1,500 cubic feet per second at its upper end to 5,400 cubic feet per second at the junction with the diversion dike from Tijeras Canyon. At that point the capacity would be increased to 20,000 cubic feet per second to accommodate the combined flows of the south diversion channel and Tijeras Canyon Arroyo.

The diversion channels would be trapezoidal and would be excavated for about two-thirds of the total depth. The upper one-third would be formed by levees. The channels would be paved where necessary with concrete and riprap. Both of these channels would provide protection against floods

Considerably greater than have been known to occur. The dike intercepting Tijeras Canyon is designed to control floods equal to the largest of record and to afford partial protection against greater floods.

Local Interests have organized the Sandia Conservancy District to cooperate with the Federal Government in the construction of the project, and to construct complementary works and supervise flood plain zoning as required. The total project cost is estimated to be $10,287,000. The Federal share would be $7,500,000, and that of local interests, $2,787,000, including an initial cash contribution of $170,000. Average annual benefits have been estimated at about $1,199,400. Preconstruction planning is now under way.

Survey Under Way

RIO GRANDE AND TRIBUTARIES, SOCORRO AND VICINITY. A review of the report on Rio Grande and tributaries, House Document No. 243, 81st Congress, 1st Session, with respect to flood protection at Socorro and vicinity was directed by the Senate Public Works Committee by resolution adopted September 8, 1950. The town of Socorro is located on the west bank of the Rio Grande directly in the path of several tributary arroyos that rise in the Socorro Mountains a few miles west of the town. Investigations and studies of damages caused by flash floods on these arroyos have been initiated. It is estimated that the report will be completed during Fiscal Year 1957.

Survey Authorized

RIO GRANDE AND TRIBUTARIES, LAS CRUCES AND VICINITY. A further review of House Document No. 243 was directed by the Senate Public Works Committee by resolution adopted July 20, 1954, to determine if flood protection could be provided at Las Cruces and vicinity which is also subject to severe flooding from arroyos and streams tributary to Rio Grande. Recent requests of local interests at nearby State College to investigate a similar flood problem have resulted in combing the studies of flood problems in this locality with those for Las Cruces into a single report. Initiation of this investigation is contingent upon appropriation of funds.

Flood Control Operation of Projects Constructed by Other Agencies

THE PLATORO RESERVOIR PROJECT is located about 80 miles above the mouth of the Conejos River, a tributary which enters the Rio Grande just above the New Mexico-Colorado State line. Regulation of floods on the Conejos River directly affects Rio Grande flows in New Mexico.

The Platoro Dam was constructed by the Bureau of Reclamation and put into operation in September 1951. The project is a dual-purpose dam and reservoir for flood control and irrigation, and is designed to control the runoff from about 40 square miles of mountainous drainage area. The reservoir has a total storage capacity of 60,000 acre-feet, of which 54,000 acre-feet is allocated for joint irrigation and flood control use and the remaining 6,000 acre-feet is allocated for inviolate flood control use. The joint storage is operated for flood control in accordance with forecasts of runoff computed from precipitation indices, snow surveys, and other water-shed conditions. The inviolate flood control storage of 6,000 acre-feet is the capacity required to control the summer and fall floods.

The project is operated and maintained by the Bureau of Reclamation; however, operation regulations of the reservoir for flood control are prescribed by the Secretary of the Army in accordance with Section 7 of the Flood Control Act of 1944.

Although Platoro Reservoir has been operated for flood control only twice, substantial benefits have accrued to the project. The peak discharge during the May 1952 flood was reduced by about 1,200 cubic feet per second at the Mogote gage on Conejos River in Colorado, and by about 500 cubic feet per second on Rio Grande at Otowi, New Mexico. It is estimated that this operation reduced damages by about $90,000 in Colorado and $50,000 in New Mexico.

PECOS RIVER WHATERSHED

The Pecos River watershed in New Mexico drains an area of about 25,470 square miles. The principal tributaries to the Pecos River in New Mexico are Salt Creek, Rio Hondo, Rio Feliz, and Rio Penasco. The larger towns in the watershed, Las Vegas, Santa Rosa, Fort Sumner, Roswell, Artesia, and

Carlsbad, are located in the valleys of either the main stem or its tributaries.

