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STATEMENT OF
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BEFORE THE
HOUSE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
COMMITTEE ON SCIENCE AND TECHNOLOGY
ON THE
1983 FLOODING OF THE
LOWER COLORADO RIVER

Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss the actions taken by the Bureau of Reclamation this summer in responding to flooding of the Lower Colorado River.

Concerned about the flood damages that occurred, the Chairmen, House Subcommittee on Environment, Energy and Natural Resources, Committee on Government Operations and House Committee on Interior and Insular Affairs and eight other Congressmen--James V. Hansen, Duncan Hunter, Ray Kogovsek, Jerry Lewis, Alfred A. McCandless, Howard C. Nielson, Harry M. Reid, and Bob Stump--asked us in late July to develop information on the events that led to this summer's flooding and the operating criteria followed by the Bureau in determining the amount of water to be released from its reservoirs. We briefed the requestors on the results of our work on August 31 and September 1, 1983.

To meet the 5-week timeframe established by the requestors, we made a limited analysis of the Colorado River flooding.

Mainly, we concentrated on the Bureau's implementation of existing flood control operating criteria including the National Weather Service's streamflow forecasts. We made no evaluation of the federal agencies' performance in fulfilling their responsibilities to the public for disaster relief assistance.

In brief, Mr. Chairman, some flooding could not have been prevented given the amount of storage space available in the reservoirs in January 1983, the minimum amounts of flood control storage space currently required to be available, and property development along the river.

BACKGROUND

Within the Colorado River Basin, the Bureau operates 10 major water projects having a combined storage capacity of nearly 62 million acre-feet.[1] Two of these projects--Glen Canyon Dam in the Upper Basin and Hoover Dam in the Lower Basin--have a combined storage capacity of over 52 million acre-feet, about 84 percent of the total storage space available.

Rapid melting of a higher than normal spring snowpack in the Upper Colorado River Basin this year resulted, for the first time in history, in filling all of the Bureau's major reservoirs in the Colorado River system. To manage the flood flows, the Bureau released record amounts of water from some of its large reservoirs beginning in June. Peak daily releases from Glen Canyon, Hoover, and Parker Dams reached 91,000, 51,000, and 40,000 cubic feet per second (cfs), respectively. This caused flood damage in the Lower

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[1]An acre-foot is the quantity of water required to cover 1 acre to a depth of 1 foot; equal to 325,851 gallons.

Colorado River Basin and the Republic of Mexico. Seven lives were reported lost and property damage and loss of business resulted.

Water releases have now decreased and further decreases are expected. However, high flows are expected to continue until December 1983, at which time, assuming normal precipitation, the flows are expected to drop below the flood damaging level of 23,000 cfs. Significant flood damage begins above 28,000 cfs.

ESTIMATED LOSSES

Federal authorities have estimated losses resulting from the Colorado River flood to total $80 million. A local power authority has estimated about $5.7 million in offsetting revenues from increased power sales. Actual losses remain uncertain because some facilities are still underwater due to continued high river flows.

In late June 1983 the Federal Emergency Management Agency (FEMA) estimated individual losses at about $13 million. These losses occurred mainly to residences and businesses in Topock Marsh and Yuma, Arizona, and the Needles, California, and Parker Strip areas of Arizona and California. In mid-July, FEMA estimated that an additional $12 million in losses to individuals would likely occur to facilities still underwater.

FEMA estimated losses to state, county, and local governments in mid-July at about $11 million. These losses include costs for emergency operations, mosquito control, foregone tax revenues, and losses to public irrigation facilities.

As a result of President Reagan declaring on July 1, 1983, that a major disaster had occurred in Arizona and California,

certain counties in those states became eligible for disaster relief assistance. Both individual and public disaster assistance are available as well as flood insurance claim payments, where appropriate. As of September 23, 1983, 861 applications for individual assistance had been received. Of the 861 applications, 622 had been processed--213 were approved and 409 were withdrawn or disapproved. The 213 approved applications totaling $1.2 million included 125 for temporary housing assistance, 54 for unemployment assistance, 27 for Small Business Administration loans, 6 for individual family grants, and one for flood insurance.

The Bureau estimated losses to federal facilities as of August at about $44 million. It included damages to Bureau facilities, such as river bankline protection structures and the spillway tunnels at Glen Canyon Dam, and the loss of stockpiled material.

