APPENDIX "E"

WATER SUPPLY

It is axiomatic that the main item of concern in the Mexican Water Treaty and in its negotiation was the water supply. Both the proponents and opponents of the treaty agreed that Mexico was entitled to some water from the Colorado River, the question seemed to be "how much". There were divergent views as to the quantity of water available from uncommitted river sources, return flow, seepage, regulatory losses, and desilting basin uses. Views also differed as to the basis for making an allocation and as to data to support the basis.

We will attempt to outline the issues as raised and the arguments advanced on both sides. Besides the quantity question, there was discussion on the prior use of water in Mexico, the use and potential use of water in the United States, the need for a diversion dam for Mexico and related sub-issues.

The conflicting views are summarized in the majority and minority reports of the Committee on Foreign Relations to the Senate. (Executive Report No. 2, 79th Congress, 1st Session). On pages 4 and 5 of the Majority Report, we find the following language:

> "This water is to be delivered mainly in the boundary section of the river, but provision is made for the delivery of a portion through the All-American Canal and a small portion across the land boundary in the vicinity of Yuma, Ariz. Certain limitations are placed upon the schedules of delivery so as to insure to the United States credit for substantially all return flows and other waste waters emanating from projects within the United States and generally reaching the river at points too low on the stream to be susceptible of further use within the United States. This is largely composed of water which has been used for the irrigation of lands within the United States and which returns to the river through drainage canals or through underground seepage. Not all of the water which is put

upon the land is consumed in plant transpirtation and seepage. The residue, which is a substantial part of the amount diverted, eventually finds its way back into the stream. This water, which will pass down the river to Mexico in any event, is supplemented by floodwaters and other excess waters which are used for desilting, canal sluicing, and other purposes. Engineers of the Bureau of Reclamation and the American section of the Boundary Commission estimate that, when full development has been reached in the United States, these return flows will be not less than 900,000 acre-feet a year, and perhaps as much as 1,125,000 acre-feet a year, thus limiting the draft on what might be called firm water upstream to a quantity somewhat less than 600,000 acre-feet a year, and perhaps as little as 375,000 acre-feet a year. While the California witnesses have testified that they believe these estimates of return flow to be too high, the committee believes that greater weight should be given the estimates of the Federal agencies, who have made long and careful studies of this problem and who are considered to be disinterested witnesses. According to all the testimony, the average annual virgin run-off from the Colorado River Basin is approximately 18,000,000 acre-feet a year.

"The amount allocated to Mexico is thus only about 8 percent of the total supply, and the amount of firm water--that is, water which must be released from storage at Davis Dam--which will ultimately be required, in addition to return flows which will be in the river in any event, is only 3 percent or less, of the total annual supply. The balance remaining for use in the United States, or approximately 16,500,000 acre-feet on the average, will permit of a total development in the United States almost treble the present development. That is to say, the United States is now using only a little over a third of the water which is made available for her use under the treaty. Mexico, on the other hand, is now using approximately 1,800,000 acre-feet a year, and in the meantime some 8,000,000 or 9,000,000 acre-feet of water flows through Mexican territory and wastes unused into the Gulf of California. The testimony is that it will be many years hence before this water can all be put to beneficial use in the United States. If and when that time arrives, present Mexican uses must be curtailed. Thus, by placing for all time a limit, measurably below present Mexican diversions, upon the obligation of the United States to supply Colorado River water to Mexico, the treaty provides needed assurance to American agencies and communities in planning future developments."

And on pages 6 and 7:

"The committee is unqualifiedly of the opinion that the language of articles 10 and 11 of the treaty is clear and subject to no other

construction than that, first, the 1,700,000 acre-feet of water referred to in subparagraph (b) of article 10 includes and is not in addition to the 1,500,000 acre-feet of water the delivery of which is guaranteed under subparagraph (a) thereof; second, that under the provisions of this article Mexico can acquire no right to any quantity of water beyond the 1,500,000 acre-feet referred to in subparagraph (a) of that article other than the right to use such additional water as might otherwise be present in the river, without any additional obligation on the part of the United States, and other than the right to use not in excess of an additional 200,000 acre-feet of water to be delivered according to schedule if and when the United States authorities (not Mexico) decide that there exists a surplus of water in excess of the amount necessary to supply users of the United States and the guaranteed quantity of 1,500,000 acre-feet annually to Mexico; and, third, that the quantities allotted to Mexico under article 10 may be composed of any waters of the Colorado River from any and all sources and whatever their origin. The committee is firmly of the opinion that the language of these two articles is clear and that there can be no occasion for any misunderstanding with respect to their meaning or application.

"Complaint is made by representatives of the State of California that the pending treaty may adversely affect the future ability of the United States to fulfill the provisions of contracts between the Secretary of the Interior and various interests in California for delivery of the waters of the Colorado River. These contracts call for a total delivery to California of 5,362,000 acre-feet per year. California is now using only a little more than half of the waters for which she has contracted. The contracts make the delivery of these waters contingent upon their availability under the Colorado River Compact and the Boulder Canyon Project Act. The compact, to which all the seven States of the Colorado Basin are parties, allocates 7,500,000 acre-feet of water a year to the upper basin, which comprises portions of the States of Colorado, New Mexico, Utah and Wyoming, and 8,500,000 acre-feet to the lower basin, consisting principally of areas in the States of Arizona, California, and Nevada, with small portions also of the States of New Mexico and Utah. The compact then makes provision for supplying any rights which may accrue by treaty to the United Mexican States. These rights are first to be supplied out of surplus over and above the specific apportionments made in the compact and, if this surplus should prove to be insufficient, any deficiency is to be borne equally by the upper and lower basins in the United States. The compact further provides for a division of the surplus after October 1, 1963, if and when either basin shall have reached its total beneficial consumptive use within

the 16,000,000 acre-feet allocated by the compact and after deducting from the surplus the Mexican apportionment. This compact was expressly approved by the Congress in the Boulder Canyon Project Act, approved December 21, 1928. Presumably then, the Mexican allocation of 1,500,000 acre-feet per year will be supplied from the amount of approximately 2,000,000 acre-feet which is estimated to be the surplus after the compact allocations, totaling 16,000,000 acre-feet, have been supplied. If, however, the surplus should be insufficient for this purpose, any deficiency must be supplied equally by the upper and lower basins. One of the conditions of the Boulder Canyon Project Act was that California should agree to limit her uses to 4,400,000 acre-feet a year plus not more than half of the unallocated surplus, which, under the terms of the compact, cannot be allocated until after October 1, 1963.

"If, therefore, there should be any infirmity in the California contracts, it existed at the time the contracts were made and solely by reason of the fact that the contracts encroach upon the surplus to the extent of 962,000 acre-feet a year. Bearing in mind the fact that the contracts are made subject to the Colorado River Compact and the Boulder Canyon Project Act, and subject to the availability of water thereunder for use in California, the committee does not believe that there is any threatened impairment of the contracts in the legal sense, nor that California has any just cause for complaint. Furthermore, the committee believes, on the basis of the consensus of engineering testimony, that any possible impairment of these contracts in the physical sense is quite remote in point of time and depends upon a number of extremely hypothetical factors and conditions which may never assume any real importance and which have little or no weight against the manifold advantages of the treaty."

The Minority Views were presented as Part 2 of the report. The Minority said at pages 1 and 2:

"I. ALLOTMENT OF COLORADO RIVER WATER

"The treaty is said in the majority report to allot to Mexico a minimum of 1,500,000 acre-feet of water per annum. Such allotment is guaranteed and will constitute a first right on the river. It is to be delivered according to a prescribed schedule. Water reaching Mexico outside the schedule, even if used by Mexico, will not be credited on the treaty obligation of the United States.

"The allotted amount is double the amount that Mexico could or did use from the natural, unregulated flow of the Colorado River prior to the construction of Boulder Dam. The peak annual use of

such unregulated flow was 750,000 acre-feet. Because of wide variations in flow of the unregulated river that use could not be sustained in all years. In 1932, for instance, only 230,000 acre-feet were used.

"All increases in use in Mexico above 750,000 acre-feet per annum are made possible by Boulder Dam. That dam, alone, makes possible dependable and regulated deliveries of water on the lower river.

"The Boulder Dam was built in and by the United States for the declared purpose of conserving water for uses 'exclusively within the United States' (Boulder Canyon Project Act, sec. 1). That declaration was intended to and should settle for all time any claim of any foreign power to the use of water conserved by the Boulder project.

"There are more lands in the United States economically available for development by use of the waters of the Colorado River than can be supplied with water, even if all of the flow of the river be brought under control and used within our own borders. Every acre permanently developed in Mexico under treaty right means that an acre in the United States must remain forever desert.

"In the majority report (p. 11) it is stated that 'The treaty does not give away any natural resource.' That statement is untrue. The treaty gives to Mexico, without consideration, a substantial part of the most valuable natural resource of the Southwest. Water originating wholly within and made useful solely by storage in the United States is certainly a natural resource.

"In the majority report (p. 9) the statement is made that 'the use of Boulder Dam is not contemplated under the treaty for the delivery of Mexican waters.' That statement cannot be supported. In the absence of Boulder Dam, it would be utterly impossible to fulfill the treaty stipulations requiring uniform control and scheduled deliveries of 1,500,000 acre-feet each year. The river is extremely irregular in production of water. It is only by the vast conservation (32,000,000 acre-feet) made possible by the Boulder Dam that water can be made available each year.

"An attempt was made at the hearings to bypass the plain language of the Project Act by asserting that the water for Mexico would be made available by Davis Dam. The Davis project, not yet constructed, will have a storage capacity of only 1,600,000 acre-feet. It lies below Boulder Dam. It will merely reregulate Boulder discharges seasonally. It will provide no long-term or cyclic storage adequate to equate the variations in the river. Without such storage, the treaty stipulations cannot be fulfilled."

And on page 8 of the minority report:

"(b) Quantity.--Article 10 (a) and article 10 (b) of the treaty are independent paragraphs. They contain no cross-references. By article 10 (a) there is allotted to Mexico 'a guaranteed annual quantity of 1,500,000 acre-feet,' the right to which is in no wise dependent upon use. By article 10 (b) there are allotted to Mexico 'any other quantities arriving at the Mexican points of diversion.' Necessarily, these 'other quantities' are in addition to the 1,500,000 acre-feet guaranteed by article 10 (a). Paragraph 10 (b), clearly referring to these 'other quantities' closes with the statement:

'Mexico shall acquire no right beyond that provided by this subparagraph by the use of the waters of the Colorado River System, for any purpose whatsoever, in excess of 1,500,000 acre-feet annually.'

"It has been argued with great force and reason that the water acquired by guaranty under article 10 (a) and that authorized to be acquired by use under 10 (b) are independent and cumulative amounts. The members of the committee joining in this report believe that the quantity of water allotted to Mexico should be unmistakably stated."

As in previous Appendices we shall set forth the presentation of the proponents, then that of the opponents followed by rebuttal of the proponents as developed in the Hearings on the treaty before the Senate Committee on Foreign Relations.

(Note: Until otherwise indicated all page references hereinafter noted shall be to the Hearings before the Committee on Foreign Relations, United States Senate, 79th Congress, 1st Session, on Treaty with Mexico Relating to the Utilization of the Waters of certain Rivers.)

At the time the treaty was being negotiated and considered by the Senate, there was a considerable volume of water passing the boundary and flowing unused into the Gulf of California. The need for the Treaty was set forth by Secretary of State Stettinius in his statement to the Committee starting on page 19 of the Hearings:

"3. On the Colorado, development in the United States and in Mexico has been proceeding at a rapid rate. With an average of over 7,000,000 acre-feet of water now wasting annually through Mexican territory into the Gulf of California, it is of the utmost importance to both nations that there should be an allocation, once and for all, of the waters of this stream, so that, on the one hand,

conflicting development and overexpansion, with their attendant disastrous consequences, may be checked and, on the other hand, development may proceed in an orderly and secure manner, free of the uncertainties as to future available water supply which hamper and retard sound growth. Hardship, misunderstanding, and bitterness are the only alternatives to an early and equitable solution of the problem.

"4. The treaty now under consideration protects, in large measure, existing uses in Mexico on the Colorado River. In the United States, not only are existing uses protected, but opportunity is given for great expansion. Less than half of the water which will be available to the United States under this treaty is now being beneficially used. On the other hand, I am informed by men skilled in these matters and familiar with all the facts that more than half of the million and a half acre-feet of water allocated to Mexico will be made up, under conditions of ultimate development in the United States, of waste and return flows from lands within the United States."

As we shall see, the opponents of the Treaty used as an argument that Mexico was entitled to no more water than what she was using prior to the construction of Boulder Dam because it would not have been possible for her to obtain more water from an unregulated river. Mr. Lawson, American Commissioner on the International Boundary Commission and Senator Downey from California set the stage for this argument at page 32:

"Senator DOWNEY. Now, Mr. Chairman, with your permission, I will ask just one further question. If you do not deem it proper at this particular time, I will withdraw it.

"Under the treaty affecting the Colorado River, Mexico is being given about 800,000 second-feet that she could not utilize except from the waters stored in Boulder Dam; is that not correct?

"Mr. LAWSON. I do not understand the question, Senator.

"Senator DOWNEY. Let me reframe the question. Would it be possible to give Mexico 1,500,000 acre-feet of water out of the unregulated flow of the river during July, August, and September, when they need the water for irrigation?

"Mr. LAWSON. Under the present situation; yes.

"Senator DOWNEY. Do you mean because we allow a great volume of water to run down from Boulder Dam, that has been stored there?

"Mr. LAWSON. Yes.

"Senator DOWNEY. Under the water rights and the uses that existed in both countries prior to 1927, when we passed the Boulder Dam Project Act, was it possible for Mexico to utilize more than 600,000 second-feet of the waters of the Colorado River?

"Mr. LAWSON. Mexico has an irrigable area of 800,000 acres. Its development has been somewhat retarded because of economic matters, not physical matters. They had before the Boulder Dam was constructed used about 750,000 acre-feet of water; since the construction of Boulder Dam, they have increased that use until we find in the last 2 or 3 years a use of pretty close to 1,800,000 acre-feet.

"Senator DOWNEY. Then, I will ask the question this way, if I may. Mr. Chairman: That use of 1,800,000 acre-feet is made possible only by the utilization of the waters in Boulder Reservoir, is it not?

"Mr. LAWSON. That is correct; by the facilities which have been created in the United States.

"Senator DOWNEY. That is all."

Mr. Lawson presented a statement on water supply of the Colorado River which included charts and graphs and which presented figures that were used by the negotiators of the treaty starting on page 74:

"WATER SUPPLY

"The water supply of the Colorado River is derived largely from the snow that accumulates in the mountains of the upper basin during the winter months and which melts to cause the usual spring floods. Records of the flow at Lee Ferry show that an average of about 12,500,000 acre-feet of water has passed that point annually since 1922. The reconstructed flow, or the virgin flow, since 1897, has been estimated as about 16,200,000 acre-feet at this point. Additional inflow above Boulder Dam would increase this amount to about 17,400,000 acre-feet as the virgin inflow into Lake Mead."