Several municipalities, together with about 25,500 acres of irrigated cropland, and many diversion structures are located in the flood plains of Pecos River and tributaries. It is estimated that a repetition of floods which have occurred during and since 1904 would cause damages of about $41,000,000 under present conditions of development on the Pecos River and major tributaries. There are no existing flood control projects constructed by the Corps of Engineers in the watershed.

There are many diversion and storage dams on Pecos River and tributaries constructed by others for the purpose of regulating and utilizing stream flow to provide water for irrigation. However, the supply, generally insufficient except in time of floods, is a limiting factor to the development of the watershed. The use of water, and water rights have been the subject of litigation for years, and until recently, basin-wide development of the resource was hampered by the lack of agreement between the States on the division and use of waters of the Pecos River and tributaries.

In 1949, a compact which provides for apportionment of Pecos River waters and contains provisions to permit and facilitate full development of the river became effective. Since that time the Corps of Engineers in cooperation with the State and other Federal agencies has carried on an extensive investigation of problems and needs in the watershed. At the present time two interim survey reports have been completed in accordance with directives contained in the Flood Control Acts of 1938, 1939, and 1950, and submitted to Congress for consideration. As an initial step in a plan of water resources development for the Pecos River watershed, Congress by the 1954 Flood Control Act authorized the construction of three flood control improvements in New Mexico: Los Esteros and Alamogordo Reservoirs project on the main stem, Two Rivers Reservoir Project on Rio Hondo, and the Artesia Diversion Channel. These projects are briefly described in the following paragraphs.

Authorized Projects

THE LOS ESTEROS AND ALAMOGORDO RESERVOIR PROJECT was authorized by the Flood Control Act of 1954 for flood protection on the Pecos River in New Mexico and Texas. However, the act provided

that no appropriations shall be made for constuction until satisfactory arrangements have been made by the State of New Mexico for the transfer of irrigation storage from the existing Alamogordo Reservoir to the authorized Los Esteros Reservoir.

The project provides for Los Esteros Dam to be built on the Pecos River about 7 miles above Santa Rosa, and for the modification of the existing Alamogordo Reservoir. Los Esteros Reservoir would be used for both irrigation and flood control while Alamogordo Reservoir would be used for flood control.

The main section of the Los Esteros Dam would be of earth fill, about 1,865 feet long and would rise 218 feet above stream bed. In addition to the main dam, a dike would be built across a low saddle about 4,000 feet east of the east or left abutment. This saddle dike would be 1,420 feet long with a maximum height of 12 feet.

The capacity of Los Esteros Reservoir would amount to 587,000 acre-feet with 60,000 acre-feet available for storage of sediment, 250,000 for irrigation, and 277,000 for flood control. It would control 2,479 square miles of drainage area. The outlet through the main dam would be controlled by two 54-inch diameter valves, permitting a release of 2,290 cubic feet per second when the pool reaches spillway crest level. An open-cut, uncontrolled spillway would be constructed between the main dam and the saddle dike, about 1,000 feet from the left abutment.

The Los Esteros-Alamogordo project would afford protection against floods larger than any of record. In addition, more irrigation water would be provided because spills would be less frequent and the life of the conservation storage pool would be greatly extended. It is estimated that the existing Alamogordo Reservoir will lose its effectiveness for conservation in about 40 years because of sediment depletion; whereas, the irrigation pool in the Los Esteros Reservoir would not even be encroached upon at the end of 40 years of operation.

The benefits expected to accrue amount to about $428,000 annually. The total estimated cost of the project is $7,060,000. Preconstruction planning has been initiated.

THE TWO RIVERS RESERVOIR PROJECT is designed to prevent damages at Roswell and vicinity by controlling floods on Rio

Hondo. The project was authorized for construction by the Flood Control Act of 1954. It consists of two dams, Diamond A Dam on Rio Hondo and Rocky Dam on Rocky Arroyo. The two dams would create a common reservoir to be known as the Two Rivers Reservoir.