THE IMPACT OF BUREAU PROJECTS ON STREAMFLOWS

Before Hoover Dam was constructed, high flows on the Lower Colorado River occurred frequently and at times exceeded 100,000 cfs. After 1935 when water storage began in Lake Mead behind Hoover Dam, the mean monthly flows on the Lower Colorado River were reduced to 35,000 cfs or less. A further reduction in the mean monthly flows to 20,000 cfs or less occurred after storage in Lake Powell behind Glen Canyon Dam began in 1963. Basically, by filling these reservoirs, water was diverted into storage that otherwise could have resulted in high flows. In fact, the filling of Lake Powell temporarily eliminated the need for flood control releases at Hoover Dam. The last flood control release from

Hoover Dam prior to this year occurred in April 1958 when an average monthly discharge of about 25,000 cfs was made. However, during the period 1963 to 1980 the reservoir system--most importantly Lake Powell behind Glen Canyon Dam--was filling. Lake Powell was first filled in June 1980.

The Bureau and the U.S. Army Corps of Engineers[2] were aware that once Lake Powell and other smaller upstream reservoirs were filled, streamflows in the Lower Colorado River would return to a pattern similar to the one experienced between 1935 and 1963. The Bureau issued a report in 1976 which pointed this out as well as the probability that flood control releases would have to be made in some years, which would cause damage to developments along the Lower Colorado River. Similarly, the Corps made this point at public meetings in 1979, which discussed Colorado River flood control operations, and in a brochure distributed prior to the meetings.

The agencies also reported that the flood control plan for Hoover Dam was based on controlling most floods on the Lower Colorado River by making maximum releases of 40,000 cfs--the flow that could be contained within the river channel and levees. However, development in the floodplain has encroached on the 40,000 cfs floodway and now significant damage occurs at flows of more than 28,000 cfs. The Bureau and Corps attributed the development in the floodplain to (1) the absence of large flood control releases from Hoover Dam while Lake Powell was filling, (2) extensive growth of water based recreation along the river, and (3) lack of adequate land use controls.

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[2]The Corps of Engineers has responsibilities for developing flood control operating plans, including flood control operating criteria.

BUREAU IMPLEMENTATION OF FLOOD CONTROL OPERATING CRITERIA

The flood control operating plan for Hoover Dam was developed jointly by the Bureau and the Corps. Basically, the criteria was designed to require that (1) various minimum amounts of flood storage space be available at certain times and (2) flood control releases be made from Hoover Dam, if needed, to make space available to store the runoff from the annual spring snow melt.

The minimum storage space requirement ranges from 1.5 million acre-feet (maf) on August 1 of each year to 5.35 maf on January 1. The criteria requires that at least 1.5 maf be available at all times to control runoff from a sudden large rainfall. The space requirement gradually increases after August 1 to at least 5.35 maf on January 1 to provide space to control runoff from the annual spring snow melt. In line with the storage space requirement, on August 1, 1982, 7.55 maf of storage space was available and 6.50 maf was available on January 1, 1983.

The amount of flood control releases needed to comply with the minimum requirement is determined by the Bureau from a mathematical formula contained in the flood control operating criteria. The formula determines how much water will have to be released from Lake Mead each month considering the forecasted inflows, space available, and need to have a minimum of 1.5 maf of space available at all times. Forecasts of the inflow to Glen Canyon, Hoover, and other projects are received by the Bureau each month from January to July from the National Weather Service's Colorado Basin River Forecast Center.

The amount of water actually released by the Bureau from Hoover Dam was more than the minimum required by the flood control operating criteria during each month from January through May. However, in June releases were less than what was required by the criteria. In June inflow forecasts increased greatly, ranging from 131 percent of average on June 7 to 210 percent on June 28. Such forecasts would have required releases from Hoover Dam in excess of 52,900 cfs to comply with the flood control operating criteria. After consulting with the Corps, the Weather Service, and others, the Bureau decided to take actions to restrict the downstream flows below Parker Dam to 40,000 cfs or less if possible (the historic nondamaging floodway), even though the criteria called for higher releases. While the Bureau has been successful in limiting releases to about 40,000 cfs, it has had to use the 1.5 maf of storage required to be available at all times.

NATIONAL WEATHER SERVICE FORECASTS

The National Weather Service forecasts of monthly inflows into Lake Powell for January through April 1983 were fairly close to the actual amounts of inflow that occurred. However, the May 6, 1983, forecast for May inflow was 700,000 acre-feet less than the actual inflow and the June 7, 1983, forecast for June was only about half of what actually occurred (about 3.5 maf forecasted as compared to an actual inflow of about 6.7 maf).

Officials of the Weather Service's Colorado Basin River Forecast Center identified several factors contributing to these forecasting difficulties.

--The snowpack continued to increase during April and May. Normally, snowpack is at its highest level on April 1, and there is limited snowpack sampling after that date.

--Above average temperatures in late May and early June rapidly melted the snow.

--Normal snow melt runoff losses to evaporation and infiltration into the soil apparently did not occur during the May and early June melt period.

--A large rainstorm in mid-June may have contributed as much as 2 million acre-feet to the runoff.

Because of the forecasting difficulties, officials of the Colorado Basin River Forecast Center are examining their forecasting methods and practices to determine what improvements can be made to the data base and procedures. However, because current procedures have produced relatively accurate past forecasts, these officials believe they should proceed carefully in making changes to them.