He then presented a chart depicting estimates of the virgin flow of the Colorado River at Yuma, Arizona covering various periods and derived from various reports. The figures were:

Estimate Year	Source	Period of years used	Annual Average Virgin Flow (acre-feet)
1922	Senate Document 142	1903-1920	18,110,000
1929	Senate Document 186	1895-1922	18,380,000
1934	U.S. B.R. Report	1897-1922	18,171,000
1937	Jacobs & Stevens Report	1902-1937	17,850,000
1944	U.S.B.R. and I.B.C.	1897-1943	18,131,000

These figures were presented, according to Mr. Lawson, ". . . to point out the small amount of difference in the estimates from separate sources, of the virgin or reconstructed flow of the river at Yuma, Ariz." At page 75 Mr. Lawson introduced a hydrograph of the Colorado River at Yuma, Arizona for each year from 1902 to 1944. The purpose of exhibiting the hydrograph was explained by Mr. Lawson as follows:

> "We exhibit it because it shows those great variations in an uncontrolled river, one without storage works until the year 1935, when the Boulder was put in operation; it also shows the flattening of those peaks of discharge where floods that formerly passed down through Mexico are now stored back of Boulder Dam in a reservoir; 1901 and 1902 saw the first water go into Imperial Valley. That came about from a filing made on the Colorado River, which filing was for the purpose of obtaining the use of 10,000 second-feet of water for use, as the filing states, 'in the United States and in Mexico.' Following that filing a canal was constructed with headworks in the United States, ..., known as the Alamo Canal. This canal was constructed by the California Development Co., later operated and taken over by the present Imperial irrigation district.
>
> "The concession was granted by the Mexican Government under the condition that one-half of the flow of that canal would be available for Mexican use.
>
> "The year 1905 was one of great disaster. Floods from the Gila, beginning Thanksgiving of that year, put a flood discharge into the river that finally found its way into Mexico and into the Imperial Valley. In the 2 years that the river ran in that direction, leaving its course to the Gulf of Mexico, it formed a lake in southern California with about 400 square miles of area.
>
> "The protection of lands from overflow in the Imperial Valley of the United States at that time, as they are now, lies in Mexico. The topography is such that much of the Imperial Valley and the Mexicali Valley area is below sea level--at one time the arm of the Gulf of

California had extended into that area--and there was the danger, which actually came about, of the discharge of the entire river into Mexico, and through Mexico, into the Imperial Valley. The topography is such that it is very easy for the river to take that course. The river runs, as we might say, on the edge of a saucer, not sea level naturally but above sea level, the lands lying below sea level, or very close to it.

"Through the years following, which saw many developments and expansion of protective works in Mexico, we come to the year 1916, which produced in the month of January the largest known, recorded, and measured flood on the lower river of 240,000 cubic feet per second. Strange enough, most of this water came from the Gila River and not from the main Colorado. The Gila River which joins the Colorado just above Yuma, Arizona, has a large drainage area in southwestern Arizona where the annual rainfall usually is about 2 1/2 or 3 inches, but which comes in the form of cloudbursts, and which already has produced two of the largest floods of record in the lower Colorado River."

Because the development of irrigation in both the United States and Mexico was considered important by the proponents and opponents of the Treaty, Mr. Lawson presented some background information on the subject beginning on page 76:

"IRRIGATION DEVELOPMENT

"At the beginning of this century there were irrigated in the upper basin in the United States about 530,000 acres of land and in the lower basin about 205,000 acres, most of this from the Gila River in New Mexico and Arizona, with a small acreage in the Palo Verde area in California. By 1940 these uses had expanded so that in that year about 1,312,000 acres were being irrigated in the upper basin and about 1,323,000 acres in the lower basin in the United States and 190,000 acres in Mexico.

"Irrigation development in Mexico and in the Imperial Valley in California started with the construction by the California Development Co. of the Imperial canal system between 1896 and 1901. The Alamo canal heads in the United States a short distance above the upper international boundary, and proceeds through Mexican territory about 43 miles, recrossing the boundary into California in the vicinity of Calexico. Difficulties were experienced because of the canal passing through Mexican territory, and in order to operate in that country a Mexican subsidiary of the California Development Co. was organized and was granted the right by the Mexican Government, by contract dated May 17, 1904, to carry through the Alamo

canal 10,000 second-feet of water. Mexico was given the right to devote half of the water passing through this canal to the irrigation of Mexican lands.

"Expansion in both countries was rapid until about 1920, by which time the irrigated acreage in this area in both countries had reached more than half a million acres. Total diversions through the Alamo canal have exceeded 3,000,000 acre-feet annually during almost every year between 1925 and 1941. Although Mexico was entitled to the use of half of this water, in practice, prior to the placing in operation of Imperial Dam and the All-American Canals, about two-thirds of the water so diverted was used in the United States and one-third in Mexico. There has been a rapid increase in irrigation uses in the Mexicali Valley since the construction of Boulder Dam, the total area irrigated there in recent years being in excess of 300,000 acres. In 1943 more than 1,800,000 acre-feet of water of the Colorado River was diverted for use in Mexico."

In his prepared statement, which was inserted into the record of the Hearings from page 149 to page 220, Mr. Lawson broke down the irrigated acreage in Mexico mentioned above as follows: (p. 207)

"The irrigated acreage has increased from about 200,000 acres in 1920 to about 300,000 acres at present. This acreage, all served from Colorado River waters, may be segregated as to means of getting this supply as follows:

	Acres
Alamo canal system (by gravity), about	200,000
Lower river (by pumping), about	91,000
San Luis area (from Yuma project), about	9,000
Total, about	300,000

"It requires headgate diversions of approximately 6.0 acre-feet per acre to successfully irrigate in this area. Hence, the 1,800,000 acre-feet that has been used in recent years by Mexico."

The opponents of the Treaty considered the Mead offer of 1929 to be preferable, at least as far as the United States was concerned, to the treaty under consideration. Mr. Lawson summarized the previous negotiations with Mexico including the Mead offer on page 81 and 82 of the Hearings in the following language:

"Negotiations with Mexico over a division of the waters of the Colorado River have been carried on intermittently since early in this century. In 1924 the Congress passed an act authorizing the President to designate three special Commissioners to cooperate with representatives of Mexico in a study regarding the equitable use of the waters of the Rio Grande below Fort Quitman, Tex. (Public Law 118, 68th Cong., 43 Stat. 118). Mexico was unwilling to discuss the Rio Grande unless at the same time the problem of the Colorado River was also discussed. Accordingly, by joint resolution approved March 3, 1927 (Public Resolution No. 62, 69th Cong., 44 Stat. 1043), the scope of the investigation provided for by the act of May 13, 1924, was extended so as to include the Colorado River, and the resolution specifically provided that the purpose was to secure information on which to base a treaty with Mexico relative to the use of the waters of the two rivers. Permission was also granted to make a similar study of the Tijuana River, subject to Mexico's concurrence. . . .

"With respect to the Colorado River, Mexico demanded an allocation of 3,600,000 acre-feet a year, whereas the offer of the American section was limited to an allocation to Mexico of 750,000 acre-feet per annum to be delivered according to schedule, and it was suggested that in addition to this amount the American section would be willing to add an additional amount to compensate for losses in the main canal in Mexico. It was also pointed out that in addition Mexico would receive certain return, drainage and other excess flows from the United States.

"I think it is important at this time to call attention to the details of that offer to Mexico by the former American section of the Commission. It has great significance. Seven hundred and fifty thousand acre-feet of water was to be delivered into laterals of the canals in Mexico."

Robert L. Lowry, Engineer, American Section, International Boundary Commission testified in more detail as to the water supply of the Colorado River. On page 235 Mr. Lowry, after restating the various estimates of virgin flow of the Colorado River at Yuma introduced by Mr. Lawson, explained the latest estimate as follows:

"Mr. LOWRY. . .

"It is significant that the difference between the lowest and highest of these estimates, based on both early and late figures, as averages before and after the drought period of the 1930's, is only about 3 percent of the total water supply.

"The most recent estimate is made up as follows, and that is the estimate that I quoted from first: 18,131,000 acre-feet. These items go into that estimate:

"The virgin flow, or reconstructed flow, as it is sometimes called, at Lee Ferry, 16,271,000 acre-feet; the inflow, Lee Ferry to Boulder, 1,060,000 acre-feet; the inflow from Boulder to Imperial Dam, 195,000 acre-feet.

"The subtotal of those three items is 17,526,000 acre-feet.

"Natural losses from Boulder to Imperial Dam were estimated at about 1,075,000 acre-feet, which, subtracted from the above, gives you a virgin flow at Imperial Dam of 16,451,000 acre-feet.

* * *

"Mr. LOWRY. The virgin flow of the Gila has been estimated at 1,300,000 acre-feet, which, added to the virgin flow at Imperial Dam, gives a virgin flow at the boundary of 17,751,000 acre-feet. To this figure there has been added in our estimate for salvaged water below Boulder, 380,000 acre-feet, which makes a total of 18,131,000 acre-feet.

"Senator MILLIKIN. Is that salvaged water as of the present time or estimated for the future?

"Mr. LOWRY. That is an estimate of the future as further development takes place upstream.

"Senator MILLIKIN. Over what period of time?

"Mr. LOWRY. It is in terms of the development reaching ultimate conditions upstream, where we are using the virgin flow to start with, before anything was done on the river.

"With respect to the above figure for salvaged water, no consideration is given to possible salvage that may be effected above Boulder Dam. Undoubtedly, as development in the upper basin takes place, there will be considerable savings in the natural losses. However, no estimate of the amount of such water has been made."

Mr. Lowry explained on pages 236 and 237 estimates of source of supply for Mexico as follows:

"Mr. LOWRY. The Mexican allocation of 1,500,000 acre-feet is expected to be made up as follows:

"Return flow, 930,000 acre-feet; desilting water, 100,000 acre-feet; unused Gila flow, 100,000 acre-feet; making a subtotal of 1,130,000 acre-feet.

* * *

"Senator HAYDEN. I was just going to say that I am in very grave doubt about the amount of return water that you say will be available. You have got to show me.

"Mr. LOWRY. I will go ahead and explain later where I think that is coming from.

* * *

"Senator DOWNEY. Mr. Lowry, I understand from the testimony which you have given to this committee that you think that Mexico would have as good a treaty as is here proposed if the treaty were changed to give Mexico the return flow and those other items which you have mentioned, plus approximately 400,000 or 500,000 acre-feet of fresh water?

"Mr. LOWRY. You said you believed Mexico would have good a treaty. Were you asking that question of me?

"Senator DOWNEY. I say to you that under your statement Mexico would have just as good a treaty if, instead of being allocated 1,500,000 acre-feet of water, she were allocated in the treaty all of the return flow and these other items that you have mentioned, plus an additional 400,000 or 500,000 acre-feet.

"Mr. LOWRY. The next statement that I was about to make indicates that that leaves a residual of about 375,000 acre-feet to be supplied from the main stream.

"The CHAIRMAN. If the treaty, instead of having its present provisions, should have those suggested by Senator Downey, would not that necessarily involve the right of Mexico to come over into the United States and see whether she is getting the return flow and whether she is getting these other items, whereas under the treaty she simply gets what is allocated to her at the boundary, and we do not want any interference? It has already been suggested that the objection of some gentlemen is that this treaty would give the international commissioner the right to come over into the United States and interfere with our administration of internal affairs. Is not that true?

"Mr. LOWRY. That is right. The question came up among the participants on the American side during the negotiations. We did not want anything in the treaty that would make it necessary for the Mexicans to come on this side and measure the water to see whether they were getting what they thought we should give them. Therefore, the amount of water was all lumped.

The following day, Mr. Lowry elaborated a little more on this item as follows from pages 239 and 240.

"Mr. LOWRY. Mr. Chairman, yesterday I concluded with a statement regarding the return flow that is expected down and available in the lower river. The figure, including desilting water and unused Gila flow, was 1,130,000 acre-feet. That leaves a residual of about

375,000 acre-feet to be supplied from the main stream, that being the amount which it is proposed to deliver to Mexico through the All-American Canal. Such an amount may be considered as the minimum that will have to be supplied from upstream, since in the event no Gila floodwater is available, the total quantity required will be increased by 100,000 acre-feet.

"Senator McFARLAND. Did you say 'minimum'?

"Mr. LOWRY. That minimum to be supplied from upstream would be the difference between the 1,130,000 acre-feet and the 1,500,000 acre-feet.

"Estimates of return flow to the lower Colorado River below Boulder Dam have been made before.

"Jacobs and Stevens, consulting engineers, in 1937 estimated the return flow under two major assumptions. . . .

"Under assumption A, which involves full development of all feasible projects on purely physical considerations, except that California usage is based on her adopted priorities, the return flow was estimated to be 1,198,000 acre-feet. Net desilting water was expected to be 387,000 acre-feet in addition to the above.

"Under assumption B, based on consideration of allocations made to the upper and lower basins in the Colorado River compact, the return flow was estimated as 900,000 acre-feet, with an additional quantity of 347,000 acre-feet from desilting water.

"I want to say that those estimates are in fair accord with the figures I submitted yesterday.

"This most recent estimate was participated in by a conference of well-known engineers from the Bureau of Reclamation in the office of the International Boundary Commission at El Paso, Tex., last month. At that time it was indicated that a total return flow of 930,000 acre-feet would be available in the lower river. Other waste water reaching the river would involve the minimum of 100,000 acre-feet for desilting purposes plus another 100,000 acre-feet of unused Gila water, making a total of 1,130,000 acre-feet of return and waste water.

"It is my understanding that the details as to how this figure was derived will be taken care of later on, because I understand that the engineers who participated in that meeting will testify."

Mr. Lowry presented figures on the acreage of land irrigated in the United States and Mexico and the use of water in the two countries on pages 240-242 as follows:

"Figures available from the study of the Colorado River by engineers of the Bureau of Reclamation, and reported as for the year 1940, show a total area within the United States presently irrigated as follows: In the upper basin, 1,311,950 acres; in the lower basin, 1,323,300 acres; that makes a total of 2,635,000 acres. . .

"It is understood that 1944 figures would increase this total acreage in the Colorado River Basin in the United States to about 2,650,000 acres. That is a few more acres than were irrigated in 1940.

"Mexico is now irrigating approximately 300,000 acres from the lower Colorado. About 200,000 acres of this is under the Alamo canal system, which prior to 1942 was used jointly for the supply of these lands in Mexico and the Imperial Valley in the United States. The remaining 100,000 acres in Mexico is scattered along both sides of the river, generally south and east of the area under the Alamo canal. The total area now being served from the Colorado River thus aggregates nearly 3,000,000 acres. . . .

"As to present water use, the best estimate we have been able to get of the total water now being used for irrigation from the Colorado River in the United States, including uses in the Gila Basin, is about 6,200,000 acre-feet, which is less than 40 percent of the 16,000,000 acre-feet of water now allocated under the Colorado River Compact.

* * *

"Mexico's use in recent years has approximated 1,800,000 acre-feet annually, and that is increasing. In other words, the development that is taking place in Mexico is increasing much faster than it is in the United States today. The total use in both countries is about 8,000,000 acre-feet each year. During the last 4 years the average flow below all points of diversion from the Colorado River that was wasted into the Gulf of California has approximated 9,000,000 acre-feet. That is the average of the figures for 1941, 1942, 1943, and 1944."

Charles A. Carson, Attorney, Colorado River Commission of Arizona, at page 251 corroborated the figure of waste into the Gulf of California and predicted that it would be 40 to 50 years before the flow through Mexico would be substantially reduced below 5,000,000 acre-feet.

Mr. R. J. Tipton, the proponents principal witness in regard to water supply, testified in support of the estimates of return flow used by the negotiators on page 316 through page 327:

"Mr. TIPTON. I will indicate now three assumptions that were made and will indicate to the committee the estimates of return flow that were made on those three assumptions.

"As to where Arizona uses its water is a matter which is entirely under the control of Arizona. So that all we can do is to make assumptions as between certain limits. That is all that the Bureau of Reclamation can do.

"One assumption was that Arizona would choose to use in central Arizona the greatest practicable amount of main-stream water.

"The CHAIRMAN. How was it to get up there? Was it to be pumped?

"Mr. TIPTON. It could be brought in in several ways, Senator.

"The CHAIRMAN. No; you started to say something about the Gila River.

"Mr. TIPTON. That would require pumping there. That water would not be applied to central Arizona, Senator; that would be applied to the lands nearer the mouth of the Gila. The Gila project is near the mouth of the Gila and central Arizona, as here used, is the area around Phoenix. Water for that area could be pumped from Parker Dam, shown on the map, and carried through a long canal system. Water could be diverted by gravity from a proposed reservoir on the stream, the dam of which would be immediately above the backwater of Lake Mead. Water could be diverted from that reservoir by gravity through a long tunnel and would enter the same canal to supply central Arizona that would be used if the water were pumped from Parker Dam or Lake Havasu, which is the reservoir created by Parker Dam. Water could be diverted to central Arizona from Marble Gorge Reservoir, the site of which is above the Grand Cayon (sic), through a long tunnel, without the use of any canals whatsoever. The tunnel would discharge into one of the main tributaries of the Salt River which would carry the water down to the present system of canals that serve the Salt River Valley.