Diamond A Dam would be an earth-fill structure about 4,994 feet long and 106 feet high, with a gated 6-foot diameter outlet. Rocky Dam also would be of earth fill, about 2,924 feet long and 120 feet high, with an uncontrolled 3-foot diameter outlet. In addition, there would be four uncontrolled spillways, with a total length of about 2,375 feet, in natural saddles on the rim of the reservoir.

The project would control 1,084 square miles of drainage area, 1,009 square miles of which are in the Rio Hondo watershed, and 75 in the Rocky Arroyo watershed. The common reservoir formed by the two dams would have a capacity of 207,500 acre-feet at spillway crest elevation, which is a little more than twice the amount needed to store the maximum flood of record.

The Two Rivers Reservoir project would reduce to nondamaging proportions such large floods as occurred on Rio Hondo in 1937, 1941, and in October 1954. In addition to affording protection to the city of Roswell and to Walker Air Force Base, the project would also reduce damages on the Pecos River. The project would cost $6,171,200, of which $121,200 would be non-Federal. The average annual benefits are estimated at about $307,290. Preconstruction planning has been initiated.

THE ARTESIA DIVERSION CHANNEL was authorized by the 1954 Flood Control Act. It consists of a diversion channel on Eagle Creek upstream from Artesia, to convey flood flows from Eagle Creek into Tumbleweed Draw, a tributary which enters the Pecos River about 4 miles downstream from Artesia.

An earth levee about 5.7 miles long with a maximum height of about 10 feet would be the principal feature of the diversion works. The borrow area would be graded to provide a channel for low flows, and the capacity of Tumbleweed Draw would be increased to accommodate diverted flood flows.

The project would protect the city of Artesia and irrigated land in the vicinity from floods on Eagle Creek up to 38,000 cubic feet per second, which is about 35 percent

greater than the estimated discharge of the flood of July 1911, the maximum known to have occurred. The average annual benefit expected to accrue is $81,800. The estimated cost of the project is $760,000, of which $170,000 would be non-Federal. Preconstruction planning has been initiated.

Survey Under Way

PECOS RIVER AND TRIBUTARIES, CARLSBAD AND VICINITY. A final report, as authorized by the 1938 Flood Control Act, on the flood control problems in the Pecos River watershed remains to be completed. The major consideration will be an improvement for the protection of Carlsbad, which has experienced severe damage from floods on Pecos River, and on Dark Canyon, a tributary to Pecos River, also Hackberry Draw, a tributary to Dark Canyon. Completion of this investigation is scheduled during Fiscal Year 1956.

Survey Authorized

RIO FELIX AND RIO HONDO AND TRIBUTARIES. As a result of the disastrous floods which occurred in the Pecos River basin in 1954, a review of reports previously submitted on the Pecos River and tributaries was authorized by Congress. The purpose of this review is to determine the feasibility of flood control improvements on Rio Felix and tributaries, and additional improvements on Rio Hondo and tributaries. A preliminary examination has been completed and additional studies will be initiated as soon as funds are made available.

EMERGENCY FLOOD CONTROL WORK

During flood emergencies the Corps of Engineers assists local interests in flood fighting and rescue work to protect life and property. Upon specific request of local interests, the Corps of Engineers repairs damaged flood control works, under various statutory authorities, when such work is determined to be sound from an engineering and economic standpoint and funds are available.

The major portion of emergency work performed by the Corps of Engineers in the Rio Grande basin has been on the main stem, particularly in the Middle Valley. About 190 miles of levees were constructed by the Middle Rio Grande conservancy District during the period 1930 to 1935. Floods occurring in 1937, 1941, 1942, 1948, 1949, and 1952 damaged these levees at

numerous points and an extensive program of repair and rehabilitation by the Corps of Engineers has been necessary to prevent complete failure. When Rio Grande flows begin to endanger the levees, vulnerable reaches are kept under continuous observation in order that preventive measures may be initiated at the earliest possible moment. In addition to the duties of observation, patrols participate in effecting emergency repairs, since a general failure of these levees would cause damage to property valued at about $460,000,000.