HYPOTHETICAL OPERATING SCENARIOS FOR 1983 FLOOD FLOWS

To determine if changes in flood control operations by the Bureau or better inflow forecasts from the Weather Service would have enabled the Bureau to prevent damaging flood control releases, we asked the Bureau to estimate the releases that would have occurred under six hypothetical operating scenarios. The attachment describes the assumptions made for each scenario and the projected releases that would have been made based on those assumptions.

For each scenario a different set of assumptions was made about such factors as the timing of accurate forecasts and the

amount of storage space available. While these scenarios provide some insight into whether damage caused by the flood could have been prevented, most of them assume the Weather Service could have accurately predicted the meteorological events which caused the heavy runoff months before such events occurred.

For 5 of the 6 scenarios flood control releases in excess of 28,000 cfs would have been required, thus causing damage along the Lower Colorado River. Releases of no more than 28,000 cfs could only have happened if a perfect inflow forecast was made on January 1, 1983, and the flood control operating criteria were disregarded so that releases could be artificially held to 28,000 cfs from February through October.

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In summary, Mr. Chairman, we have several observations on the flooding in the Lower Colorado River.

--Some flooding could not have been prevented given the levels of the reservoirs in January 1983. This is the case even if the late spring snowfall, melt, and rain runoff could somehow have been anticipated in January 1983.

--High flow levels will continue through November of this year, but increases in the rate of water releases are not expected barring above normal precipitation.

--Damaging flood control releases can be expected once every 10 to 15 years, according to Corps and Bureau officials, given current property development along the river and flood control storage space criteria.

--Fundamental questions are whether the Congress and the people in the states affected should reconsider (1) the

longstanding operating criteria for managing the river's reservoirs, (2) plans for the coming year, and (3) the need for closer monitoring of runoff. The Bureau has met with the governors of the seven affected states and planned additional meetings. It also has asked the Congress to review the river's operating criteria and consider plans for the coming year. The National Weather Service is reviewing its forecasting procedures.

Mr. Chairman, this concludes my statement. We will be pleased to respond to your questions.

SCENARIO ASSUMPTIONS

For each scenario on the next page, the following assumptions were made.

Scenario

1--Assumes 19,000 cfs releases for January, February, and March, then releases required under the flood control operating criteria based on a perfect forecast on April 1.

2--Assumes actual releases made through March, then releases required under the flood control operating criteria based on a perfect forecast on April 1.

3--Assumes 7.5 maf of storage available on January 1, 1983; unchanged forecasts of inflow for January, February, and March, which determine releases for these months; and a perfect forecast on April 1.

4--Assumes receipt of an inflow forecast of 13.3 maf on June 1 rather than June 21, 1983, as was actually received by the Bureau.

5--Shows the time necessary to dissipate the 1983 flood waters if releases were held to 28,000 cfs and 5.35 maf of storage space were to be attained on January 1, 1984. This scenario also assumes a perfect forecast on January 1, 1983, and does not consider the flood control operating criteria.

6--Assumes receipt of a perfect forecast on January 1, 1983, for the entire flood period.

ATTACHMENT

HOOVER DAM RELEASES UNDER SIX HYPOTHETICAL OPERATING SCENARIOS
(in thousands of cfs)

Date	Actual or as projected release[a]	S C E N A R I O S					
		1	2	3	4	5	6
1982							
Nov.	6.4	6.4	6.4	15.4	6.4	6.4	6.4
Dec.	7.5	7.5	7.5	16.5	7.5	7.5	7.5
1983							
Jan.	19.1	19.0	19.1	7.1	19.1	18.6	35.0
Feb.	6.6	19.0	6.6	10.2	6.6	28.0	35.0
Mar.	10.3	19.0	10.3	19.0	10.3	28.0	28.0
Apr.	17.8	40.0	40.0	40.0	17.8	28.0	28.0
May	19.8	35.0	40.0	35.0	19.8	28.0	23.3
June	31.7	32.6	40.0	35.0	60.7	28.0	23.5
Jul.	41.9	21.9	33.0	23.4	64.6	28.0	15.3
Aug.	41.3	33.5	30.7	38.7	25.4	28.0	33.1
Sept.	39.1	28.3	26.6	37.2	27.0	28.0	28.4
Oct.	39.1	25.9	25.9	34.3	25.9	28.0	25.9
Nov.	27.2	23.4	23.4	31.6	23.4	27.5	23.5
Dec.	21.9	21.9	21.8	29.6	21.8	21.9	23.9

[a]Represents actual flows through mid-August 1983 and projections thereafter based on existing water levels and average weather events throughout the calendar year.

Data prepared by: Bureau of Reclamation, Lower Colorado Region, August 22,1983.