* * *

"One assumption--getting back to Senator Downey's question--which envisioned the use by Arizona of the major portion of its main stream water in central Arizona, assumed only 80,000 acres irrigated in the Gila project. That is this lower project near the mouth of the Gila.

"Senator MURDOCK. When you mention the Gila project, is it not a fact that the water that should be used on the Gila project is not water from the Gila River, but from the main stream of the Colorado?

"Mr. TIPTON. That is correct sir. We are dealing with the same block of water and we are asking outselves, Will it be used on the Gila project or will it be used in central Arizona? In this particular assumption we are saying to ourselves that there will be only 80,000 acres irrigated by the Gila project, which would require a diversion of 480,000 acre-feet. We are assuming under that condition that in the Mojave Valley, which is partly in Arizona, there would be no water used. That is a valley along the main stream. The potential irrigation there is very nominal, anyway. We are also assuming that on the Parker Indian project, which

is a constructed project in Arizona, taking water out of the stream a short distance below Parker Dam, there would be irrigated only 60,000 acres. I think the project can serve some hundred thousand acres of land or possibly more.

"We are also assuming under that condition that there would be the minimum possible amount of water used on the Yuma project under the assumption that the Yuma project canals would be lined. Under that condition we estimate there would return to the stream below Imperial Dam about 806,000 acre-feet of water. That does not include desilting water.

"Senator DOWNEY. That was on the basis of the testimony that there would be only 80,000 acres irrigated down in the lower Gila Valley?

"Mr. TIPTON. Yes, sir; and 60,000 on the Indian project.

"Senator McFARLAND. Now will you break that down?

"Mr. TIPTON. Yes, sir. This is the break-down of the 806,000 acre-feet. . . .

"The break-down of the return flow is as follows: From north Gila Valley--north Gila Valley is an area which is at present irrigated; it has been irrigated for many years in Arizona and is immediately below the canal line which has been constructed to serve the Gila project--

"Senator McFARLAND. The return flow from that project, as I understand you, cannot be reused?

"Mr. TIPTON. By direct diversion. It could be used by pumping into the All-American Canal.

"Senator McFARLAND. How much do you estimate from that?

"Mr. TIPTON. Twenty thousand acre-feet. From the Yuma project--understand, this is cutting the diversion to the limit and only letting sufficient water return to take care of the salt balance which I mentioned a while ago--120,000 acre-feet.

"Senator McFARLAND. That is the area which you describe down there on the mesa?

"Mr. TIPTON. No; it is the existing Yuma project.

"Senator McFARLAND. Oh, the existing Yuma project?

"Mr. TIPTON. Yes, sir. I should make that plain to the committee. There is at present irrigated below Imperial Dam an area of land which comprises some 65,000 acres. Most of the land lies in Arizona. Some of it lies in California. Diversions were made in the Laguna Dam, which is immediately below the Imperial Dam, on the California side. Water was carried to the California lands and then carried to the Arizona lands by means of a siphon under the river. Those lands will now be served through the All-American Canal, which will release water at the so-called Siphon Drop.

"Senator McFARLAND. Those are lands which are now being irrigated?

"Mr. TIPTON. Yes, sir.

"Senator McFARLAND. And those are also lands upon which return water cannot be used except by pumping.

"Mr. TIPTON. Well, it would be very difficult to reuse returns from the Yuma project in the United States.

"Senator McFARLAND. Yes; even by pumping.

"Mr. TIPTON. That is correct.

"Senator McFARLAND. All right.

"Mr. TIPTON. Incidentally, at the present time some of those returns are being used in Mexico by pumping.

"Senator McFARLAND. So, just summing up, at the present time you have 140,000 acre-feet of returned water according to your testimony, which cannot be used except by pumping. Let me ask you this before we go any further. What percentage of water do you estimate the return flow to be? I mean what percentage of the water that is used do you estimate is returned?

"Mr. TIPTON. We assume that there must be 2 acre-feet per acre returned in order to maintain the salt balance on the Yuma area."

* * *

"Mr. TIPTON. . . .

"Now, continuing with my answer, which is directed at a question by Senator McFarland, as to the break-down of the 806,000 acre-feet. The first item is the North Gila Valley, 20,000 acre-feet; the second item was Yuma project, 120,000 acre-feet; the third item, the Gila project. It is estimated the return from the Gila project with 80,000 acres irrigated would be 240,000 acre-feet. That is 3 acre-feet per acre.

* * *

"Senator McFARLAND. That is a pretty high return flow, is it not?

"Mr. TIPTON. A substantial quantity of water is required to irrigate that land. As I mentioned before, a part of that area at present is being irrigated as a part of the Yuma project by pumping, understand, and about 9 acre-feet per acre is being applied. The project is consuming about 3 to 3.5 acre-feet per acre, so there are about 6 acre-feet per acre returning."

* * *

"May I read you at this moment the comment that Mr. Debler made at the time he was the Director of Project Planning for the Bureau of Reclamation. This is a memorandum to me, dated December 2, 1942, commenting on some estimates that I had made in connection with the returns from this particular area.

> 'Gila project: While diversion of water for the Gila project has in your memorandum been assumed at 4 acre-feet per acre, it now appears very likely that the diversion demand for the first unit will be in the neighborhood of 6 acre-feet per acre on account of the sandy nature of a very large part of the

land. It is anticipated that diversion for the balance of the project will probably be at the rate of about 5 acre-feet per acre. In my opinion return flow from the latter units of the project will be recovered to an extent such that consumptive use on that portion of the project will be around 3 acre-feet per acre.

'In the case of the first unit, however, the return will not be recoverable for use within the United States excepting only as a small part thereof may become available for the future uses for Yuma Valley, and consequently it will probably be in order to make some revisions in the estimated areas to be developed or in the amounts of water to be utilized.'

"Now, that is my authority for the diversion demand, and Mr. Riter, who will follow me, is with the Bureau of Reclamation and will support this. In other words, I felt as you did, Senator, particularly from the fact that the water must be pumped, that the diversion would be held at as low a quantity as possible. However, the Bureau of Reclamation engineers are intimately familiar with the area, they had had long experience in matters of this kind and I am relying on their conclusion.

"Senator McFARLAND. Now, as to the 240,000 acre-feet of water returned, that will be pretty good water, will it not?

"Mr. TIPTON. That is correct.

"Senator McFARLAND. That is, that would be reusable, except for the fact that it goes into the stream too low to be used?

"Mr. TIPTON. That is correct, sir. Some of it still could be pumped to the All-American Canal.

* * *

"Mr. TIPTON. . .

"To clear up just one question, I have been explaining one assumed condition of development in Arizona, which is not the one which formed the basis of Mr. Lowry's testimony.

"The CHAIRMAN. All right. Go ahead on your return flow.

"Mr. TIPTON. Yes, sir. Now, getting back to Senator McFarland's question again, the next item, the estimated return from the Phoenix area, is 406,000 acre-feet. Adding those up makes the 806,000 acre-feet of return flow. That does not include desilting water.

"Senator McFARLAND. 406,000 acre-feet?

"Mr. TIPTON. Yes, sir.

"Senator McFARLAND. That is the one I may be wanting to quarrel with you on.

"Mr. TIPTON. Now, before you start quarreling, I will make my explanation; then, if we have any quarrel--

"Senator McFARLAND. You in a way cut me out of this 380,000 because you have not got a chance of reusing it.

"Mr. TIPTON. There are those two differences in any stream system--opportunity for reuse from a physical standpoint and the character of water from a quality standpoint. The water I am talking about now, except from the Phoenix area, would be good water. You must understand, Senator, that none of the water that the lower basin will get from the upper basin under ultimate conditions will be virgin water. It will have been used and reused many times before the lower basin gets it. The lower basin will have the opportunity to use it. It will still probably be of a quality which will permit its use."

* * *

"The statement has been made that there is not one drop of return flow returning from central Arizona at the present time. That is a fact. There is no return flow from central Arizona getting beyond what we call the Gillespie Dam, and there is very little return flow getting down to Gillespie Dam. How can anyone conceive under that condition that if any water is brought into the area now, and there is much more land than there is available water supply, there can be from that water any return to the main stream? That is the question.

"As I have said, central Arizona is overdeveloped. The Salt River project along about--and you can correct me, Senator, if I am wrong on dates. I think along about 1928, possibly, a little before--maybe 1924 or 1925--the Salt River area began to become seeped. The water table rose. Substantial areas of land began to deteriorate to the point where it appeared that they might have to go out of cultivation.

"Senator McFARLAND. I do not think you could pick an exact date on that.

"Mr. TIPTON. It was progressive.

"Senator McFARLAND. Progressive.

"Mr. TIPTON. It appeared that the most practical means of taking care of the situation was by pumping. A number of pumps were installed by the Salt River Water Users Association. There was an immediate response to the pumping. The water table began to recede. The danger from the seeped condition began to disappear. There were being pumped about 150,000 acre-feet of water.

"Immediately there came into being a new irrigated area west of the Agua Fria, the Agua Fria being a river that runs along the west side of the Salt River area. This new area was organized under the Arizona laws, was called the Roosevelt irrigation district, and has some 35,000 acres in it. That district contracted with the Salt River Association to take over the pumps, maintain them, and reuse the pumped water, so that that water which otherwise would have been return flow is now being reused in Arizona. Pumping is now taking place on the Roosevelt irrigation district area, and the return flow is being reused a second time in that area.

"Out of this whole situation litigation started. One of the areas which had one of the oldest water rights in the area, the Buckeye irrigation district, was not only being deprived of its water, but the quality had been materially deteriorated. That situation has now been taken care of by mediation proceedings, whereby this old district will be furnished some fresh water, so-called, by the Salt River Water Users Association.

"The point I want to make--and I want to make it strong--is that there is trouble in central Arizona by this use and reuse. The water which has been diverted a short distance above the troubled area, at the mouth of the Salt River, is virgin water. I want you to get that: Virgin water; nobody has used it before; it is water right out of the mountains. But even the one or two times that it has been reused has deteriorated the quality of it until the salt concentration is 3,000 parts per million at the Buckeye heading. That condition cannot go on forever. It would be the same as if a person continued to eat and did not eliminate; he would finally die. Some of these areas are going to die. The Salt River area began to return water to the stream by pumping. Somebody else took that return, is using it, is pumping it onto his own area, and is giving some of it to the lower areas. The water is getting to be of worse and worse quality, so somebody finally must disgorge to return the salts to the stream, and that will constitute the return flow that normally would come from that area. Such returns must eventually come from that area, and in the absence of bringing in new water, it will come by virtue of abandonment of lands which cannot take the water of poorer quality.

"Let us go to this new water we are bringing into the area and see what we have as compared with that situation.

"Senator McFARLAND. I want to quarrel with you a little on that, but I am going to let you complete your statement.

"Mr. TIPTON. All right. Remember that the water that at present is being used in Phoenix--the first use of it--is virgin water. The water that will be used in central Arizona under these ultimate conditions that we are trying to envision, which probably will never happen, will be water that comes down from the upper basin and will have been used and reused many times.

"The CHAIRMAN. You are assuming, now, these artificial works of diversion?

"Mr. TIPTON. Oh, yes, sir; they must be built.

"The CHAIRMAN. That is what you express doubt about--as to whether or not they will be?

"Mr. TIPTON. No; I am thinking of the over-all situation. I am thinking, Senator, not only of this situation, where there will be only 1,500,000 acre-feet of water for Mexico remaining in the stream, but also the question, Will the United States develop to the point where

there will only be that much water? That is what I am thinking of--this ultimate that may never happen. It may be 50, 80, or 90 years from now; maybe never; I do not know. But the upper basin has a right under the compact, under the primary allocation, to consume 7,500,000 acre-feet. The upper basin produces almost all the water of the stream that formerly reached the boundary.

"The virgin flow at Lee Ferry is estimated at 16,271,000 acre-feet. In order to consume 7,500,000 acre-feet out of that, the upper basin must divert the entire flow several times, so what finally will reach the lower basin will not be virgin water; it will be water that has been used several times, so that the quality of water--

"The CHAIRMAN. That is on the assumption, however, that the upper basin will utilize its full quota?

"Mr. TIPTON. Yes, sir. Much of the water reaching Lee Ferry at the present time, of course, is return flow from the present irrigated areas in the upper basin.

"Therefore, instead of having water at the point of diversion for central Arizona that is of equal quality with the water being used in central Arizona at the present time, it will be of poorer quality. It will not be virgin flow. The criterion used to determine the estimated amount of return flow that will get back to the stream in Arizona was 3,000 parts per million of dissolved solvents. It was assumed that that water would be used and reused in Arizona to the extent that it got boiled down to a dissolved solid content of 3,000 parts per million.

"Further, it was assumed that there would be 25 or 30 percent of the water lost in transit before it got to the main stream and that the amount that ultimately flowed into the main stream would be 426,000 acre-feet, which would contain some 4,000 parts per million."

After a discussion concerning the quality of water, Mr. Tipton returns to the discussion of the quantity of water to be delivered to Mexico by return flow, operation of desilting works, etc. at page 334.

"Mr. TIPTON. . . .

"Just to complete your line of thought as to the amount of water that would be there without any water from central Arizona, you must add the desilting water; that is, water which is used at Imperial Dam for desilting purposes. That at one time was estimated by the Bureau of Reclamation to be 387,000 acre-feet, I think.

"Senator McFARLAND. For desilting purposes?

"Mr. TIPTON. Yes; but to be conservative, that estimate has been reduced to 100,000 acre-feet.

"Senator McFARLAND. Where does that come from?

"Mr. TIPTON. It comes from the desilting works at Imperial Dam.

"Senator McFARLAND. The desilting works at Imperial Dam?

"Mr. TIPTON. Yes. Those works have just begun to operate, and I do not know how much is being used. For many years it will be much more than they use, but my own personal opinion is that as time goes on the water requirement for desilting will reduce as the river becomes stabilized. So the desilting water was estimated on a conservative basis as 100,000 acre-feet. That would be added to the quantity which you suggest would be there if no water came from central Arizona.

"With the Sentinel Dam constructed for flood-control purposes, there will be some water available from the Gila River itself. The flood flows to be regulated we estimated at 100,000 acre-feet average. That will not be there every year. It will average 100,000 acre-feet. But if you kpet it in the reservoir indefinitely it would evaporate. But it can be regulated to Mexico's requirements, and the equivalent quantity withheld in the upper main stream reservoirs, and we can thereby get some use or credit for the Gila flood waters.

* * *

"Mr. TIPTON. Yes, sir; that is correct.

"I have so far explained only one condition we assumed which was the one that would result in the minimum return flow. We assume this to be the condition where Arizona would have--

"Senator McFARLAND. The minimum condition is really the important one, as far as our consideration is concerned?

"Mr. TIPTON. It depends again on where Arizona is going to use this water. The condition we finally fixed upon was the one the group of engineers discussed last month.

"Senator McFARLAND. How many acre-feet do you estimate to go in, or did you make this the basis of, or did you use as a basis of your consideration here for diversion into central Arizona--2,000,000 acre-feet, 1,500,000 acre-feet, or how much?

"Mr. TIPTON. It was around approximately 1,500,000 acre-feet.

"Senator McFARLAND. So, if you increased it another half million, it would decrease the amount down at Yuma?

"Mr. TIPTON. Yes.

"I am not going to the intermediate condition, Mr. Chairman. Instead of describing that, I think I will give the items just as I did in connection with the minimum condition. This is the condition about which Mr. Lowry testified. We have taken considerable time on a condition which was not the background of Mr. Lowry's testimony, but I wanted to build up and show you the various ranges.

"Under this condition we assume that there would be 160,000 acres irrigated on the Gila project, Senator McFarland, and under this condition we assume the return flow would be as follows:

"Yuma project, 135,000 acre-feet. There was some correction there on acreage. We assumed the full irrigation of 67,300 acres, and a return of 2 acre-feet per acre, again to maintain salt balance.

"Senator McFARLAND. Where is that now?

"Mr. TIPTON. That is Yuma, 135,000 acre-feet.

"Gila project, 160,000 acres. We reduced that to 2 1/2 acre-feet per acre. Assuming a consumptive use of 3 1/2, there would be a return of 400,000 acre-feet.

"The seepage loss from the All-American Canal, 65,000 acre-feet. That would be there under any condition.