At the request of local interests about $1,374,000 has been expended in the Middle Valley since 1942 by the Corps of Engineers in performing emergency work, including levee raising, installation of log and brush protective mats, timber pile dikes, rock revetments, flexible-type steel jetties, reconstruction and repair of levees, construction of diversion dikes, and channel straightening. In addition, the Corps of Engineers prepared plans and specifications during 1949 and 1950 for emergency repairs constructed by the State of New Mexico.

COLORADO RIVER BASIN

An area of approximately 20,000 square miles in New Mexico, or that part of the State lying west of the Continental Divide, is drained by three tributaries of the Colorado River; namely: Gila, LIttle Colorado and San Juan Rivers.

The Gila River drains an area of about 5,600 square miles in the southwestern part of the State. The area is extremely rugged and much of it is set aside as a national forest. The more important industries are mining and farming. Scattered tracts of irrigated land, totalling about 11,000 acres, are located along the Gila River and its tributary, San Francisco River. The principal towns are Lordsburg and Mogollon.

The Little Colorado River drains about 4,700 square miles in the west central part of the State. Livestock raising, mining, and lumbering are the most important industries. Rainfall is insufficient for crop production and because of the short water supply and topographic limitations, only about 8,800 acres are under irrigation at the present time. The principal town is Gallup, which is on a tributary, the Puerco River.

The San Juan River, the second largest tributary of the Colorado River, drains an area of about 9,700 square miles in

the northwestern part of the State. The principal industries in the area are farming, mining, oil, gas and helium production, and refining. About 38,000 acres of land are presently irrigated in the watershed in New Mexico. The principal towns are Farmington, Aztec, Bloomfield, and Shiprock. Parts of the urban areas of Shiprock and Blanco and about 27,000 acres of land are in the flood plain.

There are no existing Corps of Engineers projects in the Colorado River basin in New Mexico and none is under construction. The Bureau of Indian Affairs, in a feasibility report dated January 1955, recommended the Navajo Project. This project, principally for irrigation, includes the Navajo Dam on the San Juan River in New Mexico. This project is proposed as a participating project of the recently authorized Colorado River Storage Project. The Navajo Reservoir would have an initial storage capacity of 1,450,000 acre-feet and, if operated for flood control in accordance with recommendations of the Corps of Engineers, would control the maximum flood of record at the dam site, and reduce flood damages on the San Juan River in New Mexico by an estimated $39,000 annually.

There has been no emergency flood control work performed by the Corps of Engineers in the Colorado River basin in New Mexico.

Preliminary Examinations and Surveys Authorized

Pertinent information about presently authorized reports on preliminary examinations and surveys for the Colorado River basin is given in the following tabluation:

Area under investigation	Type of report	Completion date by District Engineer
Little Colorado River, Arizona and New Mex. in vicinity of Gallup, New Mexico	Survey report on flood control	Dependent upon future appropriation of funds
Colorado River & Tributaries above Lee Ferry, Arizona	Revised preliminary examination report	Dependent upon future appropriaion of funds
Animas River, Colorado and New Mexico	Interim survey report on flood control	Dependent upon future appropriation of funds
Gila River and tributaries, Arizona and New Mexico	Comprehensive survey report on flood control	Dependent upon future appropriation of funds

ARKANSAS RIVER BASIN

In northeastern New Mexico, an area of approximately 16,910 square miles drains to the Mississippi River as a part of the Arkansas River system. The Canadian River, the North Canadian River, and the Cimarron River are the principal streams in the area; the latter two are locally known as Corrumpa Creek and the Dry Cimarron River, respectively. Each of these streams is locally important and each increases in size and importance as it flows eastward.

The Cimarron and North Canadian Rivers rise in foothills areas. In New Mexico they are not dependable sources of water; development along them is comparatively minor and improved areas are widely scattered. The principal towns are Clayton, Folsom, and Des Moines. Flash floods on these streams are problems which are now under consideration.

