UPPER COLORADO RIVER COMMISSION

THIRD ANNUAL REPORT

MARCH 17, 1952


UPPER COLORADO RIVER BASIN
10 0 20 40 60 80 100
SCALE OF MILES
IDAHO
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
Bear Lake
GREAT SALT LAKE
SALT LAKE CITY
Utah Lake
Pinedale
Kemmerer
Rock Springs
Green River
GREEN RIVER
CHEYENNE
Vernal
Yampa River
Steamboat Springs
Duchesne
Meeker
Colorado River
DENVER
Price
Glenwood Springs
Grand Junction
Gunnison
Delta
Green River
Moab
Montrose
Gunnison River
COLORADO
SAN JUAN
Durango
Pagosa Springs
RIVER
LEE FERRY
SANTA FE

UPPER COLORADO RIVER COMMISSION

520 Rood Avenue

Grand Junction, Colorado

March 28, 1952

My dear Mr. President:

Article VIII (d) (13) of the Upper Colorado River Basin Compact provides that the Upper Colorado River Commission shall make and transmit annually to the Governors of the signatory States and the President of the United States of America, with the estimated budget, a report covering the activities of the Commission for the preceding water year.

A copy of the Commission's Third Annual Report is enclosed. The budget is attached as Appendix L.

A printed copy of this report will be forwarded to you at the earliest possible date.

Sincerely yours,

John Geoffrey Will

Secretary and General Counsel

Honorable Harry S. Truman
President of the United States
The White House
Washington, D. C.

Enclosure

LSB

This report was, on the same date, transmitted to the Governors of each Upper Basin State.

FRONTISPIECE

LETTER OF TRANSMITTAL

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THIRD ANNUAL REPORT

UPPER COLORADO RIVER COMMISSION

March 17, 1952

I. INTRODUCTION

Article VIII (d) (13) of the Upper Colorado River Basin Compact provides that the Upper Colorado River Commission shall "make and transmit annually to the Governors of the signatory States and the President of the United States of America, with the estimated budget, a report covering the activities of the Commission for the preceding water year."

Article VIII of the By-Laws of the Upper Colorado River Commission provides as follows:

1. The Commission shall make and transmit annually on or before April 1 to the Governors of the states signatory to the Upper Colorado River Basin Compact and to the President of the United States, a report covering the activities of the Commission for the water year ending the preceding September 30.

2. The annual report shall include among other things the following:

(a) The estimated budget;

(b) All hydrologic data which the Commission deems pertinent;

(c) Estimates, if any, of the Commission forecasting water run-off;

(d) Statements as to cooperative studies of water supplies made during the preceding water year;

(e) All findings of fact made by the Commission during the preceding water year;

(f) Such other pertinent matters as the Commission may require.

For data on the activities of the Commission during that part of the preceding water year to March 15, 1951, reference is hereby made to the Commission's Second Annual Report. In order that a

more nearly recent account of the Commission's activities may be gained, the Commission has determined to include in this report an account of the activities of the Commission through March 15, 1952.

II. THE COMMISSION

As of the date of this report, the Commission consists of the following:

Harry W. Bashore	—Commissioner for the United States of America and Chairman of the Commission
Clifford H. Stone	—Commissioner for the State of Colorado and Vice Chairman of the Commission
John R. Erickson	—Commissioner for the State of New Mexico
Joseph M. Tracy	—Commissioner for the State of Utah
L. C. Bishop	—Commissioner for the State of Wyoming

The following have acted as advisers for each Commissioner from time to time:

United States of America:

Legal—

E. W. Fisher, Chief Counsel, Bureau of Reclamation, Washington, D. C.

T. Richard Witmer, Ass't. Chief Counsel, Bureau of Reclamation, Washington, D. C.

J. Stuart McMaster, Regional Counsel, Region IV, Bureau of Reclamation, Salt Lake City, Utah.

Engineering—

J. R. Riter, Chief, Hydrology Division, Bureau of Reclamation, Denver, Colorado.

Colorado:

Legal—

Jean S. Breitenstein, Consultant, Colorado Water Conservation Board, Denver, Colorado.

Engineering—

Royce J. Tipton, Consultant, Colorado Water Conservation Board, Denver, Colorado.

Frank C. Merriell, Engineer, Colorado River Water Conservation District, Grand Junction, Colorado.

New Mexico:

Legal—

Fred E. Wilson, Attorney at law, Albuquerque, New Mexico

Engineering—

John H. Bliss, State Engineer, Santa Fe, New Mexico

I. J. Coury, Member, Interstate Stream Commission, Farmington, New Mexico

Utah:

Legal—

Clinton D. Vernon, Attorney General, Salt Lake City, Utah

Engineering—

C. O. Roskelley, Ass't. State Engineer, Salt Lake City, Utah

Wyoming:

Legal—

Harry S. Harnsberger, Attorney General, Cheyenne, Wyoming

Engineering—

*Austin P. Russell, Assistant State Engineer, Cheyenne, Wyoming

H. T. Person, Dean, School of Engineering, University of Wyoming, Laramie, Wyoming

Earl Lloyd, Deputy State Engineer, Cheyenne, Wyoming

Alternates in absence of Commissioner:

Joe L. Budd, Big Piney, Wyoming

Norman W. Barlow, Cora, Wyoming

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*Mr. Russell served until his death on January 21, 1952. We have not been advised of the appointment of his successor.

III. THE STAFF

The staff of the Upper Colorado River Commission, as of the date of this report, consists of:

John Geoffrey Will, Secretary and General Counsel
Ralph D. Goodrich, Chief Engineer
Barney L. Whatley, Treasurer
Richard T. Counley, Assistant Treasurer
Mrs. Lois S. Burns, Administrative Assistant
Mrs. Lois P. Crowder, Official Reporter
Miss Betty L. Anderson, Stenographer

IV. ACTIVITIES OF COMMISSION

During the period, March 15, 1951 to March 15, 1952, the Commission held five meetings, as follows:

March 19 & 20, 1951	—the Regular Meeting Denver, Colorado
April 22, 1951	—a Special Meeting Denver, Colorado
June 2 & 3, 1951	—a Special Meeting Salt Lake City, Utah
Sept. 17 & 18, 1951	—the Annual Meeting Denver, Colorado
January 9, 1952	—a Special Meeting Denver, Colorado

During this period also there were meetings from time to time of the standing committees. These committees and their membership, during the past year, were as follows:

Engineering Committee—

J. R. Riter, Chairman
John R. Erickson
Royce J. Tipton
Frank Merriell
Austin P. Russell
H. T. Person
C. O. Roskelley

Legal Committee—

Fred E. Wilson, Chairman
Clinton D. Vernon
Harry S. Harnsberger
Jean S. Breitenstein

Budget Committee—

C. O. Roskelley, Chairman J. R. Riter
John H. Bliss Norman W. Barlow
Clifford H. Stone

There were meetings also of the following special committees:

Committee on Rules and Regulations—

Clinton D. Vernon, Chairman Fred Wilson
Jean S. Breitenstein J. R. Riter
Austin P. Russell

Finance Committee—

C. O. Roskelley, Chairman John H. Bliss
Norman W. Barlow

V. ACTIVITIES OF THE COMMISSION AND ITS STAFF

Certain legislative proposals, made some time ago by the President's Water Resources Policy Commission and but recently disclosed, which include the creation of Federal river basin commissions give rise to the question whether such a commission is needed in the Upper Colorado River Basin and, as a necessary incident, afford an opportunity for the evaluation of the work of the Upper Colorado River Commission to-date. If, in fact, the Upper Colorado River Commission, has objectives no less exalted than those with which a Federal commission would be charged and if, in fact, it has shown a disposition to seek the accomplishment of those objectives in statesmanlike fashion, then it becomes clear that, at least so far as the Upper Colorado River Basin is concerned, a Federal commission would constitute a purposeless appendage, wastefully duplicating the functions, powers and duties of the Upper Colorado River Commission in many respects, but failing to provide adequately for prompt and suitable response to local needs and to the legitimate aspiration of those immediately affected to participate effectively in the control of their own destinies.

The briefest possible survey of the objectives of the Upper Colorado River Commission reveals beyond doubt that they are, at the very least, of equal dignity with those of any Federal commission that might be created for this area; and that, in two respects, they include fields of activity in which no Federal commission so far conceived could play an effective part. In this latter class we may

place the functions, powers and duties of the Upper Colorado River Commission with respect to findings of fact as well as its approach to administrative problems which seeks to afford the utmost practicable sensitivity to the needs and desires of the people affected. In other respects the Commission's objectives include securing the expeditious agricultural and industrial development of the Upper Colorado River Basin and the achievement of a form of administration, operation and maintenance of works and programs for the development, conservation and utilization of water resources designed to afford completeness of approach. It is in the light of these objectives that the activities of the Upper Colorado River Commission ought to be evaluated.

The hydrology section of this report and the appendices thereto will show that steady progress is being made toward the evolution of a scientific basis upon which, along with other appropriate factors, findings of fact may be predicated. The Engineering and Legal committees of the Commission, and its Committee on Rules and Regulations, have been at work also on various phases of the same problem as well as on the development of procedures that will satisfy the requirements of sensitivity to local needs and desires. To the extent that the Commission's work in these fields is pressed vigorously forward there will be achieved in due course for findings of fact on the part of the Commission a reputation and, hence, an authoritativeness that bespeaks respect for and gives meaning to Article VIII (g) of the Upper Colorado River Basin Compact, which provides that "Findings of fact made by the Commission . . . shall constitute prima facie evidence of the facts found."

Continuous efforts have been made by the Commission to secure the expeditious agricultural and industrial development of the Upper Colorado River Basin. To this end, for instance, the Commission has succeeded: first, in coordinating the comments of the Upper Basin States with respect to the Interior Department's report on the Colorado River Storage project and participating projects; second, in developing a draft of bill designed to authorize the initial stage of the Colorado River Storage project and participating projects; and, third, in continuing to give effect to its policy, whenever an opportunity therefor has arisen, of opposing proposed legislation and policies that might create conditions unfavorable to such development, while supporting proposed legislation and policies that tend to create conditions and relationships favorable thereto.

There is evident within the Upper Colorado River Basin a notably encouraging spirit of cooperation with the Commission as well as a determination on the part of individuals and groups desiring primarily the development of the water resources of this or that

locality, nevertheless to carry their share of the burden of securing authorization of the entire initial stage. As an illustration of this spirit of cooperation and of this determination, mention ought to be made particularly, but without excluding others, of the efforts of individuals and groups in and about Vernal, Utah. Moving pictures and slides of the Green and Yampa river areas, which they have exhibited with appropriate narrative on more than one occasion before highly influential groups, will, no doubt, have telling effect in the long run. These independent, but related, activities of individual groups become of increasing importance in the light of evidence that officials of the National Parks Association have been calling upon members of the Congress to urge against the authorization of the Echo Park dam. The activities of the group in question perfectly complement the message carried in a leaflet distributed by the Commission during the past year, which leaflet is entitled "Echo Park Dam—Fact and Fiction."

All members of the Congress from the Upper Basin States have been supplied with copies of the draft of bill to authorize the initial stage of the Colorado River Storage project and participating projects. They have been urged to act as a unit with respect to the same and it has been represented to them by resolution unanimously adopted that, while the judgment of the Commission is that introduction of the bill should await transmittal to the Congress of the Interior Department's report on the Colorado River Storage project and participating projects, they are nevertheless urged to introduce it at an earlier date if, in their combined judgment, such earlier introduction is deemed wise.

Extremely disappointing delays have marked the treatment accorded transmittal to the Congress of the report in question. Comments on the report, following its circularization in accordance with the terms of Section 1 of the Act of December 22, 1944 (the Flood Control Act of 1944) were made months ago. A hearing on certain conservation aspects of one of the proposed reservoirs was held months ago. A decision following careful review of the evidence presented at such hearing was made months ago. Reasons heretofore adduced for withholding the report in question are now lacking in merit if, indeed, they may be deemed to have been meritorious at any time. Consistent efforts so far made on the part of the Commission to secure transmittal of the report to the Bureau of the Budget have resulted only in eliciting wholly unsatisfactory excuses for further delay. Nor can it be claimed that the Commission has been successful, although it has bent every effort in that direction, in achieving wholehearted and unified action from all quarters looking to the release of such report. In all of these connections, it may

well be that there is particular need at this time to remind everyone that the Upper Colorado River Commission expects wholehearted support for its objectives from both major parties; and that the desirability of early development of the water resources of the Upper Colorado River Basin is not and must not be allowed to become a political issue.

Proposed policies and legislation that might create conditions unfavorable to development of the water resources of the Upper Colorado River Basin have been opposed and will continue to be opposed by the Commission. Thus, representatives of the Commission, in conference with officials of the Bureau of the Budget, have made clear the Commission's opposition to the creation of a Federal Commission for the Upper Colorado River Basin (Appendix A). They have also advised the House Committee on Interior and Insular Affairs of the Commission's desire to be heard, in the event that Committee or any sub-committee thereof should undertake the consideration of H. R. 5023 "A BILL—To prohibit the construction, operation or maintenance of any project for the storage or delivery of water within or affecting any national park or monument."

The Commission has endeavored to follow a statesmanlike, balanced and objective policy with respect to proposed legislation and policies tending to affect relationships with other Colorado River Basin States. No better evidence of the Commission's desire for the friendliest relations with all States of the Colorado River community is needed than that which is found in the Commission's attitude on the Central Arizona project and in its open espousal of authorization of the second barrel of the San Diego Aqueduct. See Appendices B and C, respectively, for the clearest expression of the Commission's position in these matters.

An example of the Commission's concern for completeness of approach to the problem of basin-wide development is the resolution (Appendix D) urging upon the Congress appropriations adequate to enable established agencies of the Federal Government to carry out their functions within the Upper Colorado River Basin. This resolution was read recently before the Interior Sub-Committee of the House Committee on Appropriations. That it is being properly construed by agencies of the Executive Branch of the Federal Government is indicated by a letter from the Secretary of Agriculture (Appendix E).

The Commission, finally, has sought to encourage, but without gratuitous interference, the solution within Colorado and New Mexico, respectively, of problems affecting apportionment within them of the use of waters of the Colorado River System and affecting also,

the size and location of one or another reservoir. As this report is written, it would appear that long strides toward amicable and satisfactory solution of these problems have been taken. All parties concerned are to be congratulated.

All in all, notwithstanding delays that have occurred in the transmittal to the Congress of the Interior Department's report on the Colorado River Storage project and participating projects, the year covered by this report has been one of solid accomplishment that augurs well for the future and in which each member of the Commission, his staff and the people of his State can take pride.

VI. HYDROLOGY

Collection of stream flow records from the Water Resources Branch of the U. S. Geological Survey and from state offices has continued and all such records are readily available in the Commission's files. The Commission also receives, through the cooperation of the U. S. Weather Bureau, annual and monthly Climatological Data bulletins for Colorado, Utah, Wyoming, New Mexico and Arizona. This includes all five states of the Upper Colorado River Basin. The Commission also receives, through the cooperation of the U. S. Soil Conservation Service, reports on snow surveys made in cooperation with other agencies of federal and state governments. Those reports cover the states of Utah and Arizona, the drainage basin of the Colorado River, the Rio Grande and the Platte and Arkansas Rivers. These data, now in the Commission's files, make possible the detailed hydrologic investigations now underway in the engineering department.

The table of gaging stations and stream discharges, which appeared in the First and Second Annual Reports, is again given as Appendix J in this Third Annual Report. Stream discharges for the water year 1951 have been added to the previous table in so far as the provisional records for these stations have been received. A few minor alterations and corrections have been made in the new table.

No forecasts of water supply were made for the season of 1951, but a study is underway in the engineering department of methods and formulas for the forecasting of stream flow in the State of Colorado. A preliminary report on this study for forecasting the summer flow of the Roaring Fork at Glenwood Springs is given as Appendix F. This report indicates the methods adopted for the study and formulas for this stream. Similar methods and formulas will be developed for the other principal streams of the State and

later for the other states of the Upper Basin. References to forecasts by federal and other agencies are also made in this Appendix.

The Commission is authorized by Article VIII of the Upper Colorado River Basin Compact to make findings of fact and through cooperation with the Water Resources Branch of the U.S.G.S., it is in a position to do so in regard to water deliveries made at Lee Ferry. Reports received to-date show that 11,057,000 acre-feet of water passed Lee Ferry during the water year of 1950 and that 9,831,000 acre-feet passed this point during the water year of 1951. These reports also show the total deliveries of water during the two ten-year periods for the water years 1941 to 1950 and for 1942 to 1951, both inclusive, of 130,375,000 acre-feet and 124,138,000 acre-feet, respectively.