"The central Arizona project, 330,000 acre-feet. We are using more water in this condition on the Gila.

"Unused Gila River flow, 100,000 acre-feet.

"Desilting water at Imperial Dam, 100,000 acre-feet.

"A total of 1,130 (sic) acre-feet.

"There is just one other condition, Mr. Chairman, and that would be the condition which would contemplate no use by Arizona of main stream water in central Arizona and the use of practically the entire amount of Arizona's share of Colorado River water on main stream projects, including the Gila project.

* * *

"Mr. TIPTON. . . .

"I will read this paragraph which is a paragraph from the report of the conference engineers held last month.

> 'In the event Arizona development occurs on the Gila project and not in central Arizona, the return flow appearing in the river below Imperial Dam will amount to approximately 1,400,000 acre-feet per annum.'

"The details of that Mr. Rider (sic) will testify to, if you want the breakdown.

"Senator McFARLAND. As to these other plans, it is just a matter of going over them with you?

"Mr. TIPTON. The principle is the same.

"Senator McFARLAND. The principle is the same. It is just a matter of percentage which we could sit down and figure out from the other. If I did not agree with you, I could figure it out on the same percentage?

"Mr. TIPTON. That is correct.

"As to the condition Mr. Lowry testified to, of the 1,130,000 acre-feet, there would be 300,000 acre-feet--something less than a third--that would have been in the category we were talking about from central Arizona. If there had been none of that return, there would remain 800,000 acre-feet under this assumption."

J. R. Riter, Hydraulic Engineer for the Bureau of Reclamation, made further explanation of the source of water in the Colorado River below Imperial Dam. His statement is as follows from page 347:

"Mr. RITER. The Imperial Dam, located on the Colorado River 15 miles upstream from Yuma, Ariz., is the lowest point of diversion for use for the United States. Below this point the river now receives return flow from the Yuma project, seepage losses from the Imperial Dam to the Pilot Knob portion of the All-American Canal and, occasionally, floodwaters from the Gila River.

"To determine the future return flow it is necessary to make assumptions regarding the future development in that part of Arizona which will drain into the Colorado River below the Imperial Dam.

"I will first discuss return flow from the Yuma project. This project embraces 15,000 acres in southeastern California and 52,000 acres in southwestern Arizona. It is one of the old projects of the Bureau of Reclamation. The first water was delivered in the year 1907. Water was originally diverted from Laguna Dam, which is also on the Colorado River, 10 miles northeast of Yuma. It was carried in a canal along the California side of the river to serve the lands located in that State, and at Yuma there is a siphon which carries water across the river to serve the lands on the Arizona side.

"Since August 1941, the water for the Yuma project is being diverted at Imperial Dam, which is located 5 miles above the old Laguna Dam, and its service is through the All-American Canal which has replaced a portion of the Yuma main canal.

* * *

"Mr. RITER. It (the All-American Canal) serves lands in the Imperial and Coachella Valleys in California. ~~However, in the process of building,~~ in the upper reaches of the canal, it was more convenient to have that canal also carrying water for the Yuma project. So for that reason, when the canal was constructed, the upper 15 miles of the canal was made 2,000 second-feet larger than the needs by the Imperial district, in order that the Yuma project water could be carried in that canal instead of in the Yuma Canal.

* * *

"At the present time the annual diversion of water from the river for the Yuma project is 1,400,000 acre-feet. One million acre-feet of this water is used for power production at the Siphon Drop plant, but that is entirely returned to the river. Four hundred thousand acre-feet are diverted for irrigation purposes, and of that amount 200,000 acre-feet are applied to the land and the remaining 200,000 acre-feet returns as waste or return flow through the drains.

"In the future it is our belief that when the demands for water in the United States become more acute there will be no water permitted to be wasted from the Colorado River for power production. We now estimate that in the future the diversion for the Yuma project will be 370,000 acre-feet, of which 235,000 acre-feet will be consumed at the land and 135,000 acre-feet will be returned to the river as return flow.

"Senator McFARLAND. That is, the Yuma project?

"Mr. RITER. Yes, sir.

"Senator McFARLAND. How many acre-feet did you say?

"Mr. RITER. A return flow of 135,000 acre-feet.

"Senator MURDOCK. It will be below any point in the United States where it could be diverted again for beneficial use?

"Mr. RITER. It will be below the Imperial Dam. There might be a possibility that some of that water could be recovered by pumping. I think the previous witness stated that.

"Senator MURDOCK. Excluding the possibility of pumping, is it below any point where it may be rediverted for beneficial use in the United States?

"Mr. RITER. Yes, sir.

"The next project I wish to discuss is the Gila project, which is located in southwestern Arizona. Construction was initiated on this project in 1936. Originally the project contemplated an area of 585,000 acres, with water to be diverted from the east side of the Imperial Dam through a gravity canal which would be 21 miles long and have an initial capacity of 6,000 second-feet. From the gravity canal 15,000 acres could be served direct. The bulk of the project area, however, would need to be served by pumping from the gravity canal. At the present time we are constructing the canal to an initial capacity of 2,200 second-feet.

"As I stated before, we have to make certain assumptions to arrive at what the future development would be. If the entire Gila project should be irrigated, the entire 585,000 acres, there would be no water left for Arizona to use in the Phoenix Valley, and we believe, therefore, that Arizona will elect to use part of her water supply on the Gila project and part of it in central Arizona. It is, therefore, assumed that the Gila project will be developed to the extent of 160,000 acres. Of this 160,000 acres there are now 8,000 acres in the north and south Gila Valleys which are irrigated. The north Gila Valley is irrigated by gravity diversion from the Colorado River. The lands in the south Gila Valley are irrigated by recovery of ground waters, by pumping.

"In the Mohawk area there was at one time 20,000 acres irrigated. These lands were irrigated by diverting the floodwaters from the Gila River, which are erratic in occurrence, and only partly irrigated by recovery of ground waters. In 1943 the area irrigated in the Mohawk Valley was only 8,000 acres.

"Senator McFARLAND. Right there, Mr. Riter: You mean by recovery of ground water, pumping?

"Mr. RITER. Yes, sir.

"Senator McFARLAND. That is water that is 12,000 parts per million?

"Mr. RITER. Yes, sir.

"Senator McFARLAND. And one of the reasons why that acreage has decreased is on account of the quality of the water?

"Mr. RITER. Yes, sir. That is the situation.

"Senator McFARLAND. Very well.

"Mr. RITER. The total area of 160,000 acres, which we assume will be irrigated in the Gila project, will require a diversion of 960,000 acre-feet per year from the Colorado River. Of that 960,000 acre-feet the consumptive use would be 560,000 acre-feet, and the return flow which will enter the Colorado River will be 400,000 acre-feet. This return flow will very largely initially enter the Gila River and return to the Colorado River through the Gila.

"The Gila River empties into the Colorado River near Yuma, and some of the return flow of the Yuma mesa just immediately west of the Yuma project, and whose lands are quite sandy, will percolate down into the Colorado River direct, not through the Gila.

"The next project to be discussed is the central Arizona project, which is located in the Phoenix basin.

"Senator McFARLAND. Before you get to that, how much did you estimate would be return flow from the other projects?

"Mr. RITER. 135,000 acre-feet from the Yuma, and 400,000 acre-feet from the Gila.

"Senator McFARLAND. That is a total of how much?

"Mr. RITER. That is 535,000 acre-feet.

"Senator McFARLAND. All right. Now, from that water you estimate that none of it can be reused except by pumping it in the All-American Canal?

"Mr. RITER. Well, I would not restrict it exactly to the All-American Canal. It might be possible that some of it might be pumped into the Yuma project canal.

"Senator McFARLAND. That would be a very small amount?

"Mr. RITER. It would have to be pumped in any event.

"Senator McFARLAND. Of course as you get on down, the possibilities for pumping are reduced because you haven't any land left to pump to at the end of the project?

"Mr. RITER. That is right. The Bureau of Reclamation in cooperation with the State of Arizona is now investigating the possibilities of bringing water from the Colorado River to serve the central Arizona area. There is now irrigated in that area in excess of 500,000 acres of land. These lands are being irrigated from the Gila River and its principal tributaries, the principal tributaries of which are the Salt River and the Verde River. The

Verde is a tributary of the Salt River. The flows of these streams are very erratic, and, to facilitate the irrigation development, reservoirs have been constructed.

"One of the early projects undertaken by the Bureau of Reclamation was to build the Roosevelt Reservoir on the Salt River. The present capacity of that reservoir is 1,400,000 acre-feet. On the Gila River, the Indian Irrigation Service have constructed the Coolidge Reservoir with a capacity of 1,250,000 acre-feet, to control the flows of that stream, and the Verde River is being controlled by the Bartlett Reservoir, which has a capacity of 182,000 acre-feet. There are other reservoirs built on the Salt River. There is the Horse Mesa, with a capacity of 245,000 acre-feet; the Mormon Flat, with a capacity of 58,000 acre-feet; and the Stewart Mountain, with a capacity of 70,000 acre-feet. These reservoirs were built by the Salt River Valley Water Users Association, and construction is now under way for an additional reservoir at the Horseshoe site, which will have a capacity of 60,000 acre-feet. In addition to the surface reservoirs, the irrigation plan also utilizes a vast quantity of underground storage. At the present time there is a serious problem of the quality of water used for irrigation, especially at the lower end of that project. I have examined records of water samples from wells throughout the area and I find that at the upper end the salinity of the water is 300 parts per million. For practical purposes, that is fresh water. However, as we progress downstream the water becomes progressively more saline.

"Senator McFARLAND. Now, you are talking about the underground supply?

"Mr. RITER. I am talking, Senator, about these. These are the wells, in the underground reservoir; yes.

"Senator McFARLAND. Of course, that would be true of the others, too?

"Mr. RITER. Yes, sir; because that reflects the mingling of waters from all sources. In the extreme lower end there are some wells that have as high as 7,500 parts per million of salts. The low flow discharged at Gillespie Dam, which is located at the lower end of the Phoenix area, has a salinity concentration of 6,000 parts per million.

"Senator McFARLAND. Now, are you talking about the water in the river?

"Mr. RITER. The water in the river.

"Senator McFARLAND. The water in the river?

"Mr. RITER. As it goes over the dam. That is where the samples were selected.

"Senator McFARLAND. That is 6,000 parts?

"Mr. RITER. 6,000 parts per million; yes, sir.

"Now, there was considerable discussion this morning with a previous witness regarding the amount of return flow from the central area. It is my

firm conviction that there will be return flow from that area if it is to be on a permanent agricultural base. We assume that there will be an annual diversion into the central Arizona area from the Colorado River of 1,330,000 acre-feet.

"Senator DOWNEY. What was the first part of that statement?

"Mr. RITER. I merely remarked, Senator, about this morning, with a previous witness there was considerable debate regarding the amount of return flow from the central Arizona area. Now it is my firm conviction that there will be some return flow from that area. And then the next statement was, sir, that in making this study I assume that there will be a diversion of 1,330,000 acre-feet from the Colorado River to the central Arizona area, and of this amount there will return to the Colorado River as return flow an annual quantity of 330,000 acre-feet.

* * *

"Mr. RITER. That will leave then, if we subtract those two figures, a figure of 1,000,000 acre-feet as the amount of water that will be consumed in Arizona from the diversion from the Colorado River to the central project.

"Senator McFARLAND. Very well, go ahead.

"Mr. RITER. Now, there was another factor discussed in this return flow and these seepage losses from the All-American Canal. This canal was constructed to serve lands in the Imperial and Coachella Valleys in California, and it diverts from the western end of the Imperial Dam 15 miles upstream from Yuma. The initial capacity of the canal was 15--

"The CHAIRMAN. Wait a minute. It is not above Yuma?

"Mr. RITER. Yes, sir. The All-American Canal heads in the Colorado River 15 miles upstream from Yuma.

"The CHAIRMAN. All right.

"Mr. RITER. I think, Senator, you have in mind the canal below Yuma, as the old canal that used to be.

"The CHAIRMAN. The old dam below Yuma.

"Mr. RITER. The old dam that used to serve the Imperial Valley, but that has been replaced by this All-American Canal, which was placed in operation in 1941. The initial capacity of this canal is 15,155 second-feet. 2,000 second-feet of this capacity is to carry water for the Yuma project, and that extends for 15 miles. For the next 6 miles on, the capacity is 13,155 second-feet, which capacity is maintained to a point called Pilot Knob. At Pilot Knob the canal runs west for 59 miles into Imperial Valley. The capacity west of Pilot Knob is 10,155 second-feet. At this point I would like to mention that 155 second-feet of capacity was constructed in the All-American Canal at the request of the city and county of San Diego.

"The bottom width of the canal is 160 feet. That is at the head end, and it will have, when running full, a water depth of 21 feet. Now, we estimate that there will be a seepage loss of 65,000 acre-

feet per year from this 21 miles of canal between the head of Pilot Knob, which will return to the Colorado River.

* * *

"Mr. RITER. Then, in summary, the quantities of return flow are as follows: From the Yuma project 135,000 acre-feet; from the Gila project, 400,000 acre-feet; from central Arizona, 330,000 acre-feet, and seepage losses from the All-American Canal, 65,000 acre-feet; and that results in a total return flow of 930,000 acre-feet."

Clay C. Elder, an engineer from Los Angeles, was lead-off man as far as technical opposition was concerned. Mr. Elder recognized that the streamflow data based on gaging station records as presented by the proponents was acceptable. He did question the use of average figures as shown by his statement on pages 462 and 463.

"After working up these statistics, we have what we call the long-time average. That was put into the record in good shape by the State Department witnesses. Questions were asked, as to shorter periods, short-time critical periods, 10- or 11-year shortages that occur and really affect the storage reservoirs. The State Department seemed totally unaware of the fact that those critical periods are the major factor in Colorado River water supply. They passed the buck, perhaps wisely, to the Bureau of Reclamation. I know personally that the Bureau of Reclamation is familiar with that matter.

"Between 1897 and 1904 a very serious drought occurred, and we made Boulder Dam large enough to fit that period. The studies of 1922 to 1930 had a certain accuracy. But before the dam was really in operation the worst drought had occurred, 1930 to 1940, and that is now the critical period for all the water-supply studies of the river. We now have to fit our expectations to that supply.

"At the time the contracts were made, about 1930, the river records indicated that the expected quantity of water below Boulder Dam in the future, as of about 1980, was possibly an average of 10,500,000 acre-feet.

"Now the Bureau of Reclamation has determined, and fairly conservatively, that 8 1/2 million acre-feet is all we can expect to have released from Boulder Dam if a period like 1930 recurs, 30 or 40 years from now.

"When the upper basin is fairly well developed, I think it only requires a development of the upper basin of about 80 percent to diminish average releases from Boulder Dam, and also Davis Dam

to about 8 1/2 million acre-feet. That estimated figure is not absolutely determined by any means. Other engineers have reduced it to as low as 7,900,000 acre-feet; but 8 1/2 million is the approximate figure that we can probably agree on.

"There are 300 miles of river channel below Boulder Dam before we reach the Imperial Dam on the American side of the boundary. Six hundred thousand acre-feet, conservatively estimated, will be lost in that river channel under ultimate conditions, in order to deliver the water to Imperial Dam. So, 8 1/2 million acre-feet is reduced to 7,900,000, any way you figure it."

* * *

"Besides the California contracts there is a Nevada water contract that I am sure they will tell you later is equally sacred to them.

"Arizona has a contract for 2,800,000 acre-feet out of the main stream of the Colorado River. Those contracts add up to 8,462,000 acre-feet.

"We started off with 8 1/2 million acre-feet at Boulder Dam, but in order to deliver it we lost some on the way. We have 7,900,000 acre-feet to do the work that needs 8,462,000 to supply. That is, without a drop going to Mexico. We already, within a period of a generation, I should say, face an inevitable shortage in the lower basin in the main stream of the Colorado River, whether Mexico is allowed a drop of water or not.

"I know nothing about international law and little about water rights, but I can add up simple arithmetic; and there is a water shortage coming on the lower Colorado River whether Mexico gets a drop or not. This is more evidence of why we really worry whether Mexico gets 750,000 acre-feet or 1 1/2 million acre-feet. The shortage of water to the lower basin can be doubled by whether Mexico gets the water allotted by this proposed treaty or does not get it.