The Candian River rises in the lofty Sangre de Cristo Range of the Rocky Mountains near Raton Pass at the northern boundary of New Mexico. From its source at about 8,000 feet elevation, it flows southward through an ever-widening valley for about 64 miles where it enters a deep, narrow canyon. Except for a short reach where the canyon floor is relatively broad, the river continues southward confined between canyon

walls, for nearly 100 miles, to its confluence with the Conchas River. From this point, the river flows eastward in a deep canyon for a little more than 100 miles to the eastern boundary of the State. Major tributaries which enter the Canadian River in New Mexico, in downstream order, are Cimarron (not the Dry Cimarron mentioned above), Mora, and Conchas Rivers, and Ute Creek. The principal towns are Raton, Springer, Tucumcari, and Cimarron.

The only completed Corps of Engineers project in the Arkansas River basin in New Mexico is Conchas Dam and Reservoir, described hereinafter. There are no projects or emergency flood control work under construction or authorized for construction at this time.

Project Completed

CONCHAS DAM AND RESERVOIR is located in San Miguel County on the Canadian River just below its confluence with the Conchas River. The drainage area above the dam is about 7,409 square miles.

Construction of Conchas Dam was approved by the President of the United States as a part of the Works Relief Program under the Emergency Relief Appropriation Act of 1935; subsequently, the project was authorized by the Congress in 1936. Construction of the dam was assigned to the Corps of Engineers, and under the provisions of the Flood Control Act of June 22, 1936, operation and maintenance of the dam and reservoir were also delegated to the Corps of Engineers.

Conchas Reservoir has a total storage capacity of 566,000 acre-feet for flood control and irrigation. Approximately 370,000 acre-feet are available for irrigation and sediment storage up to the crest of the uncontrolled spillway notch provided for flood control regulation. At this elevation, a 9,600 acre lake extends up the Canadian River valley for a distance of 14 miles and up the Conchas River valley 11 miles. About 279,000 acre-feet of storage is provided for irrigation uses and the remaining 91,000 acre-feet below the irrigation outlet is for deposition of sediment. The reservoir has a flood control storage of 196,000 acre-feet between the crests of the flood regulation notch and the uncontrolled emergency spillway. The reservoir is the prime source of water supply for the Arch Hurley Conservancy District in the vicinity of Tucumcari, New Mexico.

Within this District, where maximum productivity is just now being attained, there are about 42,000 acres of irrigable land.

Both the Corps of Engineers and the State of New Mexico have participated in the development of recreational facilities in the vicinity of Conchas Lake. The Federal Government conveyed to the State by easement deed, a tract on the south shore containing 1,487 acres. On this tract the State has remodeled and enlarged an existing lodge and has provided such other accommodations as cabin sites, a boat repair building, a minnow stand, comfort stations, fireplaces, tables, floating docks, and living quarters for the operating personnel. On the north shore the State has provided a minnow stand, a general store, a floating dock, fireplaces, and tables. In addition, the Corps of Engineers has provided a water supply system consisting of a treatment plant, an elevated storage tank and distribution facilities, a system of roads, floating docks, tables, fireplaces, and comfort stations. All recreational facilities are supervised and maintained by the State. The store and lodge are operated on a concessionaire basis.

Since Conchas Dam became operative in 1939, three floods of consequence have occurred on the Canadian River in New Mexico; in May and September, 1941, and September, 1942. During these floods the operation of Conchas Dam resulted in reductions in stages at Logan, New Mexico, about 45 miles downstream from the dam, ranging from 3.0 to 7.2 feet.

Surveys Under Way

ARKANSAS, WHITE AND RED RIVER BASINS REPORT. Studies of water and land resources and their potential development for the portions of the Arkansas and Red River watersheds in New Mexico have been completed in connection with a comprehensive investigation of the Arkansas, White and Red River Basins, Arkansas, Louisiana, Oklahoma, Texas, New Mexico, Colorado, Kansas, and Missouri. This investigation was authorized by the Flood Control Act of 1950.

The President of the United States requested that the interested Federal agencies organize an inter-agency committee to conduct the investigation. The Arkansas-White-Red Basins Inter-Agency Committee was organized for this purpose in July 1950. As presently constituted, the Committee includes

one member each from the Department of the Army, Department of the Interior, Department of Agriculture, Department of Commerce, Department of Labor, Department of Health, Education and Welfare, and the Federal Power Commission, and a representative of the Governor of each of the eight states named above. The Division Engineer, Southwestern Division, who represents the Department of the Army, is chairman ex officio of the Committee.