The investigation of reservoir losses which was mentioned in the last annual report has been undertaken during the past year and a report on these studies to-date appears as Appendix G in this Third Annual Report. This Appendix on evaporation gives formulas for estimating the approximate losses from reservoirs in the Upper Basin at possible reservoir sites where no climatological data are available. The formulas depend only upon the average elevation of the water surface and the latitude at the proposed site. The standard error of these formulas is less than 3 inches or 5.5% of the average annual depth (55 inches) of evaporation for the 24 weather stations considered in this investigation. The actual amounts of evaporation vary from an average of 91.2 inches at Lake Mead to 22.5 inches at the highest elevation considered, 10,000 feet. At such high elevations, the maximum error may be as much as 5 inches, the estimates being too low by that amount. The report also includes a table showing the estimates of the evaporation reported for the Commission in a memorandum dated November 21, 1951. The table shows the probable increase in the evaporation for the combinations of reservoirs at the Desolation and Gray Canyon sites of 261,000 acre-feet over what would probably occur from the Echo Park and Gray Canyon sites. This indicates, as has been repeatedly stated, the increased loss that must be anticipated from any substitutions of other reservoirs for those proposed in the Colorado River Storage project and participating projects report of the Bureau of Reclamation. The combination of the Desolation and Dewey sites in place of Echo Park and Gray Canyon which has been recommended from certain quarters would give an increase of evaporation over that to be expected from Echo Park and Gray Canyon of 560,000 acre-feet. This is over 3½ times as great a loss as would occur from Echo Park and Gray Canyon combined.

An interstate priority schedule for administrative purposes on the Little Snake River is required by Article XI (a) (2) of the Upper Colorado River Basin Compact. With the cooperation of the State Engineers of Colorado and Wyoming, this schedule has been completed and is included as Appendix H.

It is understood that the Water Resources Branch of the U.S.G.S. has installed the new gaging stations requested by the Commission at the time of its organization and that stream discharge records are being collected for these stations with the exception of one in the Green River Basin in Wyoming and those on the Animas River in New Mexico. All the materials and equipment for the installation of these stations are available and the installation will be made during the summer season of 1952.

During the early part of the past year a great deal of time was spent in studies connected with the Inflow-Outflow method because of several questions raised by the Engineering and Legal Committees of the Commission. The Report of the Chief Engineer given at the meeting of the Commission on January 20, 1951 gave the results of the studies up to that time and little more progress has been made because of other hydrologic investigations by this department. Appendix I contains a brief review of the studies on the Inflow-Outflow Method.

APPENDIX A

MEMORANDUM FOR BUREAU OF BUDGET ON SUBJECT OF NATIONAL WATER RESOURCES POLICY

Submitted by John Geoffrey Will, Secretary and General Counsel In Behalf of the Upper Colorado River Commission

The Upper Colorado River Commission had been aware for some time of invitations extended to various organizations to consult with the Bureau of the Budget on the subject of national water resources policy. When several months elapsed, during which the Upper Colorado River Commission was not accorded the honor of an invitation to participate even in a small way with the Bureau of the Budget in discussions that might have some effect on the formulation of proposals for legislation relating to national water resources policy, the Commission became alarmed lest there be not presented to the Bureau of the Budget the complete picture of the situation affecting particularly that part of the West which is known as the Upper Colorado River Basin, and lest, therefore, such proposals as might in due course be formulated be harmful rather than helpful to development of the water resources of that vast region. It was because of that fear that I ventured on October 30, 1951 to ask Budget Director Lawton for an opportunity to appear. I am very glad indeed that the Commission has this opportunity through me to discuss with officials of the Bureau of the Budget the subject of national water resources policy.

One group which appeared before the Bureau of the Budget apparently sought to give and perhaps succeeded in giving the impression that it was representative of the National Reclamation Association. That is the group which appeared on the 3rd day of December 1951 and which was composed of Messrs. C. Petrus Peterson, Harry E. Polk, George T. Cochran, Guy C. Jackson, Jr., Merl B. Peek, Arvin B. Shaw, Jr., and W. G. Sloan. It is worthy of note that this group did not appear before the Bureau of the Budget pursuant to any authority conferred upon it by any resolution of the National Reclamation Association. The only way in which the National Reclamation Association can speak is through its resolutions. The resolutions adopted by the National Reclamation Association do not support several of the propositions made by the group in question to the Bureau of the Budget on December 3, 1951. The resolutions adopted by the National Reclamation Association do

not support the creation of a Board of Review to examine proposed water resource development projects. Another proposition not supported by any resolution of the National Reclamation Association convention at Amarillo is that made by Mr. Shaw to the effect that the National Reclamation Association favors the sale of hydroelectric energy at the busbar and the construction of transmission lines by the Federal Government only for direct connection between plants.

Some of the discussion by the group above mentioned with officials of the Bureau of the Budget must have been reminiscent of the report of the Basin Development Committee to the 19th Annual Meeting of the National Reclamation Association at Spokane in November 1950. That report has been analyzed in detail by the Upper Colorado River Commission. Such analysis is contained in Appendix A of the Second Annual Report of the Commission. Copies thereof will be made available to the Bureau of the Budget along with this memorandum.

At the outset it may be of interest to consider whether there is occasion for the establishment within the Upper Colorado River Basin of a River Basin Commission with an independent chairman and composed of federal and state agencies sharing both the planning and financing responsibilities. So far as the Upper Colorado River Basin is concerned a good organizational base has already been established through the creation of the Upper Colorado River Commission. The Bureau of the Budget is familiar already with the functions, powers and duties of the Upper Colorado River Commission. It is, therefore, unnecessary to extend this memorandum by any discussion of them. Suffice it to say that these functions, powers and duties, coupled with the fact of representation of the United States on the Commission and with the policy which the Commission has consistently followed of seeking to encourage the full exercise by the Federal agencies concerned of their respective functions, powers and duties and the harmonization of activities of all of these federal agencies, presents a total picture of organization for water resources development, conservation and utilization that is far more complete than anything now in effect in any area of the country, including the Tennessee Valley. The creation of a Commission such as has been suggested by the Bureau of the Budget would, so far as the Upper Colorado River Basin is concerned, be superfluous and, therefore, wasteful.

The report of the President's Water Resources Policy Commission has undoubtedly been reviewed with great care by the Bureau of the Budget.

Any review of the three volumes issued by the President's Water Resources Policy Commission must, among other things, take into account that the Commission had but a limited time within which to work. It began its work in January of 1950 and it completed at least Volume I thereof (which comprises its recommendations) in December of the same year. During that limited period of time it held hearings in various parts of the country and it must have received thousands of pages of material. If, therefore, it appears to have, from time to time, an inadequate grasp of the significance of existing policies which have resulted from many years of experience and evolution in the field of water resources development, it is not to be criticized too severely. The criticisms, if any, must be leveled at those who naively supposed that any group, no matter how well composed, could do, in less than 12 months, an adequate job of analytical survey of such existing policies in order to find their weaknesses and to suggest improvement.

It would appear, from a statement made in the Introduction (See page 4, under the heading "Evolution of Water Resources Policy") that one of the purposes of the Commission was to arrive at "a restatement of national water resources policy" and also to set forth in orderly fashion and perhaps carry a step forward "a policy which has developed as a result of the constructive thinking of many able people in Government agencies and departments, special commissions, congressional committees, on the floor of Congress, and in the White House over a period extending back more than a century and a half." In no sense, however, can the Commission be said, at any point, to have achieved "a restatement of national water resources policy." It has, on the other hand, set forth from place to place its notions regarding changes in existing policy. The introduction to Volume I summarizes its position thus:

> "This Commission is convinced that the next step forward must be the application of unified responsibility to the planning of multiple-purpose basin-wide developments. This need not be in accordance with the Tennessee Valley Authority pattern so far as organization is concerned. But it must take advantage of what the country has learned from that experiment in unified development of the water resources of basins."

The respectful bow which the Commission makes in the general direction of the Tennessee Valley Authority might, it may be expected, have been somewhat less obsequious had the Commission realized (as it most certainly would if it had had time within which to make more thorough investigations) that the job which the TVA

is doing is not a comprehensive basin-wide job in the first place, and that the problem which would face the TVA, even if it undertook a truly comprehensive job in its own area, does not begin to encompass the field that must be covered in many of our great western river basins. Furthermore, neither in the Introduction nor elsewhere in its report does the Commission appear to give recognition to differences in conditions prevailing in different geographical areas.

Under the heading "The economic responsibility of the Federal Government" (beginning on page 8 of the Volume I), the statement is made that: "It is not enough, from the point of view of the Federal Government, that a project be good; it must, in order to justify itself, be the best among alternatives." This statement would appear to result from the monstrous recommendations made to the Commission by the Engineer's Joint Council. On analysis, what it might mean, in effect, is that water resources programs would or should come to a halt while the Nation spends the next few decades in examining all proposed projects and in comparing them with one another to determine that which is best. In the Upper Colorado River Basin, however, since no alternative for the Colorado River Storage project and participating projects has been produced, it may well be that the Commission would say: Go ahead.

The framework of principles upon which the Commission insists that it has proceeded is not, in all instances, compounded of principle so much as it is of catchwords or slogans. "One river, one plan" is an instance of this. Even the eminently conservative Herbert Hoover recognized that such a slogan might not be applicable to the Colorado River System. He held, on the contrary, that the Colorado River Basin is composed of two basins "varying in topography and being separated by a thousand miles of deep canyon." He held further that their "climate, crops, and use of water" were "different."

The President's Commission suggests that the great objective of a sound national water resources policy is "The strengthening of our way of life on a more enduring basis." Fortunately for all, it breaks this down as follows:

1. The "provision of a secure and expanding natural resources base for an expanding national economy, and its development as a stimulus to the expanding needs of that economy."

2. The "development of the resources of the several

regions to provide a stimulus for sound regional economies."

3. The "participation of citizens generally through their educational institutions, their non-governmental organizations, and their agencies of State and local government."

The generality of the language in which this objective is set forth and the meager delineation of the same will be of but little assistance to the Congress, one suspects. However that may be, the present objectives of the Federal Reclamation Law and the purposes to be served by the Upper Colorado River Storage project and participating projects, as well as the procedures being followed in connection with the preparation of the project scheme and plans and consultations from time to time under Section I of the Act of December 22, 1944 tend to indicate not only that the Congress has had such objective in mind for some years, but also that such objective and implementing procedures were followed in the preparation of the report on the Colorado River Storage project and participating projects as well as in the investigation that preceded its preparation.

The Commission suggests that "These objectives (recommended by the Commission and to be laid down by the Congress) should reflect the general purpose of water resources investment to achieve the maximum sustained use of lakes, rivers, and their associated land and ground water resources, to support a continuing high level of prosperity throughout the country. They should include the safeguarding of our resources against deterioration from soil erosion, wasteful forest practices, and floods; the improvement and higher utilization of these resources to support an expanding economy and national security; assistance to regional development; expansion of all types of recreational opportunity to meet increasing needs; protection of public health; and opportunity for greater use of transportation and electric power." Here again, the Commission seems to be unaware of the fact that, in the main, the Congress has dealt not inadequately with virtually all of these objectives. With respect to a few of them, however, it is undoubtedly true that some expansion and elaboration of existing law is desirable. But we ought not to complain of the failure of Congress to treat of these matters in a single statute.

The Commission feels that the "Congress should direct the responsible Federal agencies to submit new proposals for water resources development to Congress only in the form of basin programs which deal with entire basins as units and which take into

account all relevant purposes in water and land developments." Here again the Commission fails to take account of the division of the Colorado River Basin into two basins—an Upper and a Lower. In all other respects the Colorado River Storage project report and the reports on participating projects, supplemented with plans of the Soil Conservation Service and the Forestry Service, the Fish and Wildlife Service, the National Park Service, and others would seem to comply with this policy recommendation.

The Commission avers that: "To insure the preparation of sound basin programs, Congress should direct the responsible Federal agencies to cooperate with each other and with the appropriate State agencies in the necessary surveys and plans. . . Congress should set up a separate river basin commission for each of the major basins. These Commissions, set up on a representative basis, should be authorized to coordinate the surveys, construction activities, and operations of the Federal agencies in the several basins, under the guidance of independent chairmen appointed by the President and with the participation of State agencies in the planning process." To a great (and perhaps to a wholly sufficient) extent, the Federal Government agencies are doing this very thing to-date, through a committee system. The proposal for the creation of river basin commissions would, therefore, tend, to some extent, only to formalize that which is already being done. To the extent that it would proceed beyond that point, the proposal is open to the objection that it would add another layer to bureaucracy (the term is not used in an invidious sense) and that it does not afford sufficient basis for adequate participation by States and sub-divisions thereof. The Upper Colorado River Commission has already had an important part in the formulation of plans for the development of the water resources of the Upper Colorado River Basin. It expects to continue to play a major role in connection with the authorization and construction, the operation and maintenance of the Colorado River Storage project and participating projects. Its role far transcends the purely advisory role that would be handed to the States by the President's Commission. As we have already said, the creation of a River Basin Commission in the Upper Colorado River Basin would be superfluous.

While concerned only to the extent that politeness appears to require with the part to be played by the States and sub-divisions thereof in connection with the planning of water resources development, the President's Commission has displayed much greater concern with the extent to which the States and their sub-divisions shall assist in meeting the costs of such developments. For instance,

the Bureau of the Budget interprets the Presidential Commission's report as recommending that costs not allocated to water supply, power, navigation, reclamation and (presumably) flood control " . . . would be divided by agreement among the basin commission and the interested States, in an allocation meant to indicate the share of State and Federal responsibility for amortization in the interest of general welfare." It must be conceded at the outset, that, so far as many of the 17 Western States are concerned, any provision for their direct participation in the amortization of costs of a water resources development project, would probably require amendment of their respective constitutions together with the enactment of legislation in aid thereof. Neither of these seems likely to be achieved. Nor does it appear to be either necessary or wise to insist upon them. For the States and their subdivisions participate already in the amortization of the costs of water resources development projects within their borders. They do this through their citizens who pay conservancy district and irrigation district taxes and assessments. They do it through their citizens who pay municipal taxes for water and water rent besides. They do it through their citizens who pay for electric power and energy. In so far as the costs of improvements for navigation, flood control and the general welfare are concerned, the States participate through the payment by their citizens of taxes levied by the Federal Government.

The Bureau of the Budget interprets the Presidential Commission's report as recommending that "Vendible services should be fully paid for." This interpretation is open to serious question. The evidence of Bureau of the Budget officials, testifying some six months ago before the Irrigation Sub-Committee of the House Committee on Interior and Insular Affairs, on the subject of the Presidential Commission's suggestions in this respect, added up, in the words of Chairman Engle, to "a more nebulous standard than we have at the present time." On the occasion of the same hearings, the question was raised as to the Presidential Commission's position with respect to the established policy of the application toward amortization of irrigation costs, of interest returned on the Federal Government's investments in the power features of projects. The following colloquy then occurred:

Use of the Interest Component to Repay Irrigation Costs.

Mr. Engle: What do they say about the interest component and the use of that for the purpose of defraying irrigation costs?

Mr. Scheidt: In the recommendations the interest component is

not mentioned as such. There is reference to it in the discussion of the chapter on reimbursement. I would like to read a paragraph, if I may, with reference to that, which I think is probably the best reference in the entire document. The only very specific reference to it is this first whole paragraph on the left-hand column of page 71.

"A third criticism of the source of repayment funds is the use of the interest component on the power investment for excess power revenues, or other available revenues to repay a part of the irrigation investment. The principal defense of this practice is that the river resources should be used to develop the land of the basin, or region, particularly since the areas in which irrigation currently is important are generally underdeveloped. Dependence on power revenues in this manner, however, may result in failure to develop some good land because of the lack of power resources in that area, or power rates may have to be higher than would otherwise be necessary."

That is all that is specifically said in the entire report. In the recommendations no direct reference to it is made.

Mr. Engle: You cannot find any place in the report where the Commission puts its foot down and says—We think the interest component should not be used, or that the interest component should be used in aid of irrigation?

Mr. Scheidt: Not in those words, no, sir.

Mr. Engle: It looks to me like they dodge the hottest potato in the whole program.

Mr. Murdock: May I ask this—If they do not say it in so many words, do you find it implied, either for or against?

Mr. Scheidt: **It is susceptible of interpretation, I think, both ways.**

Mr. Murdock: Again, like the Oracle of Delphi.

Some fearful and wonderful things have been said, from time to time, about the long established policy, required by existing law for many years, of crediting net income (interest is a part of net income) from the Federal Government's investment in the power features of Federal Reclamation projects toward amortization (after pay-out without interest of the capital investment in such features) of other costs of the project of which they are a part. In

fact, the policy is essentially simple and straightforward. In order that it shall be fully understood, however, it must be viewed in the light of historical background.

The generation of hydroelectric energy as an incident of Federal water resource projects and the disposition thereof, "giving preference to municipal purposes," was first authorized as far back as April 16, 1906, in an act of Congress entitled 'An Act providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation act of June 17, 1902 and for other purposes' (34 Stat. 116), and, shortly after that, the Comptroller of the Treasury held that receipts from the sale of such power should be classified as repayments. Therein lie the beginnings of a policy which has been elaborated through the years, as required to meet the needs of society, until today, under the Federal Reclamation Laws, power plays an increasingly vital function both in the physical and in the financial aspects of water resource projects. With existing general Federal Reclamation Law on the subject of authorization, construction, operation and maintenance of hydroelectric power plants, including transmission lines, and governing rate-making and the distribution of power (and subject to its modernization and modification in certain respects such as to provide, among other things, for the establishment of a basin account), the Upper Colorado River Commission is satisfied. If other regions believe that they require different treatment of the subject, then they should, of course, have an opportunity to demonstrate the desirability of legislation that will permit such treatment there. The present state of Federal Reclamation Law on this subject, is, however, in general, well suited to development of the Upper Colorado River Basin.