"You have been told here that after all the treaty means 3 percent or, at most, 8 percent of the water supply. That is just nonsense and is meaningless, in that 16,000,000 acre-feet referred to in the compact is dedicated to the basin States. It is not all in use by them yet, but it is all allocated. Projects are based on that water. Every drop of that water is planned for use two or three times over in most watersheds of the basin, to my own knowledge. So that 16,000,000 acre-feet is taken up and gone.

"What we are dealing with now is the surplus beyond that allocation. We are told that we cannot do anything with that surplus until 1963. The compact says that we cannot perfect that right until 1963. That is an added handicap, of course, as I presume it is true. But we are initiating rights in that surplus that are going to stand up, I am sure. We are vitally interested in the surplus. We have built our aqueduct project to divert 1,500 second-feet for the southern California coastal plain, but half of that capacity will be totally lost and wasted, in my opinion, if the effects of this treaty

are reflected entirely on the California needs. Without a compact between the lower basin States I do not think anyone can designate just which State will suffer the most. I cannot myself, and I have tried. But the lower basin will be hurt, and hurt badly, and that hurt will not be confined to the lower basin.

"It takes a lot of engineering and arithmetic to show it, and a lot more time than you want to use here, but the Colorado River contracts in the lower basin and important water rights in the upper basin are put in jeopardy by this treaty."

Mr. Elder disagreed with the estimates of water used in Mexico as put forth by the State Department, however, he did not introduce different figures. Senator Downey and Senator McFarland entered into a lengthy discussion with Mr. Elder regarding quality of water. Following that discussion Senator Downey, at page 479, asked:

"Senator DOWNEY. How much do you think we people in the Southwest may safely rely upon, in figuring this treaty, as to the return flow from the Phoenix area?

"Mr. ELDER. Well, considering these other items as preliminary to that answer, the Gila project, as I recall it, had an estimate of about 400,000 acre-feet return flow. You might remember that yourself, Senator McFarland. But it was in that neighborhood. How, I think the unit amount was 2 1/2 acre-feet per acre. That was to be assumed as return flow, because the soil is very sandy and gravelly. That is correct--that classification of soil--but if the soil is that sandy, it is my opinion that the water will be expensive enough to justify lining the canals and ditches. If water goes to central Arizona, involving pump lifts up to 650 feet, which is not common for irrigated areas, as anyone from the West knows--if water is pumped to those limits, it becomes so costly you just cannot build your pumps big enough and economical enough to pump water merely to waste it and let it run down for somebody else to get the benefit of it. You plan for smaller pumps and put the money instead into lined canals and even lined ditches; and in California on sandy areas, we pipe water to the base of each tree and build a little levee around the foot of each tree to hold every drop of it.

"I think when planning that project for immediate consideration they would have to revise that diversion duty figure and cut it down from 6 acre-feet per acre to perhaps a figure we formerly used for planning there of 4 1/2 acre-feet per acre. But that would involve the lining of ditches and much greater care on the part of farmers in preventing waste, but the immediate effect of those tactics would be to cut this return flow down in that case by possibly half or more.

"Much the same applies to the Yuma project. That has been notorious for slopping water around, as we call it, out in the West, and as water gets scarcer in Arizona, even the Yuma people with an old water right won't be allowed to waste it the way they have. There again the return flow will gradually diminish. For this ultimate period, not the next decade or two but finally, all these projects will have to come down to an operation basis that will use water economically. It has been enforced in other States by the courts, and I think Arizona will find water valuable enough to get around to that when they have to.

"Return flow has been based on assumptions that leave us fearful that the treaty enforcement will simply have to fall back on Lake Mead storage for deliveries. Answering Senator Downey's question directly, my considered judgment is that instead of 930,000 acre-feet that was listed as return flow, the quantity for this ultimate period, with all these steps taken for proper irrigation in the valley of the Gila River, the average--long-time average, let us say--would not exceed 250,000 acre-feet. But in critical periods of drought, that we know have happened in the past and are going to come again, with less water available for diversion, because Arizona sometimes offered to take half of this shortage if California will take the other half, there will be less water to put on the fields. The return flow simply cannot be the same toward the end of drought periods when water gets scarcer and scarcer. In such a case of a long drought, it would not exceed about 150,000 acre-feet. If this 930,000 acre-feet figure should be maintained and insisted on by the other witnesses, and accepted by anyone; that figure, which is the long-time average, cannot possibly prevail in the drought period. It simply does not work out that way. Those years are the ones we are going to suffer from in the future. Those are the years when we fear the application of the treaty. When Lake Mead is full there will be water for us and for Mexico too. That period is not of real concern here. But if 930,000 acre-feet should be the average, as has been mentioned, 500,000 acre-feet would be about the maximum that could be claimed for the critical periods of drought. Then the State Department estimate of the treaty's burden on Lake Mead would inevitably be more than doubled, just when the storage would be at a minimum. My estimate, however, is from 150,000 to 250,000 acre-feet for the return flow reaching the international boundary.

"There were two other items mentioned. Gila floods were to be stored, and also desilting water."

* * *

"Mr. ELDER. That is right. But on this particular item of desilting water, we find the silt cleared up so promptly on the Colorado River that we now have a desanding problem and no longer a desilting problem. Even as early as 1939 that was true. Sand has become scoured out and moves along the river bed. That is still continuing. But for the ultimate period, 30, 40, or 50 years from now, or longer, my position is that the river bed will be stabilized to such an extent that the amount of water required to force

that sand down to and below Imperial Dam will be met by occasional releases from Boulder Dam or by water that comes from flash floods. So there will be no demand of 100,000 acre-feet on Lake Mead; it will not be automatically available for meeting treaty requirements as assumed.

"Senator McFARLAND. So you mark out desilting?

"Mr. ELDER. It would be very irregular. It would not meet treaty requirements. The very nature of moving sands requires them to go down in surges, so unless very careful arrangements have been made, the canal would be full, because you could not deprive farmers of water long enough. So it does not seem practical to operate Mexican canals or the Imperial Dam, for that matter, in such a way as to make any of that infrequent de-sanding water available to meet treaty requirements."

Mr. Elder, at pages 497 and 498, had this to say regarding the water supply of the Colorado River and the requirements for storage to equate the flow to permit the use of average flows:

"Mr. ELDER. Accepting the Colorado River run-off measurements as recorded--they were discussed in some detail yesterday--the proof is conclusive that prior to the construction of Boulder Dam the summer irrigation season flow of the Colorado River was seriously over-appropriated. This is shown by numerous seasons of heavy crop loss in the past in the Imperial Valley, particularly the year 1934, just before the Boulder Dam storage became available.

"If Boulder Dam had never been built--that is, in the absence of Lake Mead storage regulation--not even the annual quantity of 750,000 acre-feet could now be safely guaranteed to Mexico. For in about half of the last 30 years, severe to prohibitive invasion of long-established appropriation and vested natural flow water rights in the United States would have been required to fulfill such a guaranty.

"Like most water questions, this treaty, I think, is really an argument about priorities rather than mere quantities of water. We were first given long-period average flows at this hearing. That was justified by the statement that Boulder Dam had equated the flow of the river and that, therefore, those long-range, long-period averages had full significance. The fact is that Boulder Dam does not more than begin to equate the flow of the Colorado River. Detailed studies show that nearly 60,000,000 acre-feet of active storage will be necessary to fully equate the Colorado River. Many additional dams and reservoirs will be built in the basin or are planned for the basin over the years, and ultimately, of course, the river will be approximately equated. But the 16,000,000 to 18,000,000 acre-feet capacity that is available at Boulder Dam for active regulation of the river, in addition

to some bottom silt and dead storage plus considerable flood-control capacity on top of it to protect Yuma Valley in Arizona and the Imperial Valley in California and also in Mexico, is only about one-third enough to really smooth out these long-period averages. That is why we stress these shorter periods, as much as 10 years long within the record, and much longer in earlier periods, which really, with only Boulder Dam to rely on, dictate and control the amount of usable, available run-off."

Mr. Elder was critical of the State Department for what he considered was a lack of gathering sufficient basic data on the Colorado River such as was done on the Rio Grande. One phase of such an investigation had to do with ground water. In answer to a specific question by Senator McFarland as to what additional data pertaining to the Colorado River he would want, Mr. Elder answered (pp. 501-502):

"Mr. ELDER. One specific item that is much on our minds is the fact that large pumping possibilities, we know, are available across the line in Mexico, and an important resource of water supply is there that has not as yet been taken into account or brought into the treaty negotiations at all, as far as we can learn.

"Senator McFARLAND. Of course, we have no way of getting that information.

"Mr. ELDER. I myself have not, but the State Department, I am sure, does, and, in my opinion, should.

"Senator McFARLAND. Do you have any idea how the flow of the river in regard to this matter could effect the amount of water that we would let down to Mexico?

"Mr. ELDER. One possibility, probably even very likely, is that heavy pumping across the border in future years might actually affect the amount of return flow that will be evident on the surface in the river immediately above the boundary, for any pumping just below the boundary could lower the general ground-water level there, and less return flow would be measurable to be credited to the treaty. That is a little hard to explain with actual proof right now, but in your own Phoenix Valley pumping in many places is doing just that, reducing the surface return flow in the Salt and Gila Rivers. In any case, the pumping is an additional water source for Mexico that should be a part of the whole treaty picture, as its most beneficial and advantageous use is for firming-up the run-off in wet years by pumping chiefly during drought periods.

"Senator McFARLAND. I presume what you mean by that is that there is a water level building up below which, as the water comes

down, forces it out of the ground; and if that water level were not underneath the ground, it would go on down in the ground; is that the idea?

"Mr. ELDER. The ground-water level maintains the return flow in the river; otherwise there could be no return flow in the sandy channel of the river."

Senator Downey also took the position that more investigation was necessary to determine what the physical situations were in the area adjacent to the border. The possibilities of ground water utilization was used by him as an example of one phase that needed more study. At pages 1139-1140 the Senator explains:

"Now let me show you another fact here as a reason why we do not know enough about how to write a treaty. I have already stated that it is well known that down in Lower California there is a large body of underground water. We know there is a reduction of the water down there, but nobody has ever been able to guess whether there is a million acre-feet in storage in the ground or 5,000,000 or 10,000,000. Nobody has ever been able to guess, if anyone begins to pump that out in periods of drought, how much he would have; and, most of all, no one has ever been able to guess how much the pumping of 500,000 acre-feet or 200,000 acre-feet or 1,000,000 acre-feet from that reservoir basin might decrease the amount of water in the United States that we have that would go down to be credited to Mexico.

"I have talked to noted geologists, and they tell me there is not only the likelihood but the positive certainty that pumping underground waters in the lower basin will tend to reduce the channel flow that will go down to Mexico from us. Mexico might easily pick up another 200,000 or 300,000 acre-feet during the years she was pumping, which would probably be the drought years. Also, I am told by all the engineers I have talked to that it will be comparatively simple for Mexico to put up pumps in the limitrophe section and to pump out and gather in the underground waters and keep them from being in the channel when they cross the boundary into Mexico. I am positive, Mr. Chairman and gentlemen, that this is right."

Mr. M. J. Dowd, Consulting Engineer for the Imperial Irrigation District, was the other witness in opposition to the treaty on technical grounds of water supply. Mr. Dowd due to his intimate knowledge of the area in the lower basin argued

against the treaty on many grounds. The ones we are concerned with here have to do with water supply. His introductory remarks starting on page 675 contained a history of the development in Imperial Valley and in Mexico. He explained the agreement with Mexico wherein one-half the water diverted by the Alamo Canal was to be available to Mexico. He stressed that Mexico's one-half was of the instantaneous flow--not one-half of the annual diversion. Due to the difference in cropping patterns, he felt this fact was quite significant.

Mr. Dowd also explained the work that the Imperial Valley people had done and the expense involved in making the development both in the United States and Mexico. He was concerned as to the financial effect the treaty might have as against the Imperial Irrigation District.

Beginning on page 684 Mr. Dowd gives his explanation of development in Mexico leading up to the treaty in the following language:

> "Mr. DOWD. . . .
> "I come now to a discussion of the development in Mexico as to the water and the acreage that has been discussed so much here, and I would like to try to clear it up for the committee, if possible.
> "The first land was irrigated in Mexico about 1905. By 1914 there were some 150,000 acres being irrigated. By 1920 the area had increased to 190,000 acres, and from 1920 on through until just very recently the area in cultivation fluctuated from around 70,000 acres in 1932 up to a maximum of 217,000 acres in 1925.
> "I would like to point out to you that all of the data on Mexico in regard to acreage is not very reliable.
> "Senator WILEY. What is the maximum of acre-feet?
> "Mr. DOWD. I will come to that in just a minute.
> "There is no way of getting a true or accurate picture of the acreage being irrigated in Mexico. For years our water tenders on our canals in Mexico have attempted to get the acreage in cultivation. We think the figures are inflated. We have reason to believe they are, and I will tell you why. In the event of a water shortage, under Mexican law they have no such thing as a priority; whoever wants water when the water is

short, gets it in the proportion that his acreage in crop bears to the total acreage in crop. So it was natural, and we found it in a number of cases, that in giving his acreage a farmer would be inclined to enlarge it somewhat, hoping to get a little larger share of the water when it was short. There were a number of shortages in Mexico.

"We believe that there has not been over 200,000 acres irrigated in Mexico, up until just the very last few years, when the acreage has increased.

"The use of water by 1920 had reached about 600,000 acre-feet; 1920-30 was a fairly representative period of what we consider maximum use.

"The CHAIRMAN. How much did they use in 1925?

"Mr. DOWD. In 1925 they used 729,000 acre-feet.

* * *

"As has been mentioned, for the period between 1921 and 1930, a 10-year period, use of water was approximately 600,000 acre-feet per year.

"Senator McFARLAND. I wonder if I might ask where these records were obtained.

"Mr. DOWD. They are our own district records taken from the records of the subsidiary company in Mexico; the official records of the district, in other words, and they represent the deliveries from our canal system in Mexico, which I will describe.

* * *

"Senator MILLIKIN. How much water do you lose by seepage and evaporation in delivering those net amounts?

"Mr. DOWD. I will give you that now. The losses from seepage and evaporation in this canal system in Mexico were remarkably low and would average somewhere around 5 to 7 percent a year; when you were given figures of 200,000 to 250,000 acre-feet of losses to be added to the 1929 offer of 750,000 acre-feet, they are in error. It is only about 30 miles from the diversion point to what we call Cudahy Check, and at that point 30 miles from the head about one-half of the deliveries are made in Mexico. So that when you take the amounts we give you as delivered from the canals in Mexico, half of them are made from a 30-mile canal, so you do not have the same situation as if all the water had to be carried through the whole 130 miles. But our seepage and evaporation losses show from 5 to 7 1/2 or 8 percent normally.

"Since the All-American Canal has been built and all the water for Imperial Valley has been taken through the All-American Canal, and that occurred in March 1942, the Mexican system has been going through a transition period.

"At this time, of course, with the larger canal and the smaller amount of water, there is some additional loss; but for the year 1942 the loss showed only 14 1/2 percent. Even these big canals, with

just the Mexican water for 1943, showed loss of only 10.6 percent. So it is my opinion that with proper maintenance and relining and fixing the canals up, the losses based on our delivery points back to the river will not be over 5 to 7 1/2 percent.

Inasmuch as the figures of use of water in Mexico presented by Mr. Dowd were different from those presented by Mr. Lawson, Senator Hawkes wanted to know what the difference was. At page 687 Senator Hawkes asked Mr. Dowd to explain. Mr. Dowd stated that his companies' measurements showed 1,100,000 acre-feet of water diverted by the Alamo Canal to Mexico in 1943. To agree with the State Department's diversion estimate of 1,800,000 acre-feet for that year, there would have to have been 700,000 acre-feet pumped from the river. Mr. Dowd commented on this quantity of pumping "Just how it has been arrived at we do not know." And further "we cannot believe it." (p. 688)

Mr. Dowd presented testimony concerning the amount of water Mexico had used prior to 1944 and to emphasize his argument that Mexico should not be allotted 1,500,000 acre-feet per year he presented the results of a study which purported to show that had Boulder Dam not been constructed, Mexico could not have received even 750,000 acre-feet each year without suffering severe shortages. Interestingly, the study assumed that the All-American Canal was in existence (even without Boulder Dam) and that it furnished an adequate supply to the then present developed area in Imperial Valley.