Regional and basin-wide public hearings have been conducted by the Committee to determine the desires of local interests. The water and land resources, needs, and problems of the area have been carefully studied and inventoried in considerable detail by agencies and interests concerned. Studies of possible solutions and formulation of an integrated comprehensive plan of development for the three-basin area are now completed as a result of this coordinated action.

The report presents a long-range plan for coordinated development and conservation of the water and related land resources of the AWR basin. It includes projects and programs which might be developed by the Federal Government, State and local governments, or private interests. The report will not serve as an authorizing document for any Federal project or program, but instead will provide the Congress with a framework within which it may consider future separate recommendations for individual project or program authorizations. The Corps of Engineers plans to prepare supplemental reports to substantiate recommendations for future authorizatinn of specific projects in the three-basin area.

RED RIVER BASIN

A very small portion of the State, comprising 891 square miles in northern Curry County and western Quay County, is drained by the Red River which empties into the Mississippi River near Marksville, Louisiana. The New Mexico part of the Red River basin is semi-arid, sparsely settled, and used primarily for grazing of livestock.

The Corps of Engineers has no existing projects on Red River in New Mexico, and none is under construction or authorized for construction, including emergency flood control work.

Surveys Under Way

Studies in connection with the Arkansas, White and Red River Basins Report, described in the Arkansas River Basin section of this paper, include studies of the Red River basin in New Mexico.

BRAZOS AND COLORADO (TEXAS) RIVER BASIN

A small portion of the east-central part of the State, consisting of about 3,830 square miles, lies in the basins of the Brazos and Colorado Rivers of Texas. Of this, 2,670 square miles is in the Brazos Basin and 1,160 is in the Colorado Basin. Both of these streams head in New Mexico and flow in a southeasterly direction across Texas to the Gulf of Mexico.

The area is characterized by low relief and poorly-defined drainage patterns, and because of this only a small part of the precipitation over the area ever reaches the streams as surface runoff. Urban communities in the basins include Clovis, Portales, Lovington, and Hobbs, and except for these the area is sparsely settled. Livestock raising, limited irrigated farming, and petroleum production and refining are the principal industries.

A survey report recently submitted to Congress served as a basis for authorization for a number of projects on the Brazos River; however, all of these would be in Texas as no water resource development was recommended in New Mexico. The Corps of Engineers has performed no emergency flood control work in either watershed in New Mexico.

Survey Under Way

A survey report has been authorized on the Colorado (Texas) River basin, including that part of the basin which is in New Mexico. Completion of this report is dependent upon future appropriations of funds by Congress.

SUMMARY

The following tabulation gives the estimated total cost of the major elements of the water resources development program of the Corps of Engineers in New Mexico which has been authorized or constructed to date, and the estimated annual charges and benefits assignable to those projects.

COSTS AND BENEFITS

1955 Price Levels

Project	Total First Cost	Amounts made Available To Date	Annual Charges	Annual Benefits
Conchas Dam	$15,488,909	$15,488,909	Not estimated	
Jemez Dam	4,055,627	4,055,627)		
Abiquiu Dam	13,290,000	879,000)	$1,314,600	$1,716,900
Low Chamita Dam	14,700,000	266,000)		
Rio Grande Floodway (Albuquerque Unit)	3,529,000	3,529,000	174,100	304,000
Albuquerque Diversion Channels	10,287,000	60,000	433,100	1,199,400
Bluewater Floodway	323,300	0	13,900	38,100
Los Esteros-Alamogordo Reservoirs	7,060,000	50,000	280,000	428,000
Two Rivers Reservoir	6,171,200	50,000	260,415	307,290
Artesia Diversion Channel	760,000	25,000	28,600	81,800
TOTALS	*$75,665,036	$24,403,536	**$2,504,715	**$4,075,490

* Includes $3,288,200 non-Federal Costs
** Exclusive of Conchas Dam