This is so, because the present state of such law, while recognizing fully the vital role of power in itself, protecting against the monopolization of its benefits, affording preferences to municipalities and other public corporations, to REA's and other non-profit organizations, also recognizes the vital role that power plays in the financing of water resource projects as a whole, making feasible from the financial point of view many desirable and worthwhile projects that must otherwise fail to measure up to standards of feasibility. Long delayed development of the water resources of the Upper Colorado River Basin depends in large measure upon the application to that development of the established policy of the Reclamation Law that power plants shall be constructed as an incident thereof wherever the generation of power proves feasible; that preference in the distribution of such power shall be accorded to

municipalities and REA's; and other power revenues, in excess of those required to meet operation, maintenance and amortization costs of the power plants, shall be available to help pay off the other costs of water resource projects. In this connection, the suggestion has been made in certain quarters that REA cooperatives, for instance, ought not to have to pay for power a rate in excess of that required to operate, maintain and return the cost of the power generation and distribution plants themselves. Such a conception fails to take account of the fact that, in the Western States, at least, the farmers in the main owe their very existence to water resource development projects which could not, in turn, exist without power as a paying partner. So far as the Upper Colorado River Basin is concerned in any event, it appears clear that even the large scale irrigation development which is in the offing will not require financial assistance through any special component of power rates, but that interest returned on the power investment will be sufficient therefor. In other words, those irrigation costs of our prospective development that are beyond the reasonable ability of prospective water users to repay within a reasonable period of years can be financed through revenues derived from the interest component of power rates as provided by existing Reclamation Law, and, so long as the traditional policy of application of such interest revenues to return of costs permits, the REA cooperatives and others are assured of reasonable rates for power. In this connection, it should be borne in mind that the report on the Colorado River Storage project and participating projects (a report which has been favorably commented upon by the five Upper Basin States) envisages the establishment of a basin account that recognizes the financial interrelationship of projects participating and that provides for financial assistance from power revenues. This basin account recognizes the essential unity of the Upper Colorado River Basin. It serves a two-fold purpose. First, in that it averages the cost of power development throughout the Upper Basin, thus diffusing, by means of uniform rates, the benefit of the Upper Basin's power developments; and, second, in that it provides a means whereby proposed irrigation developments may be judged on their intrinsic merits, that is to say, on the basis of their benefit-cost ratios, without regard to the question whether a particular development has associated with it a power development of magnitude sufficient to repay those irrigation costs that are beyond the ability of the water users to repay. This answers the fears expressed by the Presidential Commission (referred to by Mr. Scheidt, see page 20 of this report) that "Dependence on power revenues . . . may result in failure to develop some good land because of the lack of power resources in that area . . ." We regard a basin account

as necessary for the purpose of achieving a power rate based upon the cost of all the proposed power developments in the Upper Basin and also for the purpose of providing a pool of financial assistance to irrigation developments so that their undertaking will be dependent solely upon their own merits and without regard to the geographic accident of their location in relation to a particular power development.

As has been pointed out, the policy of application of power revenues to project costs was first laid down in 1906. It was reiterated in the Hayden-O'Mahoney amendment of 1938. It has been applied ever since that date. It is an established policy that is fully consistent with sound government and with sound accounting. It is highly beneficial to existing and further water resource development in the Western States.

The historical basis for the traditional policy of application of the revenues derived from the interest component of power rates to the return of the Federal Government's investment is so often used as to give rise to the statement: 'Yes—we understand the historical argument. We understand that such has been the practice ever since the year 1906; but what about the merits?' Merit, as well as tradition, is on the side of adherence to the policy of application toward return of costs of Federal Reclamation projects of the revenues derived from the interest component of power rates.

The basis for not requiring the return, by those who repay and return the reimbursable costs of Federal reclamation projects, of interest on those costs, lies principally in the fact that encouragement thus given to the undertaking of projects for the development, conservation and utilization of water resources produces benefits for the general welfare of the country as a whole and that the cost of providing such encouragement should, therefore, be borne by the country as a whole. In the final analysis, under the provisions of the Hayden-O'Mahoney amendment, once power revenues have paid into the Reclamation Fund all sums allocated to be returned from the power revenues of a particular project, then all subsequent net power revenues flow into the General Fund of the Treasury. Thus, the Federal Government stands, in time, to collect directly, many times the interest first forgiven. And this is in addition to the gain in Federal revenues derived from increased tax revenues in the area served by the project. The Upper Colorado River Commission confidently predicts that studies will show conclusively that in particular areas this gain in tax revenues alone is much more than sufficient to reimburse the Federal Government with interest for its total outlay in the construction of a project.

The preservation and continued application of that policy is vital to further development of water resource projects in the Upper Colorado River Basin. Finally, since the abandonment of that policy would greatly increase the cost of power, the preservation and application of that policy is of immense importance to REA cooperatives, municipalities, and others, for which power should, of course, be supplied at the most reasonable rates.

In the light of the foregoing, it surely becomes clear that there is reasonable basis in law and in policy for charging for certain vendible services (e.g. power and municipal water supply) rates perhaps slightly higher than might be required to return their mere cost in order to make certain other vendible services (e.g. irrigation water) available at a price that can be met. In the Upper Colorado River Basin, however, it will not be necessary to charge a higher rate for either power or municipal water. Interest returned on the power investment will afford sufficient financial assistance toward pay-out of irrigation costs.

APPENDIX B

RESOLUTION

CENTRAL ARIZONA PROJECT

WHEREAS, in their comments on the Central Arizona Project at the time the report on such project was submitted for comments pursuant to the provisions of Section 1 of the Flood Control Act of 1944, the States represented on the Upper Colorado River Commission either endorsed the authorization of such project or offered no objections to such authorization; and

WHEREAS, having once more considered the question of the feasibility of the project, the Upper Colorado River Commission deems that the Central Arizona Project is feasible; and

WHEREAS, the Upper Colorado River Commission recognizes the extreme need for the project to prevent the collapse of the economy of a sovereign state:

NOW, THEREFORE, BE IT RESOLVED that the Upper Colorado River Commission does hereby endorse authorization of the Central Arizona Project in accordance with the terms of S. 75 and H. R. 1500 now pending in the Congress.

APPENDIX C

Statement of John Geoffrey Will
Secretary and General Counsel, Upper Colorado River Commission
Before the
Armed Services Committee
of the
House of Representatives

Regarding
H. R. 5102

A Bill

"To authorize the Secretary of the Navy to enlarge existing water supply facilities for the San Diego, California, area in order to insure the existence of an adequate water supply for naval and Marine Corps installations and defense production plants in such area."

I am deeply grateful for this opportunity to appear in support of legislation to authorize the construction of works to enable the City of San Diego, and its environs in the State of California, to receive an additional water supply for municipal and agricultural purposes. I am grateful also for this opportunity to demonstrate by act and deed, both officially and personally, that long standing friendship which the Upper Colorado River Commission and I feel toward the great State of California, one of the community of states in the Colorado River Basin—a feeling of friendship that has endured notwithstanding those occasions that have found us at times not seeing eye to eye with our friends. In that connection, Mr. Chairman, I venture to express the hope that the time is not too distant when some means will be found whereby all of the Colorado River Basin States can once more gather together under one banner to discuss their several plans and long range objectives and find those respects in which agreement lies. I am confident that, had those means existed before the introduction of H. R. 234, the original bill to authorize these works, much of the regrettable delay that has since occurred could have been obviated.

Preceding bills to authorize construction of the works that would be authorized by the enactment of H. R. 5102 have been viewed by the Upper Colorado River Commission with some lack of enthusiasm. H. R. 5102, however, goes far toward meeting those

objections to which preceding bills gave rise. I congratulate Congressman McKinnon on the inclusion in H. R. 5102 of Section 6 which provides, in effect, that all works constructed thereunder shall be subject to and controlled by the Colorado River Compact, the Boulder Canyon Project Act and the California Limitation Act and that no right or claim of right to the use of the waters of the Colorado River shall be aided or prejudiced thereby. Some such assurance is needed in the light of the statement contained in the 1948 report of the San Diego County Water Authority on the ". . . need and feasibility of increasing the capacity of the San Diego aqueduct" that "In the meanwhile, the Metropolitan Water District's water rights can either be strengthened by a policy of diverting and using increasing amounts of Colorado River water in communities where the need exists, or such rights may be weakened by pursuing a policy of restricting further use of Colorado River water until the decision of the (Supreme) court has been received." I understand that the foregoing statement from the 1948 report of the San Diego County Water Authority no longer represents the official position of that body. Nevertheless, the fears engendered by that statement remained. Section 6 of H. R. 5102 will tend to dispel them. A few additional amendments upon which, I understand, agreement has been reached will complete the job.

The project proposed to be authorized by H. R. 5102 is soundly conceived and badly needed. It would make a good project for authorization and construction under the Federal Reclamation Laws. In purpose, for instance, it is similar to a little project in Colorado, known as the "Collbran project," upon which hearings were recently held before the Irrigation Sub-committee of the House Committee on Interior and Insular Affairs. Procedures called for in connection with the authorization of flood control and Federal reclamation projects are admittedly somewhat burdensome. Reports on such projects are required to be circularized among affected states for 90 days, and the comments of such states, received within that time, must be transmitted to the Congress along with the report on the project. In the case of the Collbran project that procedure was adhered to strictly, notwithstanding the fact that one of the principal purposes of the project is to provide an additional municipal water supply to a city which is becoming known as the uranium capital of the world and in which vital national defense activities are centered. That procedure has not been followed in the case of the project proposed to be authorized by H. R. 5102. In view of the need of San Diego and San Diego County and their environs, and in view of the lapse of time, it has been

concluded that, so far as the Upper Colorado River Commission is concerned, there will be no insistence upon that procedure in this case. I point to this conclusion as another bit of evidence of friendship for our California neighbors. The policy represented by existing statutory procedures in connection with the authorization of water resources projects is wise. The present departure therefrom in H. R. 5102 ought not, therefore, to be deemed a precedent.

I am constrained to advise that there is disagreement as to the legal availability of water from the Colorado River System for the city of San Diego and its environs. I do not for one moment suggest that, because such disagreement exists, the project to transport water to the San Diego area should not be authorized. I do think, however, that this Committee and the Congress ought to be fully advised in the premises. The disagreement to which I refer is one in which two states, Arizona and California, are generally considered to be primarily concerned. It involves construction of the documents and statutes described in Section 6 of H. R. 5102 as well, perhaps, as the Mexican Water Treaty. If one view should prevail in all or virtually all respects and if the present California priority agreement should remain unamended, then it seems doubtful that Colorado River water will be available for transportation to San Diego. Should another view prevail in all or virtually all respects, there will probably be sufficient water legally available for transportation to San Diego.

The question here is similar in a sense to questions posed other committees of the Congress in connection with the proposed authorization of the Central Arizona project. In that case, the Senate has twice resolved to authorize the project notwithstanding disagreement on the legal availability of a water supply therefor. The House, on the other hand, has not finally taken a position. Action taken by this Committee and by the House on H. R. 5102 may, therefore, constitute an interesting precedent in that respect.

I have deliberately left untouched the question whether the existing priority agreement among California agencies, regarding their use of waters of the Colorado River System, should be amended. Just as the States represented on the Upper Colorado River Commission might resent suggestions from outside regarding their purely internal affairs, so might California properly object to any suggestions from me in that regard. I refer to that priority agreement only for the purpose of pointing out to this Committee that it **could** be so amended as to foreclose any doubts regarding the

legal availability of water for San Diego and her environs whatever view may finally be taken on larger questions.

As I said a moment ago, the project proposed to be authorized by H. R. 5102 is soundly conceived and badly needed. I would be happy to see it authorized, subject only to such minor amendments as will fully protect the interests of the States concerned.

APPENDIX D

RESOLUTION

WHEREAS, one of the principal objectives of the Upper Colorado River Basin Compact is to secure the expeditious agricultural and industrial development of the Upper Colorado River Basin in the interests not only of the Upper Basin States themselves but of the country as a whole; and

WHEREAS, such development hinges principally upon the development, conservation and utilization of the water resources of the Upper Colorado River Basin; and

WHEREAS, continued investigations by the Department of the Interior, particularly through the Bureau of Reclamation, the Geological Survey, the Fish and Wildlife Service, the Bureau of Indian Affairs, and the National Park Service; and by the Department of Agriculture, particularly through the Soil Conservation Service, the Forest Service, and the Rural Electrification Administration, are essential for the production and execution of the soundest plans of development, conservation and utilization of the water resources of the Upper Colorado River Basin; and all of said agencies have carried out effective programs in the Upper Colorado River Basin for a number of years,

NOW, THEREFORE, BE IT AND IT IS HEREBY RESOLVED BY THE UPPER COLORADO RIVER COMMISSION

1. That this Commission desires hereby to express its appreciation to the Departments and agencies named in the preamble to this resolution for the efficiency and effectiveness with which their programs have, in general, been carried out in the Upper Colorado River Basin.

2. That the Congress is urged, to the fullest extent practicable in the light of other needs, to appropriate for such agencies funds adequate to enable them efficiently to continue their programs in the Upper Colorado River Basin.

3. That the Secretary and General Counsel of the Commission be and he is hereby authorized and directed to do all things necessary and proper to call this resolution to the attention of the Executive and Legislative Branches of the Federal Government,

their agencies and committees, to the end of encouraging appropriations to the agencies herein named.

CERTIFICATE OF SECRETARY

I hereby certify that I am Secretary of the Upper Colorado River Commission; that I have custody of the records of its proceedings; that the above and foregoing has been compared by me with the original thereof set forth in said proceedings; and that it is a true copy of a resolution adopted by the Upper Colorado River Commission on January 9, 1952, at Denver, Colorado.

IN WITNESS WHEREOF, I have hereunto set my hand and the seal of the Commission this____day of_____19___.

John Geoffrey Will
Secretary and General Counsel

APPENDIX E

DEPARTMENT OF AGRICULTURE

Office of the Secretary

WASHINGTON

January 31, 1952

Mr. John Geoffrey Will
Secretary and General Counsel
Upper Colorado River Commission
520 Rood Avenue
Grand Junction, Colorado

Dear Mr. Will:

The Department of Agriculture has endeavored through the years to encourage and facilitate the protection, development and conservation of the natural resources of the Colorado River area, including the Upper Basin. It has large responsibilities for administration of important timber and range producing areas on the National Forests there which also perform a key watershed protection function of interest and value to all residents of the area and to many others elsewhere. It has contributed to the stabilization and improvement of the area's agricultural resources and interests.

We appreciate the recognition given to these efforts by the Upper Colorado River Commission, in its resolution enclosed with your letter of January 14, and expect to continue them as available means will permit. In order to give direction and leadership to future efforts, this Department now proposes to develop, in cooperation with the States and other Federal agencies, a multiple purpose program for the proper use and conservation treatment of the watershed lands of the Colorado River Basin that will be complementary to engineering structures on the main stem of the River. An initial appropriation request, in the form of a $200,000 increase for General Basin Investigations under the Department's Flood Control item, is included in the Budget Estimate for the Fiscal Year 1953. We believe you will be interested in this and in the prospects it holds for further sound development and use of the Basin's resources.

Sincerely,

(signed)
Charles F. Brannan

Secretary

APPENDIX F

FORECASTING STREAM FLOW

Investigations of various methods of forecastin
have been begun. In this connection, the Commission
closely the work of the several agencies participating in the Western Snow Conference and the Colorado River Forecasting Committee. The Commission is one of some fifty or more organizations and agencies which contribute to the cooperative enterprise conducted by the Western Snow Conference. The annual reports of this Conference contain many valuable papers and discussions on the subject of forecasting stream flow as well as on related topics such as cloud seeding or other investigations of possible methods for the control of precipitation. Other valuable reference material on the subject of forecasting stream flow is to be found in the Proceedings and Transactions of the American Society of Civil Engineers and in the Transactions of the American Geophysical Union. Copies of papers, some of which are not published for general circulation, and special bulletins printed by Federal and other agencies are also being collected for the library and files of the Commission. Among the latter is "Engineering Monograph No. 2," printed by the U. S. Department of the Interior, entitled "Multiple Correlation in Forecasting Seasonal Runoff," by Perry M. Ford, engineer with the Hydrology Division, Branch of Project Planning, Bureau of Reclamation, Denver. Similar correlation methods have been used for many years in the study of problems in hydrology; and multiple correlation procedures seem to promise the most reliable method by which to arrive at practical results both in forecasting stream flow and in using the inflow-outflow method. One advantage in the use of mathematical correlation, instead of graphical correlation is that the limits between which the actual discharge is most likely to fall can easily be given with greater certainty.

A review of the water resources throughout the United States and Canada is published monthly by the U. S. Geological Survey and the corresponding agency of Canada. This four page review for any month is usually received by the middle of the following month. A map of the United States and Southern Canada is given on the first page, which shows at a glance the general conditions as to stream flow. This map shows that the runoff for January 1952 was 25% or more above normal all along the continental divide from Canada across Arizona and into Mexico, while Eastern Colorado and Western Utah had about average stream flow. The discharge of the San Juan is said to have been above normal for January for the first time in two years.

Water Supply Forecasts for the Western United States are published annually by the U. S. Weather Bureau for the five months, January through May. The bulletins for January and February of the water year 1951-1952 are at hand as this Third Annual Report of the Commission is being prepared. The three later bulletins for this season will be received in due time. The March number will include revised and therefore more accurate forecasts, but probably not in time to include them in this statement. The following is quoted from the February issue, concerning the Colorado Basin.