In addition to the water supply argument above noted, Mr. Dowd also stated that it would be impossible, absent the treaty, for Mexico to get the water out of the river for physical reasons. The channel meanders and shifts too much for pumps and there are no adequate sites for a diversion dam.

Mr. Dowd then introduced a chart which showed the monthly use of water in percent of annual totals for United States and Mexico. This chart and the physical situation it represented, was important to the negotiators in preparing the scheduling of water deliveries for Article 15 of the Treaty. In general, this chart shows that diversions in Mexico, because at that time it was a one crop country (cotton), varied from a low of 0.8 percent of annual in January and December to a high of 20 percent in July. While in the Imperial Valley in the United States, the curve is quite flat, varying from 6 percent in January, February, and December to 10 percent in July (See pp. 702-704).

At page 710 Mr. Dowd argues further against allotting Mexico more water than she used prior to the construction of Boulder Dam and states that it would be possible for the United States to control development in Mexico by the regulation of Boulder and Davis Dams.

Mr. Dowd summarized his previous testimony at page 724 and 725 in the following language:

> "Mr. DOWD. (1) The low flow of the Colorado River had been over-appropriated; (2) the maximum use of 750,000 acre-feet in Mexico, which was approximated in only 2 years, was more than the dependable supply available to her; (3) Mexico had to depend upon diversion works located in the United States, because (a) the diversion of any substantial volume of water in Mexico would have violated the navigation provisions of the treaty of 1853, (b) every attempt to divert in Mexico had proved unsuccessful due to changing and unstable conditions of the river channel, and (c) a diversion dam in the limitrophe section of the river was neither feasible nor could it have been constructed without the consent of the United States and, below the lower boundary, would have been of little if any benefit to Mexico; (4) in any event, construction of the All-American Canal would have reduced the dependable supply for Mexico to considerably less than 750,000 acre-feet.

"The second major point was that with the construction of Boulder Dam and the All-American Canal (1) conditions during the past several years have shown the dependence of Mexico upon facilities in the United States for a dependable water supply; (2) without this treaty Mexico could not solely by the use of her own facilities put to successful use any larger, dependable quantity of Colorado River Water, certainly not more than 750,000 acre-feet.

"The third major point is that Mexico is the one requiring a treaty on the Colorado River, not the United States.

* * *

Mr. Dowd also cautioned against allocating all of the water in the river and predicted that there would be operational losses in delivering to Mexico 1,500,000 acre-feet. He used a figure of 200,000 or 250,000 acre-feet for operational waste or regulation losses. (see p. 732)

Senator Downey on page 739 introduces an interpretation of Article 10 of the Treaty which would guarantee Mexico 1.5 million acre-feet per year and permit her to increase her allottment by an additional 1.5 million acre-feet annually. Senator Downey does this by questioning Mr. Dowd. The exchange takes place on pages 739 to 742:

"Senator DOWNEY. Mr. Dowd, as I understand your testimony, you are of the opinion that this treaty grants to Mexico only three classes of water: First, 1,500,000 acre-feet, the guaranteed quantity, and then an additional quantity of 200,000 acre-feet that you have been testifying about, and then only the right to use the water that reaches her boundaries. Is that correct?

"Mr. DOWD. That is right.

"Senator DOWNEY. Is that the impression of the treaty that you have gotten from your discussions with various engineers and representatives of the State Department?

"Mr. DOWD. No. We have not discussed the treaty lately with the State Department, but prior to the treaty's being finally negotiated and signed we were told by a representative of the State Department that Mexico was insisting on 2,000,000 acre-feet and she would be shown how she could get it.

"Senator DOWNEY. You do not think that there is any provision in the treaty that would give Mexico 1,500,000 acre-feet of guaranteed water and another 1,500,000 that she could acquire by use?

"Mr. DOWD. I do not know what she could acquire by use, sir; but we feel that if Mexico is permitted to use all surplus water going down the river--for it says here that she is allotted water in other quantities--even though she has no right to it, it is there and can be used. If that is done over a long period of years, Mr. Carson said that 50 years from now there would be 5,000,000 acre-feet going into Mexico, it may be come serious when we take the waters back and when her improvements must be abandoned and the people that depend upon them have to be removed.

"Senator DOWNEY. You referred to some provision in the contract which you stated prevented Mexico or tended to prevent Mexico from acquiring any rights in the waters of the Colorado River by use.

"Mr. DOWD. Any right to use over 1,500,000 acre-feet.

"Senator DOWNEY. Suppose you read that clause.

"Mr. DOWD (reading):

> 'Mexico shall acquire no right beyond that provided by this subparagraph by the use of waters of the Colorado River system for any purpose whatsoever in excess of 1,500,000 acre-feet annually.'

"Senator DOWNEY. That does not say that she is guaranteed 1,500,000 acre-feet, does it?

"Mr. DOWD. No, sir; but I assume that that is what is intended.

"Senator DOWNEY. Why do you assume that? Is the 1,500,000 acre-feet gained by use a guaranteed amount? Is not 1,500,000 acre-feet gained by use and 1,500,000 acre-feet guaranteed? Read it again.

"Mr. DOWD (reading):

> 'Mexico shall acquire no right beyond that provided by this subparagraph by the use of waters of the Colorado River system for any purpose whatsoever in excess of 1,500,000 acre-feet annually.'

"Senator DOWNEY. And now will you notice that where they use that expression, throughout otherwise they say the guaranteed annual amount of 1,500,000 acre-feet?

"Mr. DOWD. That is true, sir.

"Senator DOWNEY. But they do not use it in that expression, do they?

"Mr. DOWD. If I were testifying as an attorney I would object very strongly to the loose language that is used in many places.

"Senator DOWNEY. Is that language loose?

"Mr. DOWD. It is subject to two or three interpretations.

"Senator DOWNEY. But is it subject to any other interpretation than that Mexico can get up to 1,500,000 acre-feet by use? How is there any other possible interpretation? Can you tell me that?

"Mr. DOWD. That is a legal matter that you and the other attorneys can answer.

"Senator DOWNEY. You say you have formed the opinion from reading the treaty and from what has happened that Mexico is not given 1,500,000 acre-feet by standing use. On what do you base that?

"Mr. DOWD. I said Mexico is given a guaranteed annual quantity of 1 1/2 million acre-feet.

"Senator DOWNEY. She is not given that by use; she is given that by the treaty?

"Mr. DOWD. That is right.

"Senator DOWNEY. And then she is given the right to use the waters that arrive at the boundary.

"Mr. DOWD. Any other quantities arriving at the Mexican point of diversion.

"Senator DOWNEY. And then later on is she not limited to another 1,500,000 by use?

"Mr. DOWD. That 'by use' applies to waters in excess of 1,500,000 acre-feet.

"Senator DOWNEY. No. Read that clause again, please.

"Mr. DOWD (reading).

> 'Mexico shall acquire no right beyond that provided by this subparagraph by the use of waters of the Colorado River system for any purpose whatsoever in excess of 1,500,000 acre-feet annually.'

"Senator DOWNEY. That is, she can acquire up to 1,500,000 acre-feet by use. Is not that what it says? Does not that give her the right to acquire 1,500,000 acre-feet by use?

"Mr. DOWD. She is guaranteed 1,500,000 acre-feet.

"Senator DOWNEY. Is that the same 1,500,000 acre-feet?

"Mr. DOWD. Whether it is or not, I would construe it to be a limit of 1 1/2 million acre-feet according to the treaty. I do not think it will hold, though, if Mexico does use that amount over a period of 30 or 40 years.

"Senator WILEY. You do not mean, now, that you are taking the position that over a period of 30 or 40 years the use by Mexico of water would give her any legally enforceable right unless you give it to her by treaty, do you?

"Mr. DOWD. What I maintain, sir, is that when we make a treaty by which Mexico can be delivered that amount of water, then over a period of 30 or 40 years she might develop a situation such that it would be very difficult for us to withdraw back to the 1,500,000 acre-feet.

"Senator WILEY. You mean that there might be something in the treaty whereby we would be subject to probable arbitration on that matter?

"Mr. DOWD. No, sir. I mean that in 1853 we made a treaty with Mexico in which she accepted certain obligations on the Colorado River. She now maintains that that is all 'out of the window', that the treaty does not mean anything, that navigation is not being practiced, and therefore you can 'throw it out of the window.' If the same situation came up with reference to this treaty, and if the same principles were applied, she might say the same thing here. She might say that it was not exercised for all these years and that it does not mean anything.

"Senator McFARLAND. It would be proper if she were limited to 750,000 acre-feet, would it not?

"Mr. DOWD. Yes. There is a very serious question as to whether Mexico should agree not to use any more than she has been allotted by the treaty. Some people believe that that should be the limit.

"Senator McFARLAND. You mean, you personally feel that even though the water is going down the river, and they have land there that needs the water, she should agree not to put the water on the land?

"Mr. DOWD. There is a serious question whether that should not be the case.

"Senator McFARLAND. Do you believe that that is a proper restriction to place on another country, that if water goes down that we cannot use, and we are letting it go down, you think we should ask that country not to use it?

"Mr. DOWD. I am not clear in my own mind whether we should or not. It is something that should be carefully considered from the legal as well as the engineering standpoint.

"Senator HAWKES. I would like to emphasize, Senator McFarland, that I have talked with a great many people out in that section, including your own State, and they feel that Mexico perhaps should be allowed to use that excess water that is going down there anyway, but there should be notice that she is using it at her own risk, and that it does not establish a prior right, so that she can come in and, through emotionalism and sentimentalism, say, 'We have built up this facility and now the United States is going to force us to tear it down.'

"Senator McFARLAND. The treaty provides that she shall not have any right to any more than 1,500,000 acre-feet. How much more of a notice or what better notice could you give than that?

"Senator WILEY. You heard the discussion. Senator Downey contends it is an additional right.

"Senator DOWNEY. I think there is only one possible construction to be placed on the treaty, and that is 1,500,000 acre-feet guaranteed and 1,500,000 acre-feet additional quantity for use. This sentence would clearly indicate that:

> 'Mexico shall acquire no right beyond that provided by this subparagraph by the use of waters of the Colorado River system for any purpose whatsoever in excess of 1,500,000 acre-feet annually.'

"We have been rather lured along to think that that means a guaranteed quantity. Throughout this treaty, in every other place, it says 'guaranteed quantity' except at this one place. It is very certain that Mexico does not acquire that 1,500,000 acre-feet by use; she acquires it by this treaty, by this guaranty.

"I want to direct your attention to this, Mr. Dowd. Do you not think that the sentence clearly and unequivocally gives Mexico the right to acquire 1,500,000 acre-feet by use? (Reading:)

'Mexico shall acquire no right beyond that provided by this subparagraph by the use of the Colorado River system--and I want to emphasize 'by the use'--

'for any purpose whatsoever in excess of 1,500,000 acre-feet annually.'

"I again ask you if any treaty could be more plain that Mexico is entitled to acquire 1,500,000 acre-feet by use.

"Mr. DOWD. I can see your interpretation, and I can see where it could be argued that way, but that is a legal interpretation.

"Senator DOWNEY. Let me ask you this. Would not even the most careless lawyer repeat in this particular place, 'in excess of the guaranteed quantity of 1,500,000 acre-feet'? Why is that the only place from which it is omitted?

"Mr. DOWD. I do not know, sir. It has occurred to us many times whether the language used here was the result of a careless handling of the language or whether it was deliberately used in the way it has been used. We just do not know."

Mr. Horton, attorney for the Imperial Irrigation District, repeated this idea in his written statement to the Committee on pages 832 and 833, and Mr. Scott, General Counsel, Salt River Valley Water Users Association, also adopts this interpretation at pages 996-999. Senator Downey during his testimony expands upon the "ambiguity" at pages 1120-1123 and 1134-1135.

Mr. Dowd had this to say regarding the estimates of return flow (pp. 749-750):

". . . However, I want to point out one or two things. The estimates you had of return flow from the All-American Canal were 65,000 acre-feet. At the present time, the total return flow into the river, including All-American Canal seepage and return flow from the Bard area, which is the area of the Yuma project in California, that comes into the river near Yuma, totals 35,000 to 40,000 acre-feet. This is the total in-flow. In the last few years the All-American Canal has sealed up in very good shape. The loss has dropped year by year.

"The outflow from the Yuma project at the lower boundary--return flow from seepage--has been somewhere around 60,000 to 70,000 acre-feet. So the total for the two areas has been something like 100,000 to 110,000 acre-feet. We have the feeling that with better application of water, those quantities will, if anything, decrease in the future rather than increase. So instead of having 135,000 acre-feet from Yuma and 65,000 acre-feet from the All-American Canal, or a total of 200,000 acre-feet, there should not be more than 100,000 acre-feet from the two sources.

"The question of the amount of water that has to be used for irrigation is not well known. There is very little known about it. But experiments that are being made in California and other places would indicate that only a small amount of water need be applied in addition to what the plant requires to keep the salt moving down. In fact, some experiments indicate that if you apply 8 percent more than you need for the growth of the plant, that will be sufficient.

"The estimate of 400,000 acre-feet from the Gila project, where the irrigation water must be pumped, we feel is entirely out of reason. We doubt that under the ultimate development there is any reason why there should be over 50,000 acre-feet from the Gila project. I might point out to you that the Gila project as now proposed consists of two units. One, the Yuma Mesa, the other being an area up along the Gila River. The return flow from the area along the Gila River will get back to the Colorado, but the return flow from the 60,000 acres on the Yuma Mesa, which slopes to the south, toward Sonora, will, we feel, go into Sonora or will appear in the river below the lower boundary and, therefore, not be credited to the United States."

Mr. Dowd follows his discussion of return flow with an exchange with Senator McFarland in which Mr. Dowd states that Mexico should not be permitted to build a diversion dam until it is absolutely required. He attempts to explain his position in terms of protecting land and property in the United States and that it is "against good engineering practice and principles" to permit a weir in the river (pp. 748, 751). A few pages earlier, Mr. Dowd was discussing the need of the Imperial Irrigation District for more power and power revenues from the proposed Pilot Knob powerplant.

Mr. Dowd sheds some light on the operation of the Imperial Irrigation District in attacking the treaty for not precluding Mexico from dumping her waste water into the Salton Sea. Starting at page 752 we find the following:

"Senator WILEY. All right. Hurry along. You were about to discuss the Salton Sea.

"Mr. DOWD. As I mentioned yesterday, from a point about 30 miles south of the international boundary, or about the Volcano Lake levee location, northward, the land slopes to the Salton Sea, the Salton Sea being about 241 feet below sea level. It is the only outlet, it is the only place, where the drainage, the waste, and the storm run-off waters for a very large area can flow and be handled. There is only one way in which water can get out of the Salton Sea, and that is by evaporation.

"Since it is also the drainage basin for this large area served by the All-American Canal, we have proceeded to acquire rights to the properties in and around the Salton Sea. Our district has so far invested over a half million dollars in acquiring the rights around Salton Sea. Mexico has an area of possibly 125,000 to 150,000 acres that can drain to only one place, and that is the Salton Sea.

"We feel that Mexico should not be permitted to waste her drainage waters and any excess waters she may use in reclaiming land or because of improper use of canal water, and so forth, into the Salton Sea, without restrictions. The limit that the sea can absorb is, of course, a certain quantity. If you put more water in the sea, it rises. At the present time it would appear that we are wasting a considerable amount of water into the Salton Sea. But as the All-American Canal is developing, and as there is better control of the water with elimination of silt from Boulder Dam to the All-American Canal, we realize that in the future there will not be anywhere near the amount of water wasted from the present area, but we must also consider the bringing into cultivation of 100,000 acres in the Coachella Valley and the bringing into cultivation of another 200,000 or so acres on the East and West Mesas of the Imperial Valley, all of which must drain into the Salton Sea.