"January brought above-normal precipitation to most of the Upper Colorado River Basin. In general, precipitation amounts ranged from 130% to 180% of normal; over the upper San Juan, from 170% to 300% of normal. The only areas having below-normal precipitation were lower stations in the Duchesne and Grand River Valleys and the extreme headwater area of the Green River in Wyoming.

"**Colorado River above Cisco:** The current water supply outlook for the Colorado and its tributaries above Cameo and for the Taylor River Basin is excellent; even if subsequent precipitation is as low as the minimum of record, runoff equal to or exceeding the 10-year average should be realized for these areas. The outlook for the Uncompahgre River is much less favorable; precipitation for the balance of the season must approach the maximum of record if average streamflow is to be realized. Median forecasts for the Dolores River Basin are for flows near the 1940-1949 average, which is much in excess of the low flows of the past two water years.

"**Green River Basin:** With the exception of the Wyoming drainage area of the upper Green River, runoff greatly exceeding the 10-year average is expected for the basin if precipitation for the remainder of the season is near normal. The Utah portion of the basin has the most favorable water-supply outlook. Median forecasts for the Utah tributaries range from 155% of the 10-year average for the Ashley Creek near Vernal to 190% of the average for the Strawberry River at Duchesne. The below-normal seasonal precipitation over the upper Green River watershed in Wyoming is reflected by this month's median forecast of 83% of the 10-year average for the Green River near Linwood.

"**San Juan River Basin:** As a result of the heavy precipitation which occurred during the past month, substantial increases are noted in the forecasts for the San Juan Basin. With near-normal precipitation for the balance of the season, 111% to 121% of the 10-year average flow is in prospect for the basin. Above-normal stream-

flow would be a welcome change from the poor conditions of the past two seasons."

A few forecasts from the above report are tabulated below.

FORECAST

	1000 ac. ft.	% of 10 yr. av.	10 yr. av. flow 1000 ac. ft.
Colorado River near Cameo, Colo.	4,350	145	3,100
at Lees Ferry	16,000	127	12,630
Roaring Fork at Glenwood Springs	1,240	130	952
Green River near Linwood, Utah	1,200	83	1,445
at Green River, Utah	4,700	111	4,250
San Juan River near Farmington	2,150	116	1,850
near Bluff, Utah	2,350	112	2,090

Altogether forecasts are published by the Weather Bureau for some 40 points on the Colorado River and tributaries in the Upper Basin. The forecast for the flow at Lees Ferry as of February 1, 1951 was 16,000,000 acre feet, and in the issue for March 1, it was only 10,400,000 acre feet. For the April 1 forecast the estimate had been reduced to 9,300,000 acre feet and in the May report it was 9,500,000 acre feet. The actual discharge for the year, as given in the February 1, 1952 bulletin just received, was 9,817,000 acre feet. This indicates the very great increase in the accuracy of any forecast as the time at which the forecast is made becomes later and later in the year. The May forecast was about 97% of the observed runoff at Lees Ferry. On the other hand, the February estimate was about 60% more than the actual amount while that made March first was only 6% too high. This is given to point out the relative unreliability of very early estimates of stream flow.

A forecast for the inflow to Lake Mead is made early in each month from January to May, by the Office of River Control of the Bureau of Reclamation at Boulder City, Nevada, copies of which are also made available to the Commission. These forecasts are prepared for use in the operation of Hoover Dam and Lake Mead especially for the purpose of flood control. The first paragraph of the two page forecast dated February 8, 1952, is quoted herewith.

"1. **Forecast Based on Precipitation**

(a) Precipitation over the Upper Colorado River Basin during January continued considerably above normal; therefore, prospects for the

1952 spring inflow to Lake Mead are greater than on January 1. As of February 1, the following flow in the Colorado River near Grand Canyon, Arizona, for the period April through July 1952, based on an average October through January precipitation of 8.09 inches at thirteen key stations on the upper watershed, can be anticipated:

Maximum	20,200,000 acre-feet
Mean	17,000,000 acre-feet
Minimum	13,800,000 acre-feet

The above mean figure has been obtained by reducing the value of 17.5 million acre-feet, as obtained from the least square line on the attached February 1 forecast chart, by 0.5 million acre-feet, which is the estimated depletion during the April-July 1952 period by transmountain diversions and upstream reservoirs constructed since closure of Hoover Dam (1935). The probability is 9 chances in 10 that the actual flow at Grand Canyon will fall between the above-mentioned minimum and maximum amounts. Actual runoff during the period April-July 1951 was 6,284,000 acre-feet."

Forecast of the mean flow for May, 1951 was 6,700,000 acre-feet —an error of only 6½%.

Since the correlation between the inflow to Lake Mead and the discharge of the Colorado River at Lees Ferry is very good indeed, these forecasts, together with those of the Weather Bureau, could be used by the Commission today if an emergency should suddenly arise.

It should be noted, however, that the Bureau of Reclamation's forecasts depend on only 13 stations in the Upper Basin. None of these are located in the basins of either the Green River in Wyoming or the White River in Colorado. Two stations were selected in the Colorado River basin above Grand Junction and two are in the San Juan basin. In contrast to this, four of the 13 stations used are in the basin of the Gunnison, which would seem to give rather undue weight to the discharge of this tributary, although its importance as one of the largest contributors to the outflow of the Upper Colorado River is fully recognized. These and other questions should be fully analyzed in the investigation of the problems of Forecasting Stream Flow.

Several of the other organizations and agencies u the ual River water also make independent estimates of the pr L- or summer discharge of the river.

The investigation of this subject for the Upper Commission was begun by studying the Roaring Fork of the Colorado. This stream heads in Pitkin County, Colorado, west of the continental divide between Aspen and Leadville and north of the divide between Aspen and Gunnison where the average annual precipitation exceeds 30 inches, at elevations of 10,000 feet and more. The gaging station near the mouth of the stream at Glenwood Springs is below a point where the discharge of some hot springs maintains ice-free conditions throughout the winter. The gage is therefore always accessible, discharge records are usually excellent and they are of sufficient length so that reliable results should be obtained. Of equal importance is the fact that, through the cooperation of the office of the Water Resources branch of the U. S. Geological Survey, it should be possible to secure reports on the discharge of this tributary of the Colorado River soon after the first of each month of the year from February to May, for use in making actual forecasts.

While forecasting studies for this stream are as yet incomplete, principles and conditions which should be of general application in the Upper Colorado River Basin are being obtained, so that the preliminary work for other tributaries in our river system will be materially less than at the beginning of this study.

The general procedure adopted for this investigation was to begin with several trials of simple correlations between the summer discharge of the Roaring Fork at Glenwood Springs and the most important of the numerous hydrologic factors which constitute the source and cause the major variations in that runoff. Then a series of two or more of the most important of these factors, taken together in a multiple correlation, is computed and the results compared. After numerous trials the combination which produces the most accurate and reliable results will be used until still further study develops a more complete and satisfactory formula. This is the same procedure which has been used in the investigations on the use of the inflow-outflow method.

The best formula thus far derived for the estimated discharge of the Roaring Fork at Glenwood Springs for the six months of April through September is based upon the discharge at this point for the six months of winter flow, October through March, the average water content from the snow surveys as of April first in

Aspen area, and the six months winter precipitation at the Leadville station of the Weather Bureau. With rounded coefficients, the formula is:

$$Y_S = X_2 + 45X_3 + 30X_4 - 245\ (\pm 77) \qquad (1)$$

Y_S = estimated 6 months summer flow, May—September in units of 1,000 acre-feet

X_2 = observed 6 months winter flow, October—March in units of 1,000 acre-feet

X_3 = water equivalent of snow in inches on April 1st in the Aspen area

X_4 = winter precipitation, October—March, at Leadville in inches depth.

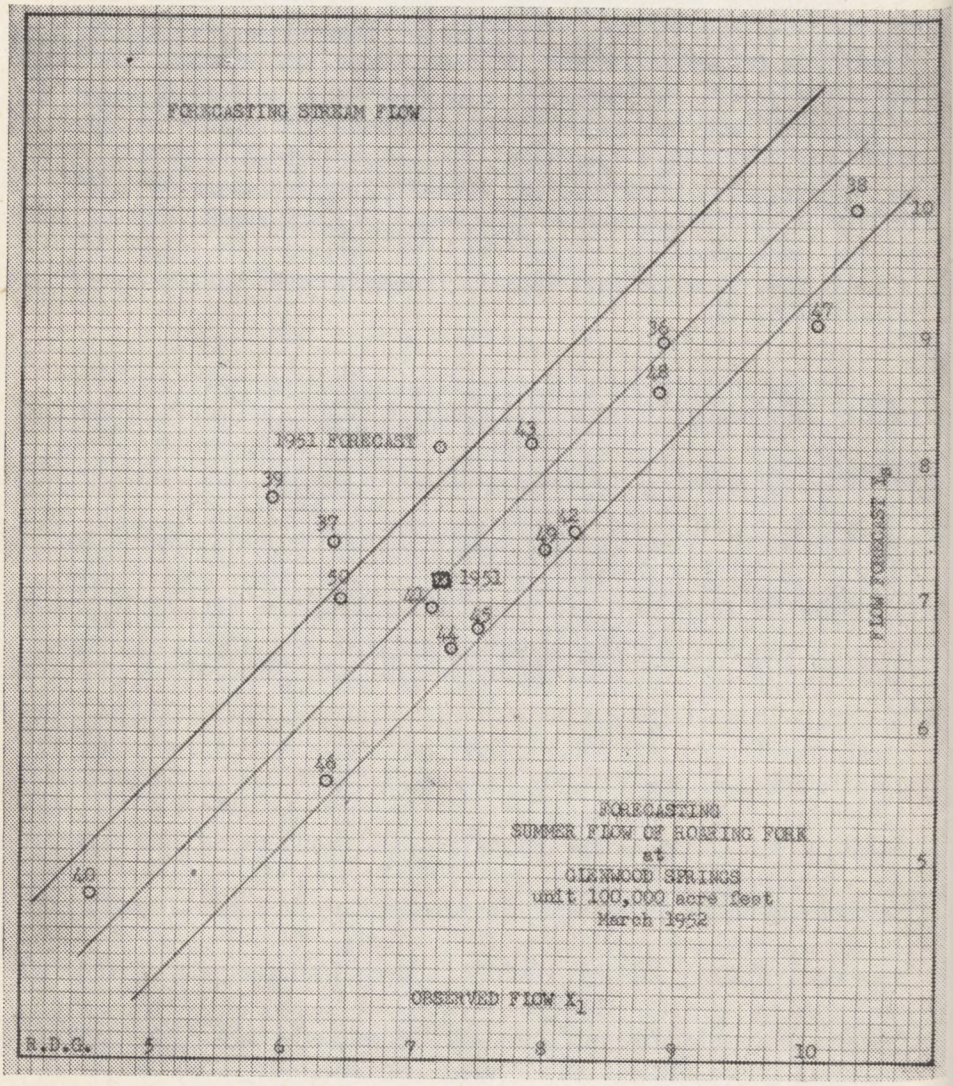
Or, for the estimated total flow for the water year, Y_y:

$$Y_y = 2X_2 + 45X_3 + 30X_4 - 245(\pm 77) \qquad (2)$$

With formula (1) the flow of Roaring Fork can be estimated for the six summer months of May through September and the forecast of the outflow from this tributary basin will account for about 78% of the possible variations in inflow and depletions along the stream. Furthermore the chances are 2 out of 3 that the actual outflow for any year will fall between values not greater than the estimate plus 77,000 acre-feet or less than the estimate minus 77,000 acre-feet. For example, the formula was based on the fifteen years of records 1936 to 1950 inclusive, and the summer flow in 1951 was 719,000 acre-feet at Glenwood Springs. By formula (1) the estimated summer flow was 819,000 acre-feet, with a 2 to 1 probability that it would lie between 896,000 and 742,000 acre-feet. As a forecast this would have been 100,000 acre-feet more than actually occurred last summer and the lower value of the range indicated by the standard error (742,000 acre-feet) is also greater than the observed flow. When values computed by formula for all the other 15 years are also compared with the observed quantities, in addition to 1951 the estimates differed from the true values by more than the standard error of 77,000 acre-feet in 1937, 1939 and 1947. Hence, 12 out of 16 times or with the slightly greater frequency of 3 out of 4 instead of 2 out of 3, the estimates came within the limits of ± the standard error. The accompanying diagram shows how the computed forecasts vary from the observed values of the summer discharges of Roaring Fork. The central diagonal passes through the point for 1951 if the the forecast had been exact and indicates the trend relating forecasts and observations. The other two lines indicate the range of values between which two-thirds of the forecast should fall.

It is not difficult to account for the large increase in the actual discharge of this stream above the estimate. No satisfactory method of predicting summer precipitation has yet been found and therefore when the pattern of summer rainfall differs materially from the average, the difference between forecast and reality will be greater than the limits indicated. Last summer in April, before the irrigation season was more than started, the rainfall at Glenwood Springs was more than 40% above normal for that month while at Aspen it was nearly 20% above normal. Again in August when irrigation demands are relatively small, precipitation in these areas was even more above normal than in April (60% and 30% respectively). This illustrates the uncertainties that are always present in making predictions of this sort. If April runoff and rainfall had been taken into account and the forecast were made early in May, it is probable that this discrepancy would have been materially reduced.

The engineering department of the Commission seeks to derive similar forecasting formulas using only 5 months of winter runoff and precipitation records with snow conditions as of March 1st for the first annual forecasts and later, 6 and 7 months runoff and precipitation with snow as of April 1st and May 1st for more dependable forecasts. When this has been done for the main stem of the Colorado River and the principal tributaries in each state, so that forecasts of stream flow within and at the border of each state and at Lee Ferry can be made, this problem will be considered completed for some time, except for refinements as more data become available.


FORECASTING STREAM FLOW
1951 FORECAST
1951
FORECASTING
SUMMER FLOW OF ROARING FORK
at
GLENWOOD SPRINGS
unit 100,000 acre feet
March 1952
OBSERVED FLOW X_1
FLOW FORECAST Y_1
R.D.G.
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APPENDIX G

RESERVOIR EVAPORATION

An immediate cause for the undertaking by the Engineering Department of the Commission of the independent investigation of probable evaporation loss from reservoirs lay in the question whether a large increase in loss by evaporation would take place if the Gray Canyon, Desolation or Dewey reservoir sites were substituted for the Echo Park site proposed in the Colorado River Storage project report. Furthermore, Article V of the Upper Colorado River Basin Compact, paragraphs (a) and (b), contains provisions concerning "losses of water occurring from or as a result of storage in reservoirs." Section (a) provides that "Water stored in reservoirs covered by this paragraph (a) shall be for the exclusive use of and shall be charged to the State in which the reservoir or reservoirs are located." By the proper application of the inflow-outflow method, losses from existing reservoirs will be automatically included in the stream depletions in the drainage where such reservoirs are located, since such depletions will be measured at state lines. However, new reservoirs proposed for construction and use as irrigation and power development takes place in the Upper Basin will involve several considerations which will require very extensive and careful investigation. These considerations arise in connection with paragraph (b) of Article V which states in part "All losses of water occurring from or as the result of the storage of water in reservoirs constructed after the signing of this Compact shall be charged" in accordance with the provisions of subparagraphs (b) (1) and (b) (2).

In undertaking this investigation, the basic data on evaporation in the Upper Colorado River Basin which was collected, tabulated and analyzed under the direction of the Engineering Advisory Committee to the Upper Colorado River Basin Compact Commission was checked and used, except that in a few cases, where evaporation records were available for years subsequent to 1945, the data were brought up to date. Such was the case with the Weather Bureau Stations at Farmington, New Mexico, and Montrose, Colorado. The results of the Engineering Advisory Committee investigations are available in the final report of that committee to the Upper Colorado River Basin Compact Commission in the form of curves for the principal subdivisions of the basin and the Bureau of Reclamation engineers used these curves in their reservoir operation studies to determine the probable loss due to evaporation from the reservoirs proposed in the report on the Colorado River storage project.

Since seldom is there an actual record of observation of evaporation at a proposed reservoir site, it was determined to use some form of geographic and topographic reference by which to estimate evaporations. In this study of the problem, the elevation and latitude of the Weather Bureau Stations in the basin where climatological data have been collected, were found to give remarkably satisfactory results. From these data for 18 localities in the Colorado River Basin the following preliminary relation was derived, hereinafter referred to as formula (1)—

$$E = 90 + 48\cos 2x - 10A \qquad (1)$$

In this formula

E is the annual evaporation in inches depth from the free water surface of the reservoir

x is the latitude of the given location

A is the altitude or elevation of the station or water surface at the reservoir site in units of 1,000 feet

A most comprehensive study and tabulation of evaporation data was compiled by the late Robert B. Horton, eminent civil engineer and hydrologist. The tabulation which Mr. Horton compiled for the Natural Research Council was published in the Transactions of the 24th Annual Meeting of the American Geophysical Union, Part II, April 1943, and contains data for some 150 Weather Bureau Stations throughout the United States. Mr. Horton adjusted these data in all cases giving results equivalent to those for the standard Class O Weather Bureau pan while data covering only short periods were further adjusted to the most probable long time means. The validity and reliability of these data is above question and they constitute a most valuable reference source which has been frequently consulted and was used in checking the data used in this study. With this evaporation formula, a table was prepared to show the approximate mean annual evaporation in acre-feet for several combinations of alternative reservoir sites suggested as substitutes for Echo Park and Split Mountain Reservoir sites. Considerable additional study was given to this subject after the computation of the first table, and records from two additional Weather Bureau stations in or very near the Colorado River Basin were utilized for additional basic data. Formula (1) was then revised with the following slight change in the numerical coefficients and is hereinafter referred to as formula (2)—

$$E = 86.4 + 46\cos 2x - 10A \qquad (2)$$

E, x and A have the same significance as before. Analysis of

this linear multiple correlation formula showed that it was quite satisfactory for the range of elevation or altitude included between Lake Mead, with an elevation of 1,200 feet and latitude of 36 degrees, up to an elevation of about 7,000 feet and latitudes of 40 to 42 degrees. However, if extrapolation was considered, it appeared that, while some lower elevations could be used with reasonable results, when higher elevations were inserted in this formula, results became more and more inaccurate.

After quite extensive investigation it was found that increase in elevation up to 10 or 12 thousand feet had decreasing influence upon evaporation from open water surfaces. The amount of total annual evaporation appeared to approach some finite limit at these higher elevations. This study also indicated that as elevations were decreased toward sea level the amount of evaporation also approached a limit in that direction, as indicated by formula (2), which reduces to—

$$E = 86.4 + 46\cos 2x$$

at sea level. Finally it was found that a curve of the second degree, based on the equation of the hyperbola, would give quite satisfactory results for a range of 500 to 9,000 feet elevation. The final equation which has been developed, hereinafter referred to as formula (3), is—

$$E = 57\cos 2x + 548(A+1.275)^{-\frac{1}{2}} - 387(A+1.275)^{-1} - 123 \qquad (3)$$

This formula reduces to $E = 60 + 57\cos 2x$ for locations at sea level. The standard error for formula (3), based on the data for 24 stations, is about $\pm$ 3 inches in the depth of evaporation while the square of the coefficient of correlation is about 98%. These factors may be compared with those for the revised formula (2) which were: standard error $\pm$ 2.5 inches and square of coefficient of correlation 98.5%. The results of computations for either equation showed differences between observed and computed quantities up to about double these standard errors in some cases, so that either equation might be used with reasonable results within the smaller range of elevations that is, from 1,200 to 7,000 feet, while above that range the use of the longer equation is recommended. Estimates of evaporation were made by the two formulas (2) and (3) and the results compared both arithmetically and graphically. Considering the relatively small differences in the two sets of results, there is no advantage to be gained by the use of the longer formula within the range of elevations and latitudes to be expected for reservoir sites in the Upper Colorado River Basin, and, therefore, formula (2) was used in computing the following table.

Reservoir site	Height of Dam feet	Mean Annual evaporations acre feet	Active Storage acre feet
Echo Park	525	112,100	5,460,000
Gray Canyon	445	40,200	1,390,000
Total		152,300	6,850,000
Desolation	365	395,000	6,000,000
Gray Canyon	250	18,300	250,000
Total		413,300	6,250,000
Increased evaporation		261,000	
Deficient storage			600,000
Desolation	370	406,000	6,600,000
Gray Canyon	250	18,300	250,000
Total		424,300	6,850,000
Increased evaporation		272,000	
Desolation	370	406,000	6,600,000
Dewey		306,600	6,000,000
Total		712,600	12,600,000
Increased evaporation		560,000	

The change, due to the use of revised formulas, in the amount of increase in evaporation which would result from the substitutions of the Desolation reservoir site in one or another combination with the Gray Canyon and Dewey sites would only reduce the evaporation loss by from 2% to 5% below that first reported. Any conclusions which might be drawn from the earlier study would, therefore, not require revision. That is, the substitution of reservoirs thus far proposed for the Echo Park and Split Mountain sites would increase the losses by evaporation by an amount of the order of 300,000 acre feet. The loss by evaporation at the Desolation site of about 400,000 acre feet is 3½ times as great as would be the loss of 112,000 acre feet at the Echo Park site. Finally, the table shows that with the maximum feasible economic development at the Desolation and Dewey sites the loss of 700,000 acre feet would be more than 4½ times as great as the 150,000 acre feet which could be expected if the Echo Park and Gray Canyon sites were used.

With the actual construction and operation of any large reservoirs in the Upper Colorado River Basin for holdover storage and river regulation under the provisions of the Upper Basin Compact, other important questions will arise which will require the solution of other and perhaps even more difficult problems involving evaporation. These investigations will, therefore, be continued and extended as time permits and the results will be reported when further progress is made.

The mean annual evaporation shown in this table is the estimated **total** evaporation loss. The figures do **not** represent the increased stream depletion at the reservoir site. To secure the increased stream depletion that would be caused by the reservoir, there will need be subtracted the estimated present losses from the stream channel through the reservoir site. No estimate has been made of such present losses.

APPENDIX H

RESOLUTION

LITTLE SNAKE RIVER-INTERSTATE PRIORITY SCHEDULE

WHEREAS, Article XI, Section (a) (2), of the Upper Colorado River Basin Compact provides that "Water diverted from the main stem of the Little Snake River below a point one hundred feet below the confluence of Savery Creek and the Little Snake River shall be administered on the basis of an interstate priority schedule prepared by the Commission in conformity with priority dates established by the laws of the respective States"; and

WHEREAS, under date of August 22, 1950, the Hon. M. C. Hinderlider, State Engineer of Colorado, and the Hon. L. C. Bishop, State Engineer of Wyoming, were requested to join in the preparation of an initial draft of schedule of water rights on the Little Snake River; and

WHEREAS, under date of November 25, 1950, a tabulation of adjudicated and valid water rights for the diversion and appropriation of water from Little Snake River in Wyoming, below a point one hundred feet below the confluence of Savery Creek and the Little Snake River, which had been prepared from the records of the State Engineer and State Board of Control of Wyoming, was forwarded to the Upper Colorado River Commission; and

WHEREAS, under date of April 16, 1951, a list of decreed Colorado ditches, which divert from the main stem of the Little Snake River below a point one hundred feet below the confluence of Savery Creek and the Little Snake River, was submitted by the office of the State Engineer of Colorado to the Upper Colorado River Commission; and

WHEREAS, a proposed interstate priority schedule, attached hereto and marked "Exhibit A," was then prepared by the Chief Engineer of the Upper Colorado River Commission, and copies thereof were forwarded to the offices of the State Engineers of Colorado and Wyoming, respectively, under date of August 21, 1951, and comments thereon were solicited; and

WHEREAS, no suggestions or critical comments thereon have been received:

NOW, THEREFORE, BE IT RESOLVED, That the said interstate priority schedule, attached hereto and marked "Exhibit A," is hereby approved and shall constitute the basis for administration of diversions within Colorado and Wyoming, respectively, from the main stem of the Little Snake River below a point one hundred feet below the confluence of Savery Creek and the Little Snake River.

EXHIBIT A

INTERSTATE PRIORITY SCHEDULE OF WATER RIGHTS ON THE LITTLE SNAKE RIVER BELOW A POINT 100 FEET BELOW THE CONFLUENCE OF SAVERY CREEK AND THE LITTLE SNAKE RIVER

NO.	PERMIT	DITCH	APPROPRIATOR	PRIORITY COLO. NO.	PRIORITY DATE	USE*	CU. FT. PER SEC.	AREA ACRES	HEADGATE LOCATION S.T.R.
1	Terr.	Reed	Lycurgus Calvert		3 - 75	I,S	2.90	200	10-21-91
1	Do	Do	Bernard Hynes		Do	Do	.60	40	Do
1	Do	Do	C. W. Orchard et al		Do	Do	.60	40	Do
2	Do	Perkins	Charles F. Perkins		6 - 77	I,S,D	.80	50	13-12-90
		Point of diversion and means of conveyance changed to First Mesa Canal, 13-12-90							
3	Do	Baggs	Robert Temple		Fall 77	Do	1.60	110	4-12-91
3	Do	Do	Edward Bailey		Do	Do	1.20	80	Do
4	Do	Aylesworth	Lydia Aylesworth		6-1-78	I	.21	15	1-12-91
5	Do	Lynch	Baggs Livestock Co.		Sea. 82	Do	2.92	205	7-12-91
		Changed to the Gibson and Blair Ditch, 7-12-91							
6	Do	George Wren	George Wren		10-1-82	I,D	1.50	100	13-12-90
6	Do	Do	Jerry Sheehan		Do	I,S,D	1.50	100	Do
6	Do	Do	James Douglas		Do	I	1.00	70	Do
7	Do	Perkins	Charles F. Perkins		11-12-82	Do	3.71	260	13-12-90
		Point of diversion and means of conveyance changed to First Mesa Canal, 13-12-90							
8	Do	Carruthers	J. M. Calvert		Fall 84	I,S	1.75	120	6-12-90
8	Do	Do	Lycurgus Calvert		Do	Do	2.35	160	Do

8	Do	Do	R. O. Cook	Do	Do	2.35	160	Do
9	Do	Highline	John C. Kane	3-18-85	Do	2.10	140	Do
10	Do	Brush	E. A. & Oscar J. Goodman	3-28-85	I	4.85	340	13-12-93
11	Do	John Irons	Mrs. M. E. Temple Gideon	4-10-86	Do	.57	40	6-12-91
	Point of diversion and means of conveyance for irrigation of 33 acres transferred to Baggs Ditch, 4-12-91							
12		Blair	8	4-16-1886		5.83		20-12-92
13		Snake River Irrig.	8a	4-26-1886		8.50(1)		14-12-93
14		Excelsior No. 2	8a	5-1-1886		4.60(2)		22-12-92
15	Terr.	Baker	James Baker	Early 86	I	1.43	100	10-12-90
15	Do	Do	J. Douglas, Pres. Dixon Townsite Co.	Do	Do	.57	40	Do
	Same land claimed under Perkins Ditch							
16	Do	Baggs	John Irons	10 - 87	Do	2.85	200	4-12-91
16	Do	Do	Platt A. Hinman	Do	Do	2.00	140	Do
16	Do	Do	Sarah Carroll	Do	Do	1.43	100	Do
16	Do	Do	Lou Godelt	Do	Do	2.00	140	Do
17	Do	Extension Reed	Richard C. Magor	Do	Do	1.43	100	10-12-91
18	Do	Bennett & Aylesworth	W. H. Challis	Fall 87	Do	.57	40	1-12-91
18	Do	Do	C. H. Aylesworth	Do	Do	.57	40	Do
19	Do	Highland	P. T. Hinman, Sec. Highland Ditch Co.	9-88	I,S,D,	6.85	480	9-12-90
20	Do	Baggs	A. F. Haver	12-4-89	Do	1.43	100	4-12-91

NO.	PERMIT	DITCH	APPROPRIATOR	PRIORITY COLO. NO.	PRIORITY DATE	USE*	CU. FT. PER SEC.	AREA ACRES	HEADGATE LOCATION S.T.R.
21	Do	Majors		15	5-1-1890		3.33		29-8-97
22	Do	Aylesworth	Lydia G. Aylesworth		Sea. 90	Do	1.21	85	1-12-91
23	Do	Snow	Jerry Sheehan		8 - 90	I,S,D,	1.14	80	18-12-89
23	Do	Do	James Douglas		Do	Do	2.85	200	Do
24		Two Bar		64	4-15-1891		7.00		31-8-97
25	90E	Enl.	A. L. Emigh		10-11-94	Do	2.06	144	6-12-90
		Carruthers							
26		Woodbury		23aaa	5-27-1895		6.98		13-12-92
27	1111	West Side	Peter Jons		12-9-95	I	.57	40	9-12-90
27	1111	Do	Ralph Wilson		Do	Do	.61	43	Do
27	1111	Do	H. D. McSwain		Do	I	.42	30	Do
27	1111	Do	Mike McCune		Do	Do	1.12	79	Do
27	1111	Do	Roy Adams		Do	Do	.42	30	Do
27	1111	Do	Orville Hall		Do	Do	2.14	150	Do
27	1111	Do	F. F. Wedemeyer		Do	I,D	1.18	83	Do
27	1111	Do	H. J. McCune		Do	Do	.13	9	Do
27	1111	Do	John Blair		Do	Do	1.28	90	Do
27	1111	Do	L. W. McLaughlin		Do	Do	.88	62	Do
27	1111	Do	Emma C. Johnson		Do	Do	1.07	75	Do
27	1111	Do	Ferdinand Jebens		Do	Do	1.14	80	Do
27	1111	Do	Peter Jons		Do	Do	.78	55	Do
27	1111	Do	Ed Yoakum		12-9-95	I,D	1.14	80	9-12-90
27	1111	Do	Roy Adams		Do	Do	.28	20	Do

27	1111	Do	Estate Anna E. Jebens		Do	I	.57	40	Do
27	1111	Do	Andrew A. Jebens		Do	Do	1.14	80	Do
27	1111	Do	Reverse Four Cattle Co.		Do	Do	2.24	157	Do
27	1111	Do	E. W. Leggett		Do	Do	1.97	138	Do
27	1111	Do	A. F. Gledhill		Do	Do	1.00	70	Do
27	1111	Do	Estate Geo. Ence		Do	Do	1.00	70	Do
28	1232	Franklin Irrigating	Mrs. Lottie M. Ward		6-4-96	I	.21	15	9-12-91
	Adjudicated from Hynds Slough Channel of Little Snake River								
29	236E	Enl. Franklin Irr.	Mrs. Lottie M. Ward		2-8-97	I	1.21	85	9-12-91
30	1538	Gibson & Blair	A. H. Christensen et al		3-13-97	Do	4.77	334.2	7-12-91
	Lands adjudicated are in Colorado								
30	1538	Do	C. B. Boyce		3-13-97	Do	1.28	90	Do
30	1538	Do	Theodore Castidy		Do	Do	3.42	240	Do
31	1567	Kohleffel	John D. Kohleffel		8-11-97	I	.84	60	10-12-90
31	1567	Do	Thomas Kilgore		Do	Do	.57	40	Do
32		Heeley		26aa	4-15-1898		11.08		14-12-93
33		Trowel		26b	5-4-1898		10.32		21-12-92
34	368E.	Enl. Gibson & Blair	Andrew H. Christensen		9-21-98	Do	2.92	205	7-12-91
34	368E.	Do	A. P. Peterson		Do	Do	2.28	160	Do
34	368E.	Do	Baggs Livestock Co.		Do	Do	3.00	210	Do
34	368E.	Do	A. H. Christensen et al		Do	I,S	11.373	796.3	Do
	Lands adjudicated are in Colorado								

NO.	PERMIT	DITCH	APPROPRIATOR	PRIORITY COLO. NO.	PRIORITY DATE	USE*	CU. FT. PER SEC.	AREA ACRES	HEADGATE LOCATION S.T.R.
35	440E.	Enl. George Wren (First Mesa)	Fred C. Rasmussen		6-10-99	Do	1.43	100	13-12-90
35	440E.	Do	Fred Jackson, et al		Do	Do	1.78	125	Do
35	440E.	Do	Matthis Weber		Do	Do	4.14	290	Do
35	440E.	Do	Charles R. Benson		Do	Do	2.00	140	Do
35	440E.	Do	J. Henry Weber		Do	Do	1.92	135	Do
35	440E.	Do	Mollie Ellas, Admx.		Do	Do	1.75	123	Do
35	440E.	Do	Joseph Morgan		Do	Do	.85	60	Do
35	440E.	Do	John B. Kohleffel		Do	Do	.14	10	Do
35	440E.	Do	Thomas Kilgore		Do	Do	1.07	75	Do
35	440E.	Do	W. A. Clark		Do	Do	2.21	155	Do
35	440E.	Do	D. C. Jones		Do	Do	.22	16	Do
35	440E.	Do	J. E. Cowan		Do	Do	.21	15	Do
35	440E.	Do	Charles R. Benson		Do	I	.28	20	Do
36		Escalanta		102	10-1-1899		12.00		15-8-97
37	2450	Woodbury	John U. Woodbury		1-31-00	Do	1.64	115	13-12-93
	Point of diversion in Colorado								
38	2450	Woodbury	Baggs Livestock Co.		Do	I	1.14	80	7-12-91
	Point of diversion and means of conveyance changed to Gibson & Blair Ditch, 7-12-91								
39	2808	Trowel	John W. Woodbury		9-9-00	Do		600	21-12-92
	For the irrigation of 278 acres in Wyoming and 322 acres in Colorado. Beneficial use completed May 13, 1904—Right valid but not adjudicated.								
40	*620E.*	*Enl. Franklin*	*J. F. Kelley*		*2-9-01*	*Do*	*1.57*	*110*	*3-12-91*

40	*620E.*	*Enl. Franklin Irr.*	*J. F. Kelley*		*2-9-01*	*Do*	*1.57*	*110*	*3-12-91*
41		Oneco		105	4-29-1901		11.34		31-8-97
42		Schoonover		28a	2-27-1902		6.66		1-7-98
43	3968	Heeley	John U. Woodbury		6-6-02	Do	.40	28	14-12-93
43	3968	Do	Joseph Heeley		Do	Do	2.00	140	Do
43	3968	Do	A. L. Emigh		Do	Do	1.41	99	Do
43	3968	Do	K. Murphy		Do	Do	1.28	90	Do
43	3968	Do	Benson Gardner		Do	Do	.85	60	Do
43	3968	Do	E. D. Gould, et al		Do	Do	1.50	105	Do
44	901E.	Enl. First Mesa	Fred W. Wilmes		8-1-02	I	.82	57.5	13-12-90
45	958E.	Enl. Perkins	J. C. Madsen		12-12-02	Do	.38	27	Do
	Point of diversion and means of conveyance changed to First Mesa Canal, 13-12-90								
46	967E.	Enl. Hay Queen	Frank A. Michael		1-2-03	Do		448	7-12-91
	Work commenced in September 1893 and beneficial use completed January 10, 1903. Right valid but not adjudicated. Lands irrigated in Wyoming.								
47	1012E.	Enl. Kohleffel	J. C. Madsen		4-2-03	I	1.00	70	10-12-90
48	1152E.	Enl. First Mesa	John B. Weaver		11-24-03	I,S	1.00	70	13-12-90
49	5967	Buzzard Bend	W. H. Protz		3-2-04	I	1.05	75	5-12-91
49	5967	Do	W. H. Van Fleet		Do	Do	3.07	215	Do
50	1209E.	Enl. Dixon Mer. & Lumber Co.	D. C. Jones		5-28-04	Do	.79	55	13-12-90
	Point of diversion and means of conveyance changed to First Mesa Canal, 13-12-90.								