"For many years there is going to be surplus water going to Mexico under the treaty. She has a right to use all waters reaching her points of diversion. There is no limit upon what she may bring in and waste through her canal wasteways into the Salton Sea. The treaty is silent on that subject. We believe that it should be in some way accounted for and taken care of.

"Senator McFARLAND. Is it physically possible for you to recapture those waters and use them on the other lands?

"Mr. DOWD. Not from New River. We are now, from the Alamo River, using some water near Holtville and near Calipatria. We are intending to spend some $300,000 or $400,000 in building a different source of supply for the land at Calipatria, which has not been getting satisfactory water from the Alamo River because of poor quality. While we will continue to take it out near Holtville, we do not want salty drainage waters from Mexico coming down the Alamo River channel to be the supply for those lands.

"Senator McFARLAND. Are there any waters coming down from that land now?

"Mr. DOWD. For the land near Holtville, there is. We divert water into the Alamo River in order to provide a supply for them. The amount of drainage water is very small. But if Mexico is going to keep her land in cultivation, there has got to be a very large amount of drainage work done, and the drainage water from Mexican lands when combined with our own waste, will be salty and very undesirable to use for irrigation purposes.

"Senator WILEY. How will you stop it--that is, the natural flow?

"Mr. DOWD. It is not natural flow when it comes from the canal, sir. It would be a deliberate act if Mexico opened the waste gates in her canals and allowed the water to come in here. We do not think we can stop it, and for that reason we think there should be some agreement set up in the treaty to stop it. Mexico should accept a limit on quantity and also the payment of some proportion of our investment in providing this outlet for her water.

"Senator McFARLAND. Senator Wiley, as I understood him, meant How could Mexico stop it and irrigate that land?

"Mr. DOWD. Mexico can't stop drainage water. Mexico can control the waste from her canals. There is no reason why American farmers should pay the entire cost of providing a drainage basin for Mexican lands."

Senator Downey summarized the feelings of the opponents in regards to the estimates of return flow that were to be available to satisfy part of the treaty allotment at pages 1105 and 1106:

"Now, I want to discuss as rapidly as I can but as exhaustively as I can in the limited time I have certain of the basic, underlying, important facts of this dispute that are totally ignored by the proponents of the treaty or are stated as positive facts when they are highly speculative. One of the important and salient facts urged by the proponents of the treaty is that, of the 1,500,000 acre-feet of water alleged to be given to Mexico, something over 1,000,000 acre-feet will come from return flow; and the implication is left that therefore the States of the United States will only have to contribute out of water that they could not use but 500,000 acre-feet. As a matter of fact, one witness for the State Department testified very positively in his opinion that the return flow that could not be used in the United States at the boundary of Mexico would be 1,200,000 or 1,300,000 acre-feet, and only 300,000 or 400,000 acre-feet would have to be given by the Colorado River Basin States.

"When the suggestion was made that we would willingly give to Mexico all of the return flow plus 500,000 or 600,000 acre-feet, it that

was what this treaty meant, why, then, of course, there was a change and the witnesses stated that Mexico would not accept that.

"Now, first I want to say, Mr. Chairman, that after months of investigation I know that the amount of return flow is highly speculative and uncertain; that return flow may be 150,000 or 250,000 acre-feet, or it may be 1,000,000 or 1,500,000 acre-feet, depending upon the total amount of water available in the lower basin State, its salinity, and the extent to which it is used. We cannot hope to definitely know the amount of that return flow unless we know what the State of Arizona is going to do, what the State of California is going to do, and what the water users of those basins are going to do. It is possible in the United States by souring our own lands, by over-using the water, that there would be almost no return flow to Lower California. It could be that if we handle our irrigation projects another way there might even be in excess of 1,500,000 acre-feet of saline, impregnated, unusable water go down; so first I say that the proponents of this treaty have stated as a possible fact that we can rely upon there being upwards of a million acre-feet of return flow, incorrectly and unfairly, because that fact rests on the uncertainty of the futures and what the different States and water users may do.

"Now, a subject allied to that is this. We are supposed to receive credit from Mexico for this allocation to her that is alleged to be 1,500,000 acre-feet, by the return-flow waters that reach, I am not sure whether it is the upper or the lower boundary of Mexico, but it is one or the other. Under the treaties, I think that point is left indefinite. Every engineer with whom I have talked has told me it will be possible for Mexico to install pumps along the bank of the river about where this return flow comes in or above it in the limitrophe section of the river; that is, the 20 miles in which the river is the common boundary; and it will exhaust that return flows in pumps; but what would mean that Mexico or Lower California would get that water and we would not get credit for it.

"Now, apparently the State Department has not thought to bind Lower California or its water users not to pump, there. Apparently the Department is entirely oblivious that as a simple engineering problem Mexico can utilize the great part of that return flow and we not get credit for it. Now, of course the treaty could be so framed that Mexico would agree not to put pumps down there in that section of the river."

In rebuttal, Mr. Lawson stated positively that in his opinion it would be entirely feasible for Mexico to build its own diversion structure to irrigate her lands, and that therefore it is possible for Mexico to continue to increase her use of Colorado River water absent the treaty. He also presented testimony and charts showing the

amounts of water used by Mexico in 1943 and how the figures were determined. This was in reply to Mr. Dowd's comments that the use in Mexico of 1,800,000 acre-feet in 1943 was in error (see pp. 951-954).

Mr. Tipton returned to the stand for the major part of his testimony, having only covered return flow in his earlier appearance. His first actions upon returning were to rebutt Mr. Dowd's testimony especially as it concerned the use of water by Mexico and the comparison of the treaty under consideration with the Mead offer. (see pp. 967-972 and 1027-1031)

Senator Downey attempted to follow through with the argument advanced by Mr. Dowd that by regulation of Boulder and Davis Dams the United States could prevent Mexico from enlarging her use of Colorado River water. After a preliminary discussion of this matter by Senator Wiley and Mr. Tipton, Senator Downey at page 1067 asked:

> "Senator DOWNEY. I think that by asking a few questions, Mr. Chairman, I might help develop the matter.
>
> "I agree with you that it is one of the most important questions here. You say that for a long time there will be 10,000,000 acre-feet washing down that river, and that if we try to take that water away from Mexico in order to prevent her from building up a right we thereby depreciate our power resources to such an extent that it becomes impracticable. Is that a fair statement of your testimony?
>
> "Mr. TIPTON. Yes. There is a little shade of difference--that if we did attempt to make unusable any substantial quantity of the water going to Mexico it would impair the ability of Lake Mead to generate hydroelectric energy.
>
> "May I amplify that slightly? We are talking here--
>
> "Senator DOWNEY. You understood what I said, and I think all the members the committee did. I just wanted to get in a few brief questions.
>
> "Senator GREEN. May we hear the rest of his answer?
>
> "Mr. TIPTON. The balance of my answer is this. I cannot conceive by any stretch of the imagination that Mexico would put to

beneficial use, prior to the time that the United States can, the 10,000,000 acre-feet of water that is going to Mexico. The manipulation of works in the United States to prevent Mexico from expanding her uses would have to be a manipulation of the first, say, 7,000,000 acre-feet, making it unusable, and then going on down into the balance of the 3,000,000 acre-feet, and then on down into the last 1,500,000 acre-feet which this treaty provides. So I think that, using common sense, which I am going to use insofar as I can throughout testimony--just common sense could indicate that it would not be practicable to so manipulate our works as to make unusable 9,000,000 acre-feet or more of water that is going to Mexico at the present time in a more or less controlled fashion."

Mr. Tipton at page 1071 attempted to reassure the committee that there was sufficient water in the Colorado River for a long time to come by the following statement:

"Mr. TIPTON. Referring back to the allocation provisions of the Colorado River compact, your attention is directed to subsection (c) which provides specifically that should a treaty be negotiated with Mexico the waters allocated to Mexico should come from water in addition to that apportioned by subsections (a) and (b), or, in other words, water in excess of 16,000,000 acre-feet per annum. The subsection provides further that should such surplus over the 16,000,000 acre-feet be insufficient to satisfy the Mexican allocation the deficiency should be borne equally by the upper and lower basins.

"Attention is directed also to provisions of subsection (f). This subsection recognizes all waters covered by subsections (a), (b), and (c) as apportioned waters. It then specifically provides that any waters in excess of that apportioned by subsections (a), (b), and (c) may be apportioned after October 1, 1963, if and when either the upper or lower basin shall have reached its total beneficial consumptive use of waters apportioned under subsections (a) and (b).

"It is probable that for many years, extending well beyond 1988, when the costs of Boulder Dam and all other works presently constructed in the basin are amortized, ample water will be available under all conditions to supply all uses in the United States and the obligation of the United States to Mexico under the terms of the treaty."

In that same vein, there seemed to be a difference of opinion as to how much water was being consumed in the United States. California presented one set of

figures and Mr. Tipton another. The exchange concerning these estimates is found on page 1175 as follows:

"Senator WILEY. There was an exhibit here in the last few days from California which showed, as I recall it, already something like 5,300,000 acre-feet. Am I right, Senator Downey?

"Senator DOWNEY. Yes. I think I have it here (handing a paper to Senator Wiley).

"Senator WILEY. I think it is important to get your comment on that, Mr. Tipton (handing paper to the witness).

"Mr. TIPTON. This paper, which has just been handed to me, purports to show the total consumptive use in the lower basin, at the present time, 5,800,000 acre-feet, and an additional consumption of 2,700,000 acre-feet in order that the lower basin's consumptive use might equal its allocation under the compact of 8,500,000 acre-feet.

"I do not agree that the total consumption in the lower basin at the present time is 5,800,000 acre-feet. I shall later on state that in my opinion the consumption in the entire Colorado River Basin is 7,200,000 acre-feet, of which 2,500,000 acre-feet is in the upper basin, which would leave 4,700,000 acre-feet as the amount of water being at the present time consumed in the lower basin.

"The Bureau of Reclamation engineers will come on at some time during these hearings I believe their estimates are some 7,000,000 acre-feet.

"Senator WILEY. Will you put that statement in the evidence at this time, and then say what specific items you claim are in error, so that the committee will know what the difference is between you folks again?

"Mr. TIPTON. Would it be satisfactory, sir, if I supply this for the record, or does the committee want me to offer oral testimony on that at this point? I would have to go through my records and pick out individual items.

"Senator WILEY. I would not want to hold you to your recollection of the figures, but you might indicate what items are in error, in your judgment, and then you can correct it afterward with definite figures, if you prefer.

"The CHAIRMAN. Why would it not be well to give him a little time? He says he has to pick out items from his report.

"Senator WILEY. I am trying to get an understanding about it at this time. I do not hold him to his figures.

"Mr. TIPTON. I think that the one figure that would be in the greatest dispute would be the item which appears on this tabulation which I have before me, of estimated consumption in the upper Gila

(central Arizona), in the amount of 1,800,000 acre-feet. I believe that the Bureau of Reclamation will indicate that their estimate of that consumption is 1,100,000 acre-feet.

"I think the difference there comes from an interpretation of consumptive use under the compact, as to whether it means depletion to the main stream or whether it means depletion up in the areas where the water is used. That brings into the picture salvaged water, which I will discuss later on.

"If it were considered that this item of 1,800,000 acre-feet for consumption in the upper Gila was a correct figure--and that might be the actual consumption up at that point--then the total estimated water supply would be increased by the difference between the 1,100,000 acre-feet and 1,800,000 acre-feet.

"Senator WILEY. Are there any other items?

"Mr. TIPTON. That is the outstanding item, sir. The other items, as I say, I would have to check in greater detail in order to determine where the difference might be. I could go down the list and indicate those on which there could be agreement.

"Lake Mead evaporation I think is somewhat higher than estimate. Here is given at 800,000. We have gone into that in great detail, and our estimate is somewhat lower than 800,000 acre-feet.

"Senator WILEY. How much?

"Mr. TIPTON. We estimate that the evaporation from Lake Mead, Parker Reservoir, Bullshead Reservoir, which is not yet built, Bridge Canyon Reservoir, which is not yet built, Marble Gorge Reservoir, which is not yet built--that the net evaporation from those reservoirs will be 830,000 acre-feet. When we are talking about net reservoir evaporation, that means the new losses which are occasioned by the operation of the reservoirs.

"Senator WILEY. Would you mind taking a pencil and putting opposite those figures the approximate amount that you believe should be there, and then we can have it in the record, and if you want to correct it afterward you may do so, and we will have some basis of understanding."

Following an interruption, Mr. Tipton presented the exhibit by California with corresponding estimates of his own. This tabulation is found at page 1183:

EXHIBIT XY
Present Consumptive use in Lower Basin

	Acre-feet (Calif.)	(Tipton)
Lake Meade, etc.	800,000	713,000
Nevada and Utah and New Mexico	150,000	117,500
Parker Reservoir	50,000 [i]	
Palo Verde	150,000	
		144,000
Parker Valley	50,000	
All-American Canal	2,500,000	2,500,000
Yuma, Calif.	50,000	35,000
Yuma, Ariz.	150,000	167,000
Lower Gila	50,000	32,000
Upper Gila (central Arizona)	1,800,000	1,150,000
Metropolitan	50,000	50,000
Total	5,800,000	4,908,500
To go	2,700,000	3,591,500
Compact, 3A and 3B	8,500,000	8,500,000

[i] Included in first item.

California many times throughout the hearings referred to the dangerous situation in which her junior appropriations would be placed if the Treaty were approved. Mr. Tipton outlined the priorities in California in detail on pages 1171-1175 and 1183-1189. At page 1189 Mr. Tipton summed up the situation in the following language:

> "The reason for the concern on the part of the interests holding the junior priorities is apparent. However, the uncertain status of water for these priorities was not created by the terms of the treaty. That status existed under the terms of the Colorado River Compact at the time the priorities were set up. If the terms of the proposed treaty in any way adversely affect the status of these junior priorities, it is probable that their status would be even more jeopardized if the problems concerning the use of the waters of the Colorado River by

the two Nations were arbitrated, and it is certain that their status would have become increasingly more hazardous had treaty negotiations been long delayed, with the result of a further material increase in the use of the waters of the Colorado River by Mexico.

"It is believed that the terms of the present proposed treaty are the best that can be had. Under such terms, potential uses in the basin in the United States can be crystallized and definitely fixed.

"The question of the availability of water for various California priorities is a California dilemma.

"California, by her own act, set up a system of priorities which placed one-half the water assumed to have been necessary for the metropolitan water district of California and all the San Diego water from the Colorado River on an infirm status, leaving the water that would be available for those junior priorities to come out of surplus, which cannot be allocated until some time after 1963.

"If a conflict between major agricultural uses and major municipal uses should develop in California it will be California's problem to determine which is the most important use and adjust the differences."

In response to specific objections by California, Mr. Tipton attempted to answer them in order. Those applying to water supply are as follows, starting on page 1190:

"Mr. TIPTON. . . .

"The first objection: After full development, the water supply will be insufficient to meet lower basin obligations and the delivery of 1,500,000 acre-feet to Mexico.

"Sufficient water will be available to meet the United States' obligations to Mexico and the amount of water apportioned to the lower basin by Article III (a) and III (b) of the compact. These are the only firm apportionments of water to the lower basin. Any other obligations which the lower basin interests might have to deliver water in addition to that apportioned to the lower basin by article III (a) and III (b) of the compact are not firm obligations because no water has been allocated to it by the compact for that purpose, and no allocation can be made until after October 1, 1963. Future allocations must be made to the basins by commissioners appointed by the Governors of the seven Colorado River Basin States.

"The second objection:

"California's contracts were the basis for a large bonded indebtedness and now stand to be injured or repudiated by the provisions of the treaty.

"California has firm contracts for the delivery of only 4,400,000 acre-feet of water from Lake Mead. Contracts for the delivery of water to the so-called junior priorities, amounting to 962,000 acre-feet, are not firm contracts because no allocation of water for that purpose has been made by the Colorado River Compact.

"Again, such allocation must await future action, after 1963. Also, one witness suggested that the Bureau of Reclamation had estimated that conditions of 1988--I am amplifying somewhat the testimony of this witness to round it out--would be such that consumption in the upper basin would be 6,200,000 acre-feet and that with no further main-channel reservoirs on the streams, Lake Mead would furnish for a 10-year period, such as 1931 to 1940, inclusive, only 8,500,000 acre-feet of water.