NO.	PERMIT	DITCH	APPROPRIATOR	PRIORITY COLO. NO.	PRIORITY DATE	USE*	CU. FT. PER SEC.	AREA ACRES	HEADGATE LOCATION S.T.R.
51	1515E.	Enl. John Irons	A. T. Shank		7-15-04	I	1.14	80	6-12-91
52	1450E.	Enl. Perkins Irr.	Thomas Kilgore		10-23-05	Do	.14	10	13-12-90
	Point of diversion and means of conveyance changed to First Mesa Canal, 13-12-90.								
53	1662E.	Enl. Gibson & Blair	Charles B. Boyce		2-13-07	Do	.18	13	7-12-91
54	1954E.	Enl. West Side Canal	James Maurace Wilson		10-12-08	I,D	1.14	80	9-12-90
55	2012E.	Enl. First Mesa	Matthias Weber		2-8-09	I	.36	25	13-12-90
55	2012E.	Do	Ella Pancost		Do	Do	1.93	135	Do
56	2454E.	Enl. Bennett & Aylesworth	Clarence J. Etherington		5-2-11	Do	.38	27	1-12-91
56	2454E.	Do	Mrs. Zelma Etherington		Do	Do	.51	36	Do
56	3972E.	Do	C. W. Orchard		3-1-19	Do	.28	20	Do
57	4608E.	Enl. First Mesa	Mrs. C. R. Benson		12-6-26	Do	1.00	70	13-12-90
58	4601E.	Enl. West Side Canal	A. H. Christensen		8-11-28	P			9-12-90
	Completed November 5, 1931—right valid but not adjudicated.								
59	4602E.	Enl. West Side Canal	Christensen Construction Co.		11-7-28	I,S	6.92	485	Do

59	4602E.	Do	Est. A. H. Christensen	Do	Do	1.50	105	Do
59	4602E.	Do	Eliza A. Burch	Do	I,S,D	2.27	159.72	Do
59	4602E.	Do	Christensen Construction Co.	Do	Do	.37	25.97	Do
59	4602E.	Do	Do	Do	Do	6.13	429.50	Do
60		Christensen Enl. of West Side Canal		11-27-28		5.067		
61	4999E.	Enl. Bennett & Aylesworth	C. J. Etherington	12-13-34	I	1.26	88	1-21-91
62	5475E.	Enl. First Mesa	First Mesa Ditch Co.	11-17-48	Do		138	13-12-90

Right valid—Time for completion to beneficial use expired December 31, 1952.

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*USE
I — Irrigation
S — Stock
D — Domestic
P — Power

APPENDIX I

INFLOW-OUTFLOW METHOD

During the earlier part of the past year, a major portion of the time and effort of the engineering department was spent upon studies of the inflow-outflow method; that is to say, in the development of formulas and procedures for the application of the inflow-outflow method as required by Article VI and by Article VIII (d) (6) of the Upper Colorado River Basin Compact. Substantial progress has been made. These investigations must, however, be continued and extended to include tributary areas in each state.

The Green River Basin in Wyoming was chosen as the area for the initial investigation of means for determining the detailed procedures and formulas for the application of the inflow-outflow method for several reasons, among which is the fact that the gaging station at Linwood, Utah is practically on the state line between Wyoming and Utah and that a fairly long period of stream flow and climatological records is available in that Basin. The table of stream flow and an accompanying plate of the inflow-outflow manual in the First Annual Report of the Upper Colorado River Commission contains the data and indicates the results of the studies of the Engineering Advisory Committee as reported to the Upper Colorado River Compact Commission up to the time of the organization of the present Commission. The number of inflow index stations will be increased from the original 5 to 9 or more and the stream discharge records have been brought up to include the year 1950 for the present investigation. The relation between the inflow index and the outflow at the Wyoming-Utah state line is approximately given by the following relation hereinafter referred to as formula (1)—

$$Y = 2.524\ X_2 - 770$$

In this formula, X_2 is the inflow index for the Wyoming basin of the Green River and Y is the corresponding theoretical outflow, the units being 1,000 acre feet per year. Plate 13 of the Manual (Appendix L, First Annual Report) shows considerable variation between the outflow for individual years and the theoretical outflow quantities indicated by the trend lines. At the time of the adoption of the inflow-outflow method, the best means of compensating for these variations, a few of which are extreme, was found to be by the adoption of 10 year averages for determining the inflow-outflow relationships. However, the Commission also requires the determination of stream discharges and depletions at state lines and at

Lee Ferry on an annual basis, as well as for continuing 10 year series averages. It is therefore necessary to investigate all possibilities for securing closer relationship between index inflow quantities and outflow of the main tributaries of the Colorado River at state lines and of the river system as a whole at Lee Ferry.

To do this, multiple correlation computations were undertaken in place of the simple linear correlation given by formula (1). Reviewing the over-all situation, it is apparent that the principal causes of variations in stream flow must be considered separately and the relative influence determined mathematically if possible in order to improve the relationships sought. In the case of the Green River Drainage Basin in Wyoming, it is evident that some of these causes of variations are due to extreme differences in elevation, topography and geology as these affect the slope of the terrain and of the streams draining that terrain. There are also variations in climate, particularly as to the amount and distribution of precipitation, also variations in mean temperature, both annual and seasonal.

It seems apparent that these factors will greatly influence the rate of run-off per square mile from the regions where most of the irrigation development in the basin is for meadows and pastures as compared with that from lower undeveloped areas and from the settled and irrigated areas themselves.

Variations in the consumptive use of water due to the activities of man probably also vary greatly from year to year, due, among other causes, to differences in the availability of water during the ordinary irrigation season. During seasons of short supply, the depletion of stream flow will obviously be less than the depletion during years of average supply. On the other hand, where storage of water for late irrigation is at a minimum, as in the Green River Basin, during seasons of high and excessive run-off, larger quantities of water would be diverted and probably spread over greater areas, especially on meadow and pasture lands with greater consumptive uses. It was found that applying the principles of Debler's method of adjusting for this variation, the inflow-outflow relationship was somewhat improved. The Debler method, it will be recalled, is based on the assumption that consumptive use or stream depletion is greater or less than the normal depletion in the proportion of ½ the ratio of the difference between the virgin flow and the average virgin flow, to the average virgin or undepleted flow. Expressed as a mathematical formula, this becomes:

$$D = D_n + \frac{1}{2}\left(\frac{V - V_m}{V_m}\right)D_n$$

In which D = probable depletion for a given year, D_n = the normal

or average depletion for any period of approximately constant acreage irrigated, V = the probable virgin flow of the stream for the given year; and V_m = the average virgin flow.

This variation of consumptive uses of water depending on fluctuations in the available annual supply, is, however, insufficient for adequate compensation of the discrepancies between the theoretical and observed outflow quantities. It is indicated in the report of Mr. Blaney and Mr. Criddle, which is Appendix B of the Final Report of the Engineering Advisory Committee to the Upper Colorado River Basin Compact Commission, that actual consumptive use rates of irrigation water are reduced by reason of precipitation during the growing season. Summer precipitation must, therefore, be one of the causes of deviations from the average trend in the relations between inflow and outflow on any drainage basin. Although temperature variations during the growing season may also have a material effect in causing these deviations from average conditions, the relation indicated in formula (2), below, does not take such variations into account. Preliminary trials using summer precipitation indicated that further improvement of the inflow-outflow equation could be secured by the use of this factor. The best relationship thus far obtained in this investigation is given by the following formula (2)—

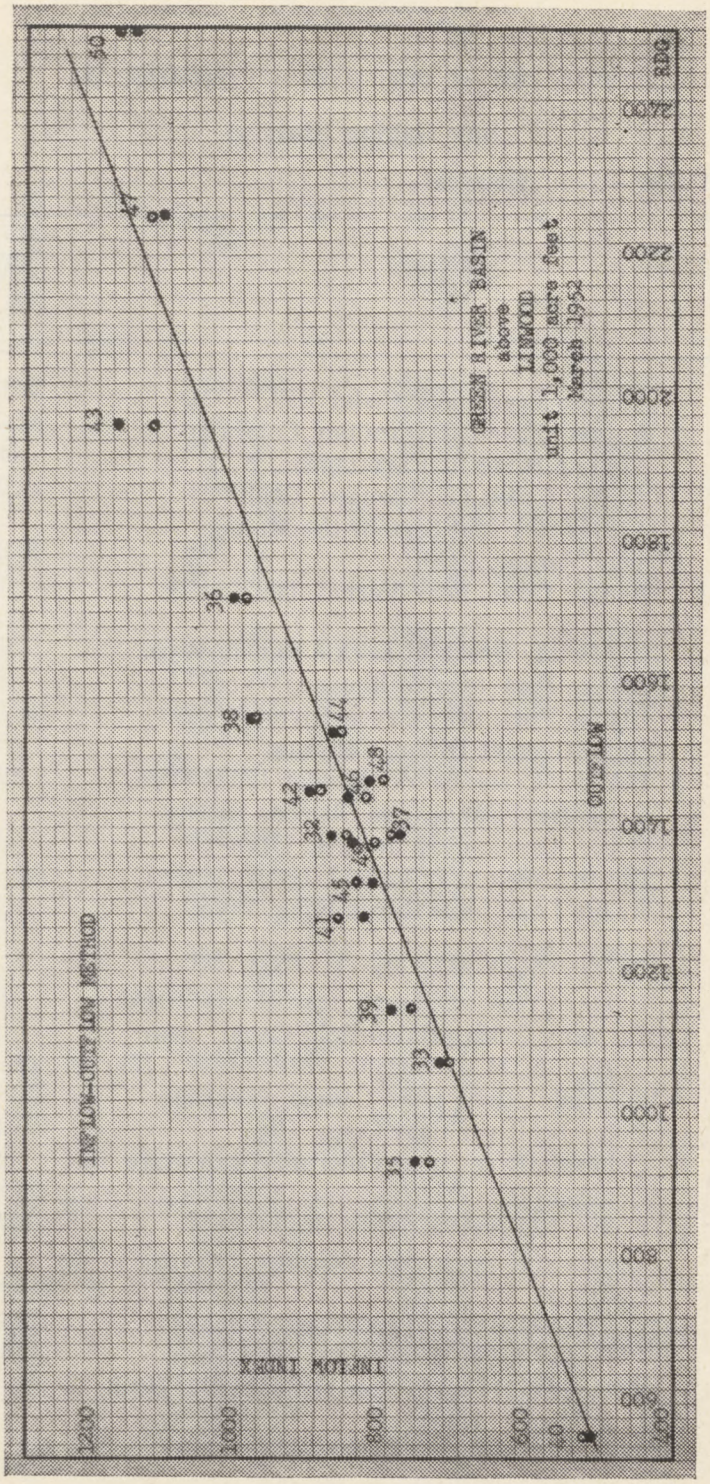
$$Y = 2.5086X_2 - 239.5\left(1 + 0.576\frac{X_2 - M_2}{M_2}\right) + 14.88X_5 - 733$$

In this equation, Y is the theoretical outflow and X_2 the inflow index as in formula (1), M_2 is the average of the inflow index and X_5 is the amount of the summer precipitation in inches of depth. The term in parentheses is the factor indicating the amount of variation to be applied to correct the average depletion of 239,000 acre feet for variations in the available water supply. With this equation, the standard error is reduced by some 10,000 acre feet while the square of the coefficient of correlation is increased in about the same proportion. The solid diagonal line and the dots on the accompanying Plate show the average trend in the relation between the inflow index and outflow quantities, arrived at through the application of the simple linear correlation provided by formula (1). The open circles show the relation as determined by formula (2). It is evident that in most cases the circles fall nearer the theoretical line than before, although in a few cases the reverse is true. This indicates that certain causes of variations have not been accounted for by the variables included in formula (2).

In addition to the introduction of variations in irrigation, consumptive uses and the effect of summer precipitation, other causes of variations in outflow will be investigated including summer

temperature and conditions of ground water storage, discharge and recharge. Work has been begun on the effect of subdivision of the total basin into two or more sub-basins, the relative contribution from sub-basins to inflow, and the influence on total outflow. Preliminary results from the introduction of some of these variations on the final solution of this problem have shown considerable promise.

Another phase of the application of the inflow-outflow method and one which will necessitate continuing these investigations, is the effect on stream depletion already apparent with the greatly increased transmountain diversions because of the practical completion of the Colorado Big-Thompson Project. This investigation has only begun and no results or progress can be reported at this time. Results of this investigation, when more data are available, will be of great value in connection with the application of the inflow-outflow method.


INFLOW-OUTFLOW METHOD
INFLOW INDEX
OUTFLOW
GREEN RIVER BASIN
above
LINWOOD
unit 1,000 acre feet
March 1952
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
RDG
50
47
43
36
38
44
42
46
48
32
37
41
45
40
39
33
35

APPENDIX J

UPPER COLORADO RIVER COMMISSION

Key Gaging Stations

Unit of flow—1000 acre-feet

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
1.	Animas River near Cedar Hill, N. M.	1,092
2.	Animas River at Durango, Colorado	692
3.	Animas River at Farmington, N. M.	1,360
4.	Ashley Creek near Jensen, Utah	386
5.	Ashley Creek at Sign of the Maine, near Vernal, Utah	241
6.	Ashley Creek near Vernal, Utah	101
7.	Big Sandy Creek at Leckie Ranch, Wyo.	94
8.	Blacks Fork near Millburne, Wyo.	156
9.	Blacks Fork near Green River, Wyo.	3,670
10.	Blue River at Dillon, Colorado	129
11.	Boulder Creek below Boulder Lake, Wyo.	130
12.	Bloomfield Canal (See Citizens Ditch)	
13.	Brush Creek near Jensen, Utah	255
14.	Brush Creek near Vernal, Utah	82
15.	Burnt Fork near Burnt Fork, Wyo.	53
16.	Carter Creek near Manila, Utah	
17.	Carter Creek at mouth near Manila, Utah	110
18.	††Citizens Ditch (Bloomfield Canal) near Turley, N. M. Diverting water around Blanco gage	
19.	*Colorado River near Cameo, Colorado	8,055
20.	Colorado River near Cisco, Utah	24,100
21.	Colorado River near Colorado-Utah state line	20,680
22.	*Colorado River at Glenwood Springs, Colorado	4,560
23.	Colorado River at Hite, Utah	76,600
24.	Colorado River at Hot Sulphur Springs, Colorado	782
25.	(A) Colorado River at Lee Ferry, Arizona	@109,889
26.	Colorado River at Lees Ferry, Arizona	@108,335
27.	Cottonwood Creek near Orangeville, Utah	200
28.	Crystal River near Redstone, Colorado	225

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (D)WSP. 1149 1949 (6)	(Provisional) 1950 (7)	1951 (8)
793.9	1914-48	945.1	464.9	372.9
650.5	1914-48	774.9	410.2	324.4
741.2	1914-48	861.0	395.0	294.6
59.7	1947-48	58.0	78.8	31.5
97.6	1940-48	104.6	118.3	75.8
77.2	1914-48	80.4	87.4	59.6
(E) 56.2	1932-48	58.2	91.0	76.6
113.2	1914-48	104.9	117.1	111.6
311.3	1948-50	221.9	441.8	307.8
86.2	1910-48	94.8	71.1	102.0
126.9	1932-48	133.2	175.8	194.9
34.3	1914-48	18.9	22.8	
39.35	f 1940-48	34.0	36.3	
24.8	1914-48	28.1	20.8	18.6
	1948	9.1	6.6	5.5
55.6	1947-48	58.2	47.9	32.1
	Mar-Sept 51			51.3
3,480.2	1914-48	3,341.0	2,557.0	2,910.7
6,131.0	1914-48	6,287.0	4,236.0	3,916.0
	May-Sept. 51			2,837.4
2,066.5	1914-48	2,048.0	1,476.0	1,847.6
11,055.0	1948-49	11,130.0	9,738.0	8,783.7
469.5	1914-48	478.0	155.9	239.0
13,633.8	1914-48	14,359.6	11,053.5	9,830.6
13,608.8	1914-48	14,340.0	11,040.0	9,816.7
74.6	10-20,12-27 32-48	83.3	51.0	57.9
270.8	1936-48	262.4	245.6	256.2

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
29.	†Dirty Devil River near Hite, Utah	
30.	††Dolores River near Cisco, Utah	
31.	Dolores River at Dolores, Colorado	556
32.	Dolores River at Gateway, Colorado	4,350
33.	Duchesne River at Myton, Utah	2,705
34.	Duchesne River near Randlett, Utah	3,820
35.	Duchesne River near Tabiona, Utah	352
36.	Eagle River below Gypsum, Colorado	957
37.	East River at Almont, Colorado	295
38.	*East Fork of Smith Fork near Robertson, Wyo.	53
39.	†East Fork of Beaver Creek near Lonetree, Wyo.	
40.	Elk River at Clark, Colorado	206
41.	Escalante River near Escalante, Utah	315
42.	††Escalante River near mouth, Utah	
43.	Florida River near Durango, Colorado	96
44.	Fontenelle Creek near Fontenelle, Wyo.	224
45.	†Fontenelle Creek above Irrigation, Wyo.	
46.	††Green River near Greendale, Utah	
47.	Green River at Green River, Utah	40,920
48.	Green River at Green River, Wyo.	7,670
49.	Green River near Jensen, Utah	**
50.	Green River near Linwood, Utah	14,300
51.	Green River near Ouray, Utah	**
52.	Green River at Warren Bridge, Wyo.	468
53.	Gunnison River near Grand Junction, Colorado	8,020
54.	Gunnison River near Gunnison, Colorado	1,010
55.	Gunnison River below Gunnison Tunnel, Colorado	3,980
56.	†Hams Fork above Irrigation, Wyo.	
57.	Henrys Fork at Linwood, Utah	530
58.	Henrys Fork near Lonetree, Wyo.	55
59.	LaPlata River at Colorado-New Mexico state line	331
60.	LaPlata River at Hesperus, Colorado	37
61.	Little Snake River near Dixon, Wyo.	1,028
62.	Little Snake River near Lily, Colorado	3,680
63.	Little Snake River near Slater, Colorado	285

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (D)WSP. 1149 1949 (6)	(Provisional) 1950 (7)	1951 (8)
		95.4		
351.8	1921-48	378.2	233.0	
767.9	1914-48	818.7	378.3	158.2
426.8	1914-48	456.2	431.4	349.2
632.1	1914-48	603.3	581.2	434.8
152.6	1914-48	182.0	201.5	184.5
494.6	1947-49	460.2	396.3	464.2
254.8	1910-13 16-20, 34-48	244.4	219.8	234.8
32.4	1914-48	38.7	31.4	31.4
6.1	1948-49	5.8	6.35	
257.5	14-22,31-48	291.6	248.3	233.1
10.47	1943-48	16.6	7.4	
86.9	1910-12, 17-24,27-48	104.1	42.6	30.1
42.6	16-19,31-48	43.9	91.9	88.3
4,633.0	1914-48	4,897.0	5,511.0	4,725.0
e 1,273.3	1914-48	(E) 1,129.0	(E) 2,010.0	
3,558.5	1947-48	3,408.0	4,097.0	
1,518.8	1914-48	1,358.0	2,493.0	2,256.8
4,032.0	1948-	4,826.0	5,461.0	
355.1	1932-48	354.0	463.7	488.5
2,038.0	1914-48	2,119.0	1,387.0	
624.0	11-14,16-28 45-48	539.0	469.5	460.1
931.1	1943-48	1,118.0	607.0	569.1
66.3	1914-48	64.4	56.5	45.9
31.9	1914-48	31.7	29.6	28.2
29.5	1914-48	35.0	13.0	8.0
34.4	1917-48	47.0	20.4	17.9
414.9	1914-48	461.2	399.0	291.2
462.6	1914-48	536.4	442.0	294.6
166.3	1943-47			153.1

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
64.	Los Pinos River near Bayfield, Colorado	284
65.	(C) Los Pinos River at LaBoca, Colorado (near Colorado-New Mexico state line)	
66.	Los Pinos River at Ignacio, Colorado	448
67.	†Mancos River near Towoac, Colorado	550
68.	†McElmo Creek near Colorado-Utah state line	
69.	McElmo Creek near Cortez, Colorado	233
70.	†Middle Fork Beaver Creek near Lonetree, Wyo.	
71.	†Minnie Maud Creek near Myton, Utah	231
72.	Navajo Creek at Edith, Colorado	165
73.	North Fork Gunnison River near Somerset, Colorado	521
74.	†North Fork White River near Buford, Colorado	240
75.	North Piney Creek near Mason, Wyo.	58
76.	Paria River at Lees Ferry, Arizona	1,550
77.	†Pine Creek near Fremont Lake, Wyo.	
78.	Pine Creek at Pinedale, Wyo.	118
79.	Plateau Creek near Cameo, Colorado	604
80.	Price River near Heiner, Utah	430
81.	Price River at Woodside, Utah	1,500
82.	Rio Blanco River near Pagosa Springs, Colorado	58
83.	Rito Blanco River at Pagosa Springs, Colorado	23
84.	Roaring Fork at Aspen, Colorado	109
85.	Roaring Fork at Glenwood Springs, Colorado	1,460
86.	San Juan River near Blanco, N. M.	3,558
87.	San Juan River near Bluff, Utah	23,010
88.	San Juan River at Farmington, N. M.	7,245
89.	San Juan River at Pagosa Springs, Colorado	298
90.	San Juan River at Rosa, N. M.	1,990
91.	San Juan River at Shiprock, N. M.	12,876
92.	San Miguel River near Placerville, Colorado	308
93.	San Rafael River near Green River, Utah	1,690
94.	Savery Creek near Savery, Wyo.	330
95.	Sheep Creek near Manila, Utah	46
96.	Sheep Creek at mouth near Manila, Utah	111
97.	(B) Sheep Creek Upper Canal, near Manila, Utah	

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (D)WSP. 1149 1949 (6)	(Provisional) 1950 (7)	1951 (8)
266.4	1927-48	368.1	196.2	145.5
				32.0
246.9	1914-48	282.4	53.1	26.7
49.2	1914-48	(F) 50.0		
40.8	1914-48	(F) 54.0		13.8
16.9	1948-49	18.8	15.0	
17.2	1948-49	25.6	22.3	
127.2	1914-48	120.4	66.0	52.2
339.6	1934-48	339.1	335.5	256.1
36.3	1932-48	35.8	60.8	75.3
25.0	1914-48	19.6	13.5	13.9
95.8	1914-48	86.8	113.2	130.6
183.4	1914-48	160.6	117.2	
89.8	1914-48	85.6	80.8	72.6
37.3	1946-48	84.1	67.7	60.1
67.0	1936-48	73.3		
14.0	1936-48	16.2		
158.0	26 yrs.	75.7	50.3	
1,026.8	1914-48	958.6	798.1	872.7
1,218.7	1914-48	1,389.4	535.1	331.4
2,214.0	1914-48	2,523.0	902.3	668.3
2,051.0	1914-48	2,239.0	942.2	651.0
287.4	1936-48	370.4	182.1	130.7
926.4	1914-48	1,063.6	477.3	327.9
2,007.7		2,321.1	959.9	666.2
191.6	1943-48	199.8	122.8	95.7
1,686.9	10-18,46-48	130.8	56.9	67.8
76.0	42-46 & 48	105.0	92.3	55.8
14.2	1944-48	16.1	6.8	
24.7	1947-48	25.0	16.6	

Ref. (1)	Stream (2)	Drainage Area Sq. Miles (3)
98.	(B) Sheep Creek Lower Canal	
99.	Slater Fork near Slater, Colorado	161
100.	†Snake River near Montezuma, Colorado	59
101.	†South Fork White River near Buford, Colorado	
102.	(C) Spring Creek at LaBoca, Colorado, near Colorado-Utah state line	
103.	Strawberry River at Duchesne, Utah	1,040
104.	Taylor River at Almont, Colorado	440
105.	Tenmile Creek at Dillon, Colorado	113
106.	Tomichi Creek at Gunnison, Colorado	1,020
107.	Uinta River near Neola, Utah	181
108.	Uncompahgre River near Colona, Colorado	437
109.	West Fork Beaver Creek near Lonetree, Wyo.	
110.	West Fork Smith Fork near Robertson, Wyo.	37
111.	White River near Meeker, Colorado	762
112.	White River near Watson, Utah	4,020
113.	Whiterocks River near Whiterocks, Utah	115
114.	Willow Creek near Ouray, Utah	967
115.	Yampa River near Maybell, Colorado	3,410
116.	Yampa River at Steamboat Springs, Colorado	604

*This is a U. S. G. S. station but is not required at the present time for administration by the Upper Colorado River Commission.

**Drainage area not shown in latest U. S. G. S. water supply paper available.

†This station is to be installed or reestablished and operated by the U. S. G. S. for administration purposes by the Upper Colorado River Commission.

††This station has recently been installed.

(A) Lee Ferry one mile down stream from the mouth of the Paria River is the 1922 "Compact Point," and the discharge at this point is taken as the sum of Nos. 25 and 76.

Average Annual Historic Flow (4)	Period Covered by Average (5)	Flows in Water Years (D)WSP. 1149 1949 (6)	(Provisional) 1950 (7)	1951 (8)
51.3	1932-48	76.3	67.9	39.1
44.9	1943-45			
	Jan.-Sept. 51			11.0
113.7	1914-48	134.2	130.2	101.5
252.0	1911-48	242.7	224.4	204.0
88.3	11-19,30-48	94.4	86.1	114.1
131.0	1939-48	187.4	81.5	89.5
123.8	25-26,30-48	152.9	137.6	114.6
213.8	1918-48	230.8	126.2	93.6
		12.9	10.9	
16.2	1914-48	14.8	16.8	16.6
461.5	1914-48	522.8	429.2	440.2
574.7	1914-48	573.4	446.8	467.8
92.8	1914-48	93.8	93.2	73.0
16.3	1948-	28.6	26.8	
1,183.2	1914-48	1,322.0	952.0	1,016.0
344.1	1914-48	390.0	287.6	346.0

(B) Discharge measurements reported in U. S. G. S. Water Supply Paper 1059 (1946) p. 384.

(C) Add Spring Creek to Los Pinos River at LaBoca to give flow at Colorado-Utah state line.

(D) U. S. G. S. Water Supply Paper 1149.

(E) Flow estimated for some years included in the period.

(F) Flow estimated by correlation.

e Flow for the years 1940 to date is estimated by correlation with flow at Green River, Utah.

f This station is not now operating but is to be reinstalled. These flows are estimated.

@ Area from Final Report of Engineering Advisory Committee to Upper Colorado River Compact Commission, November 1948.

TRANSMOUNTAIN DIVERSIONS IN COLORADO

Ditch or Tunnel	Stream	Acre-feet Year		
		1949	1950	1951
Alva B. Adams Tunnel (East Portal)	Shadow Mountain Reservoir	17,476	26,369	56,311
Berthoud Pass Ditch	Fraser River Tributaries	327	490	716
Eureka Ditch	Tonahutu Creek	91	77	124
Grand River Ditch	Colorado River Tributaries	17,194	16,161	24,967
Moffat Tunnel (East Portal)		24,664	29,565	33,789
*Fraser-Jim Creek Ditch	Fraser River	(9,950)	(13,661)	
*South Ranch Creek Ditch	South Ranch Creek	(1,416)	(1,020)	
*Vasquez Creek Ditch	Vasquez Creek	(13,513)	(14,983)	
Independence Pass Tunnel (Twin Lakes Tunnel)	Roaring Fork Tributaries	38,193	34,880	44,925
Sub Total (Table 5)	Upper Colorado River	97,945	137,806	160,832
Williams Fork Tunnel (Jones Pass)	Williams River	1,889	9,090	11,136
Boreas Pass Ditch	Blue River	none	69	176
Columbine Ditch	Tenmile Creek Tributaries	none	1,268	1,744
Fremont Pass Ditch	Tenmile Creek	none	none	none
Ewing Ditch	Eagle River	1,337	783	1,419
Wurtz Ditch	Eagle River	2,687	1,987	2,942

Busk-Ivanhoe Tunnel	Fryingpan River	4,295	3,406	5,134
Larkspur Ditch	Tomichi Creek	394	24	121
Sub Total above Colo.-Utah Line		10,602	16,627	22,672
Tabor Ditch	Gunnison River	none	none	396
Fuchs Ditch (Weminuche Pass) (Table 2)	N. Fork Los Pinos River	512	361	175
Raber-Lohr Ditch	Los Pinos River		976	735
Treasure Pass Ditch	San Juan River	none	208	160
Treasure Pass Ditch	San Juan River		69	
Squaw Pass Ditch	San Juan River			159
Piedra Ditch	San Juan River			67
Sub Total		512	1,614	1,296
Grand Total		109,059	156,047	185,196

*Supply Ditch to Moffat Tunnel.

TRANSMOUNTAIN DIVERSIONS IN UTAH

Ditch or Tunnel	Location	Acre-feet Year 1950	Acre-feet Year 1951
Ephraim Tunnel	near Ephraim	3,102	3,180
Reeder Ditch	near Spring City	251	116
Twin Creek Tunnel	near Mt. Pleasant	163	205
Horseshoe Tunnel	near Ephraim	698	703
Cedar Creek Tunnel	near Spring City	313	338
Spring City Tunnel	near Spring City	1,370	1,620
Fairview Ditch	near Fairview	1,490	1,820
Candland Ditch	near Mt. Pleasant	138	224
Black Canyon Ditch	near Spring City	206	260
Larsen Tunnel	near Ephraim	751	865
Madsen Ditch	near Ephraim	7	70
John August Ditch	near Ephraim	182	299
Coal Fork Ditch	near Mt. Pleasant	159	209
Lower Hobble Creek Ditch	near Heber	248	654
Upper Hobble Creek Ditch	near Heber	389	632
Strawberry River and Willow Creek Ditches	Strawberry River, Willow Creek	2,730	2,500
Strawberry Tunnel*	Strawberry River	69,140	68,170
	Total	81,337	81,865

*Diversion in 1949; 63,270 acre-feet.
Others in above table were not measured in 1949.

APPENDIX K

WALTER E. DALBY
Certified Public Accountant
310 First National Bank Building
Grand Junction, Colorado

July 31, 1951

Upper Colorado River Commission
Grand Junction, Colorado

I have examined the balance sheets of the General Fund and the Property and Equipment Fund of the Upper Colorado River Commission as of June 30, 1951, and the related statement of revenue and expense for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying balance sheets and revenue and expense statement present fairly the financial position of the Upper Colorado River Commission at June 30, 1951, and the results of its operations for the year then ended.

(signed) WALTER E. DALBY
Certified Public Accountant

BALANCE SHEET — GENERAL FUND

UPPER COLORADO RIVER COMMISSION

June 30, 1951

ASSETS

CASH		
Office cash fund	$ 10.65	
Demand deposit	22,292.71	$22,303.36
RETURNABLE DEPOSIT—United Air Lines		425.00
		$22,728.36

LIABILITIES, RESERVES, AND FUND BALANCE

ACCOUNTS PAYABLE—		
for supplies and expenses		$ 2,130.54
RESERVES		
For encumbrances	$ 327.95	
For fiscal year 1951-1952 assessments received prior to June 30, 1951	17,372.00	
For contingencies	1,124.12	18,824.07
UNAPPROPRIATED FUND BALANCE		
Balance at July 1, 1950	$ 1,124.12	
Add: Excess of revenues over expenditures for the fiscal year ended June 30, 1951	1,773.75	
	$ 2,897.87	
Less: Amount transferred to reserve for contingencies	1,124.12	1,773.75
		$22,728.36

BALANCE SHEET — PROPERTY AND EQUIPMENT FUND

UPPER COLORADO RIVER COMMISSION

June 30, 1951

ASSETS

PROPERTY AND EQUIPMENT—at cost			
Furniture and fixtures			$4,840.66
Automobile			2,765.17
Engineering equipment			778.00
			$8,383.83

FUND BALANCE

FUND BALANCE			
Investment in property and equipment at July 1, 1950		$6,263.68	
Transactions for the fiscal year ended June 30, 1951:			
Additions	$2,241.24		
Retirements	121.09	2,120.15	$8,383.83
			$8,383.83

REVENUE AND EXPENSE STATEMENT

UPPER COLORADO RIVER COMMISSION

For the fiscal year ended June 30, 1951

	BUDGET AMOUNT	ACTUAL AMOUNT	ACTUAL AMOUNT OVER-UNDER*
Revenues:			
Assessments	$45,700.00	$45,700.00	$ —0—
Sale of reports	—0—	814.34	814.34
Sale of typewriter	—0—	100.00	100.00
Insurance premium refund	—0—	2.09	2.09
TOTAL REVENUES	$45,700.00	$46,616.43	$ 916.43
Expenses:			
Personal services:			
Administrative salary		$13,750.00	
Engineering salary		10,000.00	
Clerical salaries		4,545.16	
	$29,090.00	$28,295.16	$ 794.84*
Travel:			
Automobile expense		$ 667.87	
Transportation, hotel, meals, etc.		7,117.35	
	7,150.00	$ 7,785.22	635.22
Current expenses:			
Reporting		$ 842.58	
Telephone and telegrams		697.92	
Office supplies		1,273.05	
Postage		297.20	
Insurance and bonds		554.78	
Accounting fees		625.00	
Engineering services		745.36	
Miscellaneous		35.00	
	5,115.00	$ 5,070.89	44.11*
Capital outlay:			
Furniture and fixtures		$ 1,467.49	
Engineering equipment		773.75	
	2,695.00	$ 2,241.24	453.76*
Printing expenses:	1,650.00	$ 1,450.17	199.83*
TOTAL EXPENSES	$45,700.00	$44,842.68	$ 857.32*
EXCESS OF REVENUE OVER EXPENSES		$ 1,773.75	$ 1,773.75

CASH RECEIPTS AND DISBURSEMENTS

UPPER COLORADO RIVER COMMISSION

For the fiscal year ended June 30, 1951

Balance of cash and demand deposit at July 1, 1950			$20,667.11
Cash receipts:			
Assessments		$47,419.75	
Sale of reports		814.34	
Sale of typewriter		100.00	
Insurance premium refund		2.09	
On employee account receivable		16.45	
Refund of unused plane fare ticket		88.66	48,441.29
			$69,108.40
Cash disbursements:			
Personal services		$28,251.51	
Travel		7,121.78	
Current expenses		4,815.40	
Capital outlay		1,963.29	
Printing		320.87	
Returnable deposit		425.00	
Expenses of fiscal year ended June 30, 1950 not paid until after July 1, 1950:			
For withholding tax	$ 1.35		
For accounts payable and encumbrances	3,905.84	3,907.19	46,805.04
Balance of cash and demand deposit at June 30, 1951			$22,303.36

INSURANCE COVERAGE

	TYPE OF COVERAGE	AMOUNT OF COVERAGE
Furniture and fixtures	Fire and comprehensive	$6,000.00
Automobile	Comprehensive	Actual cash value
	Bodily injury and property damage	$5/$100,000.00
Treasurer	Fidelity bond	$40,000.00
Assistant Treasurer	Fidelity bond	$40,000.00
Employees	Workmen's compensation	Various

APPENDIX L

BUDGET FOR FISCAL YEAR 1953

UPPER COLORADO RIVER COMMISSION

PERSONAL SERVICES		
Administrative	$16,990	
Engineering	22,600	
Clerical	3,360	$42,950
CAPITAL OUTLAY		
Engineering equipment, office equipment and automobile	2,650	2,650
OFFICE SUPPLIES	2,500	2,500
TRAVEL	9,000	9,000
CURRENT EXPENSE		
Reporting	3,300	
Telephone and Telegraph	1,050	
Printing	2,000	
Accounting	500	
Insurance and Bonds	750	7,600
INFORMATION		
Radio	3,000	
Exhibits	2,000	
Publications	7,000	
Travel	1,500	13,500
RESERVE FOR CONTINGENCIES	5,000	5,000
		$83,200

APPENDIX M

A BILL

To authorize the Secretary of the Interior to construct, operate, and maintain the Colorado River Storage Project and participating projects, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in order to initiate the comprehensive development of the water resources of the Upper Colorado River Basin, the Congress, in the exercise of its constitutional authority to provide for the general welfare, to regulate commerce among the States, and to make all needful rules and regulations respecting property belonging to the United States, and for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the obligation undertaken by the States of the Upper Division in Article III of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the control of floods and for the improvement of navigation, and generating hydroelectric power, hereby authorizes the Secretary of the Interior (1) to construct, operate, and maintain the following initial units of the Colorado River Storage Project, consisting of dams, reservoirs, power plants, transmission facilities and appurtenant works: Echo Park, Flaming Gorge, Glen Canyon, Navajo and a dam or dams in the Gunnison River Basin at a site or sites to be determined by the Secretary after consultation with the Colorado Water Conservation Board; and (2) to construct, operate, and maintain the following additional reclamation projects (including power generating and transmission facilities related thereto), hereinafter referred to as participating projects: Central Utah (initial phase), Emery County, Gooseberry, Florida, San Juan-Chama, South San Juan, Shiprock Indian Reclamation, Hammond, LaBarge, Lyman, Paonia (including the Minnesota unit, a dam and reservoir on Muddy Creek just above its confluence with the North Fork of the Gunnison River, and other necessary works), Pine River Extension, La Plata, Seedskadee, Silt and Smith Fork: **Provided,** That no appropriation for or construction of the San Juan-Chama Project, the South San Juan Project, or the Shiprock Indian Reclamation Project shall be made or begun until coordinated reports thereon shall have been submitted to the affected States pursuant to the Act of December 22, 1944 (58 Stat. 887), and approved by the Congress. The benefits of the Act of July 1, 1932

(47 Stat. 564) are hereby extended and shall apply to Indian lands served by each of the foregoing participating projects.

SEC. 2. In constructing, operating, and maintaining the units of the Colorado River Storage Project and the participating projects listed in section 1 of this Act, the Secretary shall be governed by the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto): **Provided,** That (a) irrigation repayment contracts entered into pursuant to those laws may, except as otherwise provided for the Paonia and Eden Projects, provide for repayment of the obligation assumed thereunder over a period of not more than fifty years exclusive of any development period authorized by law, (b) that in constructing, operating and maintaining the Shiprock Indian Reclamation Project, the Secretary shall be governed by the laws applicable to the development of irrigation projects on Indian reservations, and (c) as to Indian lands within all participating projects, payment of construction, operation and maintenance costs shall be subject to the Act of July 1, 1932 (47 Stat. 564). Said units and projects shall be subject to the apportionments of the use of water between the Upper and Lower Basins of the Colorado River and among the States of the Upper Basin fixed in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, and to the terms of the treaty with the United Mexican States.

SEC. 3. Because of the interrelationship of the projects in the Upper Colorado River Basin and in order to assist in the administration of section 1 of this Act, the Secretary is authorized to establish an Upper Colorado River Account. To said account shall be credited (1) all power revenues derived from (a) the Colorado River Storage Project and (b) participating projects located within the natural confines of the Colorado River Basin above Lee Ferry, and (2) all net power revenues derived from the Central Utah Project (initial phase) and the San Juan-Chama Project subsequent to complete reimbursement of the reimbursable costs of those projects and additions to either of said projects. Said account shall be charged with (1) all reimbursable construction, operation, maintenance, and replacement costs of the Colorado River Storage Project and of the participating projects located within the natural confines of the Colorado River Basin above Lee Ferry that are allocated to power or assigned to be returned from power revenues, (2) that portion of the irrigation allocation of the construction cost of each participating project (whether within or without the natural confines of the Colorado River Basin above Lee Ferry) which is required to be so charged in order to account for full reimburse-

ment thereof within fifty years following a suitable development period for that project, (3) those portions of the reimbursable construction costs of the Paonia Project (including the Minnesota unit, a dam and reservoir on Muddy Creek just above its confluence with the North Fork of the Gunnison River, and other necessary works) and of the irrigation features of the Eden Project, as authorized in the Act of June 28, 1949 (63 Stat. 277), which are, in the case of the Paonia Project, beyond the ability of the water users to repay within the period prescribed in the Act of June 25, 1947 (61 Stat. 181), and, in the case of the Eden Project, in excess of the amount prescribed in the Act of June 28, 1949, and (4) the amounts required to be so charged in order to carry out the purposes of section 6 of this Act, exclusive of funds made available pursuant to the last sentence thereof. Anything in this section to the contrary notwithstanding, said account shall not be charged with construction costs deferred under the Act of July 1, 1932 (47 Stat. 564).

SEC. 4. The hydroelectric power plants authorized by this Act to be constructed, operated, and maintained by the Secretary shall, to the fullest practicable extent consistent with the purposes of this Act, the Colorado River Compact and the Upper Colorado River Basin Compact, be operated in conjunction with other Federal power plants, present and potential, so as to produce the greatest practicable amount of power and energy that can be sold at firm power and energy rates. The Secretary is hereby authorized to enter into such contracts or agreements as, in his opinion, are feasible based upon a recognition and evaluation of the benefits arising from integrated operation of other hydroelectric power plants and of the works herein authorized.

Electric power generated at plants authorized by this Act ~~Electric power and energy generated at plants authorized by~~ and disposed of for use outside the States of the Upper Colorado ~~this Act which is disposed of for use outside the States of the Upper~~ River Basin shall be replaced from other sources, as deter- ~~Basin shall be replaced from those or other plants, as determined by~~ mined by the Secretary, when required to satisfy needs in the ~~the Secretary, when required to satisfy the needs of customers or~~ States of the Upper Colorado River Basin, at rates not to exceed ~~prospective customers in such States, at rates not to exceed those in~~ those in effect for power generated at plants authorized by this ~~effect for energy generated at the plants authorized by this Act,~~ Act. Contracts for the sale of power for use outside the States of ~~and provision shall be made for the termination upon reasonable~~ the Upper Colorado River Basin shall contain such provisions as the ~~notice, of contracts relating to the disposition for use outside the~~

Secretary shall determine to be necessary to effectuate the purposes ~~States of the Upper Basin of power and energy generated at plants~~ of this Act, including the provision that if and when the Secretary ~~authorized in this Act, whenever and to the extent that the Secre-~~ finds (a) that such power can not practicably be replaced from other ~~tary finds that such power and energy cannot practicably be replac-~~ sources at rates not exceeding those in effect for power generated ~~ed from other sources at such rates and that such power and energy~~ by plants authorized by this Act, and (b) that such power is re- ~~is required to satisfy the needs of preference and other customers in~~ quired to satisfy needs in the States of the Upper Colorado River ~~the Upper Basin. Contracts for the disposition of electric power and~~ Basin, then such contracts shall be subject to termination or to modi- ~~energy generated at the plants authorized in this Act shall contain~~ fication to the extent deemed necessary by the Secretary to meet ~~such provisions as the Secretary shall determine to be necessary to~~ power requirements in the States of the Upper Colorado River ~~effectuate the provisions of this section.~~
Basin.*

SEC. 5. In order to achieve such comprehensive development as will assure the consumptive use in the States of the Upper Colorado River Basin of waters of the Colorado River System the use of which is apportioned to the Upper Colorado River Basin by the Colorado River Compact and to each State thereof by the Upper Colorado River Basin Compact, it is the intent of the Congress to authorize the construction, operation, and maintenance of further units of the Colorado River Storage Project, of additional phases of participating projects authorized in this Act, and new participating projects as additional information becomes available and additional needs are indicated. It is hereby declared to be the purpose of the Congress to authorize as participating projects only projects (including units or phases thereof)

(1) for the use, in one or more of the States designated in Article III of the Upper Colorado River Basin Compact, of waters of the Upper Colorado River system the consumptive use of which is apportioned to those States by that article;

(2) whose total benefits exceed their total costs including, but without limitation, costs attributable to

*As amended by unanimous action of the Upper Colorado River Commission, March 17, 1952.

the direct use of the facilities of the Colorado River Storage Project or any other project and an appropriate share of the costs of the Colorado River Storage Project;

(3) which are able, with their anticipated revenues from irrigation, based on the irrigators' ability to pay, to meet the operation, maintenance, and replacement costs allocated to irrigation and to pay within a period of fifty years following a suitable development period at least part of the construction cost allocated to irrigation;

(4) which have available, to aid them, an appropriate district, preferably of the water-conservancy type, which is satisfactory to the Secretary, one purpose of which shall be to provide revenues for the project over and above those paid by the irrigators, to assist in repayment of construction costs allocated to irrigation;

(5) which do not require assistance from the Upper Colorado River Account in an amount which, taking into consideration the prior obligations of the account and its anticipated revenues from existing and authorized units of the Colorado River Storage Project, will leave the account in a deficit position at the end of the participating project's payout period as specified in (3) above or will require an increase in the general level of the Colorado River Storage Project power rates;

(6) for which pertinent data sufficient to determine their probable engineering and economic justification and feasibility shall be available.

It is likewise declared to be the policy of the Congress that a new project, unit, or phase thereof shall be authorized as a participating project only when and to the extent that all sources of revenue directly available to said project, unit, or phase are insufficient to return its reimbursable costs during a 50-year payout period. The charges to the Upper Colorado River Account arising out of authorization of any participating project which commingles the waters specified in subsection (1) of this section with other waters shall not exceed an appropriate share of the cost of the works required by that project to use the water specified in said subsection (1). No project, unit, or phase thereof shall be eligible to participate in the Upper Colorado River Account save upon authorization by the Congress.

SEC. 6. There is hereby established in the Treasury a special fund, designated the "Upper Colorado River Development Fund," to which shall be transferred at the end of each fiscal year, beginning with the initial year of commercial power production by the Colorado River Storage Project 7½ percentum of the net power revenues for that year after such net revenues exceed five million dollars annually, but not to exceed one million dollars in any one fiscal year. The moneys so transferred shall be available upon appropriation (such appropriation to remain available until expended) for expenditure by the Secretary, without prejudice to the use by him for the same purposes of other appropriated moneys, for studies and investigations relating to the development, conservation, and utilization of the waters of the Upper Colorado River Basin, all expenditures from said fund to be nonreimbursable and nonreturnable under the reclamation laws. Funds appropriated for carrying out the authorizations contained in section 1 of this Act shall also be available for carrying out the studies and investigations set forth in this section.

SEC. 7. There is hereby established in the Treasury, from the receipts of the Colorado River Storage Project, a continuing fund of $1,000,000 to the credit of and subject to expenditure by the Secretary to defray emergency expenses and to insure continuous operation of the project.

SEC. 8. The Secretary shall report to the Congress as of the close of each fiscal year beginning with the fiscal year 1955 upon the status of the Upper Colorado River Basin Account and on the revenues from and the cost of constructing, operating, and maintaining the Colorado River Storage Project and the participating projects. The Secretary's report shall be prepared in such manner as accurately to reflect the Federal investment allocated to power, to irrigation, and to other purposes and the progress of return and repayment thereon, and the estimated rate of progress, year by year, in accomplishing full repayment.

SEC. 9. The Secretary is authorized to plan, construct, operate, and maintain public recreational facilities on lands withdrawn or acquired for the development of the Colorado River Storage Project or of the participating projects; to conserve the scenery, the natural, historic, and archeologic objects, and the wildlife on said lands, and to provide for public use and enjoyment of the same and of the water areas created by these projects by such means as are consistent with the primary purposes of said projects; and to mitigate losses of and improve conditions for the propagation of fish and wildlife in connection with the development of the Colorado River

Storage Project and of the participating projects. The Secretary is authorized to acquire lands and to withdraw public lands from entry or other disposition under the public land laws for the construction, operation, and maintenance of recreational facilities in connection with the said projects, and to dispose of them to Federal, State, and local governmental agencies by lease, transfer, exchange, or conveyance, upon such terms and conditions as will best promote their development and operation in the public interest. The costs, including the operation and maintenance costs, of all said undertakings shall be nonreimbursable and nonreturnable under the reclamation laws, and funds appropriated for carrying out the authorization contained in section 1 of this Act shall, without prejudice to the availability of other appropriated moneys for the same purposes, also be available for carrying out the investigations and programs authorized in this section.

SEC. 10. The Secretary is hereby authorized to undertake the investigations and programs of cooperating Federal agencies outlined in paragraphs 33 to 39, inclusive, of the report of the Regional Director, Region 4, Bureau of Reclamation, dated December 15, 1950, and entitled "Colorado River Storage Project and Participating Projects, Upper Colorado River Basin." The cost thereof shall be nonreimbursable and nonreturnable under the reclamation laws, and funds appropriated for carrying out the authorizations contained in section 1 of this Act shall, without prejudice to the availability of other appropriated moneys for the same purposes, also be available for carrying out the investigations and programs authorized in this section.

SEC. 11. Nothing contained in this Act shall be construed to alter, amend, or repeal the Boulder Canyon Project Act (45 Stat. 1057) or the Boulder Canyon Project Adjustment Act (54 Stat. 774).

SEC. 12. Construction of the projects herein authorized shall proceed as rapidly as is consistent with budgetary requirements: **Provided,** That actual construction shall not be commenced, and no contracts therefor shall be entered into, on any portion of the projects hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds, with the concurrence of the President, that the materials and labor, or either, necessary for said construction are more urgently needed for other national defense purposes and by appropriate general regulation, order or otherwise, suspends or prohibits their use for construction of these projects or portions thereof, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised.

SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be required to carry out the purposes of this Act.

SEC. 14. As used in this Act:

The terms "Colorado River Basin," "Colorado River Compact," "Colorado River System," "Lee Ferry," "States of the Upper Division," and "Upper Basin" shall have the meaning ascribed to them in Article II of the Upper Colorado River Basin Compact;

The term "States of the Upper Colorado River Basin" shall mean the States of Arizona, Colorado, New Mexico, Utah and Wyoming;

The term "Upper Colorado River Basin" shall have the same meaning as the term "Upper Basin";

The term "Upper Colorado River Basin Compact" shall mean that certain compact executed on October 11, 1948 by Commissioners representing the States of Arizona, Colorado, New Mexico, Utah and Wyoming, and consented to by the Congress of the United States of America by Act of April 6, 1949 (63 Stat. 31);

The term "treaty with the United Mexican States" shall mean that certain treaty between the United States of Amrica and the United Mexican States signed at Washington, District of Columbia, February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers, as amended and supplemented by the protocol dated November 14, 1944, and the understandings recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.