"Lake Mead obviously, therefore, is not of sufficient capacity to supply water during such a 10-year period of drought to the holders of these junior contracts. So these contracts are infirm from that standpoint. There would be no water over a 10-year period from Lake Mead for that purpose.

"The CHAIRMAN. That is, for the junior?

"Mr. TIPTON. That is for the junior.

"Now, other reservoirs will be on the stream--many additional reservoirs. The stream will be entirely equated, so that, as far as the lower basin is concerned, there will be no low-water period. The water supply that will be furnished under that condition, not only from Lake Mead but also from other reservoirs built along the upper basin, will approach the long-time average.

"Senator LUCAS. These contracts were entered into on the sole theory that the water would be delivered from Lake Mead?

"Mr. TIPTON. That is correct. However, Lake Mead cannot deliver the water for a 10-year drought period under future conditions."

Following a recess Mr. Tipton continues on pages 1195 to 1197:

"Mr. TIPTON. When we recessed I was discussing certain objections that California has raised to the treaty. I will come to No. 3, that Mexico is not entitled to more water than it used or could have used before the construction of Boulder Dam, namely, about 750,000 acre-feet per year.

"It must be understood that the actual diversion for the benefit of Mexico prior to the construction of Boulder Dam was more than 750,000 acre-feet. All reports of the use of water by Mexico prior to the placing in operation of Boulder Dam are in terms of aggregate deliveries to the Mexican laterals of the Alamo canal and do not include canal losses or wastes. Neither do they include desilting water.

"I call attention to the present situation, when 1,100,000 acre-feet of water per year is being diverted through the Alamo canal to serve 191,700 acres of land in Mexico that at present is being irrigated under the Alamo canal, which is less land than was irrigated prior to Boulder Dam, when it was reported that the use by Mexico was 750,000 acre-feet, when that use was a delivery to the laterals and not a diversion from the main stream.

"Under natural-flow conditions with development in the United States, as it was immediately preceding the placing in operation of Boulder Dam and for such a period of run-off as 1902 to 1940, there would have been sufficient water in the river each year, so far as quantity is concerned, to have provided Mexico with 1,500,000 acre-feet. However, the seasonal distribution would not have been parallel in all years with the seasonal distribution of the 1,500,000 acre-feet, in accordance with the manner in which Mexico is using water.

"For 26 years of a 39-year period, 1902 to 1940, the maximum deviation from an assumed ideal requirement would have been 1 percent or less per annum.

"Senator JOHNSON of California. Were you there in 1902?

"Mr. TIPTON. No, sir; I was not, sir.

"There would have been 7 years when the deviation would have been greater than 5 percent, 5 years when it would have been greater than 10 percent, and 2 years when it would have been greater than 15 percent. The same conditions were to some extent true with respect to the lack of parallelism between the water supply and the requirements of the Imperial irrigation district.

"An analysis was made of the records of run-off at Yuma. Those records were adjusted for increased uses that had taken place upstream during the period of record. The Gila River flow was entirely eliminated, because it is largely unusable on account of its flashy character. It was found that after taking care of the Imperial irrigation district and taking care of 1,500,000 acre-feet of the Mexican area and the Imperial irrigation district, whose requirements was assumed of 2,500,000 acre-feet, there would have remained in the stream a very substantial quantity of water, ranging from a minimum amount in 1934, which was the lowest year of record, of only 4,000 acre-feet, to a maximum of 19,000,000 acre-feet. The next lowest year was 1940. Three million six hundred thousand acre-feet would have remained in the stream unused in that year.

"I wish to correct my statement. The next low year would have been 1902, when there would have been 2,625,000 acre-feet remaining unused.

* * *

"Shortages as great as these and much greater exist under many large canal systems in the upper basin. So it is my opinion that Mexico

could have diverted and carried on successful irrigation requiring the diversion of 1,500,000 acre-feet of water prior to Boulder, with uses in the United States as they were immediately prior to Boulder.

"Moreover, Mexico then had a right to use up to half the water carried by the Alamo Canal. The average annual diversion by the Alamo Canal for the 13-year period immediately preceding the placing in operation of Boulder Dam was approximately 3,000,000 acre-feet. The maximum diversion was 3,423,511 acre-feet and the minimum was 2,049,954 acre-feet in the low year of 1934."

After an interruption, Mr. Tipton continues on page 1200:

"California objection No. 4: That the allocation of 1,500,000 acre-feet is double that heretofore offered Mexico.

"The statement itself is not true; but if it were true, there seems to be little point to this connection. It must be understood that Mexico did not accept the offer of the so-called 750,000 acre-feet per annum formerly made, nor did the United States accede to the demand of Mexico for an annual delivery of 3,600,000 acre-feet. No agreement was reached at that time. It is just as pertinent to say that the present allocation to Mexico is only 40 percent of that which Mexico formerly demanded as it would be to say that the present allocation is double the amount which the United States offered.

"I want to make it plain that the former offer did not limit the annual delivery of water to Mexico to 750,000 acre-feet. That is the Mead offer of 1929.

"Under the so-called Mead offer it is my firm belief that Mexico might have received more water than she will receive under the terms of this treaty.

"Senator JOHNSON of California. She would not accept it, though.

~~"Mr. TIPTON. No, sir. In the 1929 offer the American Section~~ headed by Dr. Meade (sic) of the International Water Commission, suggested that 750,000 acre-feet per year be delivered to Mexico according to a schedule, after Boulder Dam was built, and suggested there might be added to that amount sufficient water to compensate for losses in the main canal."

Objection No. 5: That the allocation to Mexico would be in violation of the Boulder Canyon Project Act, which specifically restricted its benefits to the United States, involved primarily a legal question, not water supply.

California's objection No. 6 had to do with a possible reduction in the power produced at Hoover. At pages 1209-1212, Mr. Tipton explained that as of that time

and even as foreseen in 1980 water to be released for the generation of power, even firm power, was more than sufficient to satisfy United States uses and the amount to be allotted to Mexico. Mr. Tipton pointed out that in a period of low runoff, the allottment to Mexico might increase the power production at Hoover.

Objection 7 went to the feasibility of constructing a diversion structure in the limitrophe section. While this objection does not go to water supply directly, the problem caused considerable concern. We will digress at this point and review some background testimony on the matter of a diversion structure for Mexico before giving Mr. Tipton's answer.

Senator McFarland on page 129 expressed a fear of some of his people that a diversion dam in Mexico or in the limitrophe section of the river might prove detrimental to the lands in the Yuma area. His discussion on this point with Mr. Clayton, the attorney for the International Boundary Commission, is as follows:

> "Senator McFARLAND. There is another question. We were talking about these works and the dams that were being constructed in the river. I refer to article XII. In the first paragraph it says:
>
> 'Regardless of where such diversion structure is located, there shall simultaneously be constructed such levees, interior drainage facilities, and other works, or improvements to existing works, as in the opinion of the Commission shall be necessary to protect lands within the United States against damage from such floods and seepage as might result from the construction, operation, and maintenance of this diversion structure.'
>
> "Some of the people down in Yuma County expressed fear that if a diversion dam is placed in this river, which has never been permitted heretofore, it may cause the water level to rise up and alkalize their lands in such a way that the lands will be useless. It being left to the Commission, the Mexican Commissioner would never agree to the proper levees and proper drainage system to prevent that; or at least it might not be prevented until the lands were already ruined, and then it would be too late.

"I should like to hear any answer you might care to give in regard to that objection which has been raised by some people against this treaty.

"Mr. CLAYTON. I will make a brief statement about that. There will be some engineering testimony about that too. But here are the salient features of it.

"Senator McFARLAND. The legal end of it having to be agreed upon by the Mexican member of the Commission.

"Mr. CLAYTON. But simultaneously. In other words, the design and construction of this dam, over which the American section has veto power, will be tied up and interrelated with whatever protective devices are considered necessary to protect against any such floods or seepage.

"As you know, in the past there have been temporary dams put in the river there. This proposal in the treaty has the advantage over such a temporary dam in that it will be designed and planned so as to pass floods and likewise simply to divert the water into Mexico, wherever it is built. This is not a storage dam. It does not impound water; it simply diverts it. Engineers tell me there is no reason why the water surface should be kept at any higher elevation than it is now. That is borne out by a portion of article XI(c) where it speaks about deliverying water to Mexico through the All-American Canal, and so forth, into the Alamo Canal; and of course diversion from the river will also be in the Alamo Canal. It says:

> 'In either event the deliveries shall be made at an operating water surface elevation not higher than that of the Alamo canal at the point where it crossed the international boundary line in the year 1943.'

"If we want to get credit for return and waste flows, as I say, within the Mexican allocation, it is necessary, of course, to have a diversion dam there to put it in the canal. It is not necessary to impound waters and to make the water surface elevation any higher.

"But since we have veto power over the location of that dam in the limitrophe section of the river, and over the plans for that structure, no such location or plans will be approved unless at the same time whatever protective devices the American section considers to be necessary are likewise approved.

"The CHAIRMAN. Right there, let me ask you this: The language of article XII, referred to by Senator McFarland, reads:

> 'Regardless of where such diversion structure is located, there shall simultaneously be constructed such levees, interior-drainage facilities and other works or improvements to existing works, as in the opinion of the Commission shall be necessary to protect lands within the United States against damage from such floods and seepage--'

"That is what you are talking about--seepage of alkali to the top of the ground, ruining the land--

'as might result from the construction, operation, and maintenance of this diversion structure.'

"That has to be agreed to by the American section before it can be done, has it not?

"Mr. CLAYTON. That is right.

"The CHAIRMAN. Furthermore, the article says:

'These protective works shall be constructed, operated, and maintained at the expense of Mexico by the respective sections of the Commission, or under their supervision, each within the territory of its own county.'

"So it leaves it up to the American section to operate these works; and, of course, it would not operate them in such fashion as to ruin the land by letting alkali seep through.

"Senator McFARLAND. I shall go into this more when engineers testify, since it is more an engineering question. But one of the objections is--one of the fears is--that the Commissioners will not recognize what is necessary. There is a feeling that it should be done by the Department of the Interior. The Commissioners are not irrigation people. The Department of the Interior, through the Bureau of Reclamation, is the agency to do what is necessary. However, we will go into that later.

"Mr. CLAYTON. On that point, Senator, I wish to give this committee assurance that the Boundary Commission is not going to approve any plans--is not going to approve any location--without consultation at least with the Bureau of Reclamation. The chances are that they will not only approve them but that they will design those works and build them, if they are willing to do it. They are primarily concerned."

Mr. Ainsworth refers to the provision in article 12 of the treaty which permits the construction of a diversion dam to serve Mexico on page 226. Senator Hayden questions him in regard to this provision as follows on pages 226-228:

"Mr. AINSWORTH. Article 12 of the treaty with Mexico provides for the building by Mexico, at her expense, of a diversion structure in the bed of the Colorado River below the upper boundary.

"The CHAIRMAN. How many boundaries are out there?

"Mr. AINSWORTH. They refer to them as two: The upper boundary is the northern boundary line, coming across the southern boundary of California, hitting the river at Yuma; and the lower boundary that is referred to, which, after starting 20 miles down the river, goes east, forming the southern boundary of Arizona.

"The CHAIRMAN. All right.

"Mr. AINSWORTH. If the structure is built in the boundary portion of the river--this is the diversion structure I am talking of--its location,

design, and construction are subject to the approval of the Commission, which will thereafter operate the structure. Regardless of where it is located, the treaty provides for the building, at Mexico's expense, of such levees, interior drainage facilities, and other works or improvements to existing works, as, in the opinion of the Commission, are necessary to protect lands within the United States. Each section of the Commission is to perform the work located in its own country.

"The provision for the building of the diversion structure was considered necessary by the United States representatives in order that the United States could make use of all its return and drain flows in filling Mexico's schedules of delivery, thus proportionately reducing the draft on firm water. In other words, Mexico could not be expected to receive and be charged with the return waters and other flows in the river unless she was permitted to install the facilities needed for their diversion.

"As noted above, if the structure is located in the boundary portion of the river, the Commission is to pass on its location, design, and construction. This provision gives the American section a voice in the determination of such location, design, and construction. It is proposed to submit the plans to the Bureau of Reclamation for its study and advance advice if the structure is to be located in the boundary portion of the river."

* * *

"Senator HADEN (sic). It is argued by some of our friends at Yuma that the present treaty with Mexico prohibits the construction of a dam of any kind that would obstruct navigation and that, therefore, if this treaty is not adopted Mexico could not build a dam within its own territory to divert water; and also it is argued that if that dam were immediately below the southern boundary, against Lower California, it would back up the water and still do damage to American lands by increasing seepage. What have you to say about that?

"Mr. AINSWORTH. Well, as to the first part of your question, with reference to the prohibition upon Mexico, under the navigation clause, against building a dam at any time without this treaty, I believe that Mexico guarantees passage under the old treaty, and that if she proposed to build a structure that would permit passage of such boats as actually use the Colorado River, such a structure could be built.

"Senator HAYDEN. It is a prohibition against impeding navigation by the construction of a dam?

"Mr. AINSWORTH. That is my understanding.

"Senator HAYDEN. If the dam had a lock in it, so that boats could come and go through the dam, then it could be built under the Treaty of Guadalupe Hidalgo?

"Mr. AINSWORTH. That is my opinion; yes.

"Senator HAYDEN. As to the dam upstream, above the Arizona-Sonora border, how high can that dam be built?

"Mr. AINSWORTH. It is limited by treaty to the elevation of the water surface in the Alamo Canal during 1943.

"Senator HAYDEN. What does that actually mean as compared with the water level or elevation now in the Yuma project?

"Mr. AINSWORTH. It means it would not be changed by the dam.

"Senator HAYDEN. That is, that the water level in the main stream of the Colorado River below Yuma could not be raised over what exists at the present time?

"Mr. AINSWORTH. That is right.

"Senator HAYDEN. As you run a line back from the level of the Alamo Canal, it works out that way from an engineering point of view?

"Mr. AINSWORTH. Yes, sir. Actually we believe it would be slightly lower, because the diversion would be in Mexico and not about a mile upstream in the United States. There is some loss of head through structures in the United States--through Rockwood heading and Hanlon heading--which Mexico can avoid in its construction of the new canal heading to a large extent.

"Senator HAYDEN. As an engineer, would you say that the practical effect of building such a dam would be not to increase the amount of water that would seep into the land of the Yuma project?

"Mr. AINSWORTH. Yes, sir. The water surface in the river will be no higher under ordinary flows than it has been for many years. To prove that point, the Imperial irrigation district has been diverting water to the Alamo Canal for the past 40 years, and Mexico does not need to divert water at any higher elevation.

"Senator HAYDEN. Is the elevation of water in the river the controlling factor as to seepage from the adjacent lands in Arizona?

"Mr. AINSWORTH. Yes, sir; that is the only factor that the river represents."

With this background to California's objection number 7, we turn to Mr. Tipton's answer found on pages 1212 and 1213.

"Mr. TIPTON . . .

"California objection No. 7: The treaty contemplates the construction of diversions and protective works, the feasibility of which has not been established.

"It must be recognized that Mexico could construct a diversion structure below the lower boundary without a treaty. It would be practicable also for Mexico to construct a gravity heading in the Limitrophe section of the river without providing a diversion dam across the river.

"I have discussed that; I shall not repeat it.

* * *

"Mr. TIPTON. Yes. It would be perfectly practicable for Mexico to make a cut in the bank of the river immediately below the upper boundary and to divert substantial quantities of water under present conditions. Such a structure would be on her soil. In fairness, it has been said that the clear water has eroded the stream, so that there is not at present the same opportunity to divert water that there formerly was. However, the land slopes rapidly away from the river. There might be a little area lost near the point of diversion, but it would be possible to cover a very substantial area.

"Further, the clear water has been going down the stream due to the fact that the sand which has been picked up below Boulder has been captured in the reservoir formed by the Imperial Dam. This reservoir is now filled with sand. It is only in the last year that the desilting works at Imperial Dam have been placed in operation. I know of my own personal knowledge that the engineers for the Bureau of Reclamation are very much concerned as to what will happen in the river channel after the desilting works go into full operation. There might be a building up of that channel opposite a practical point of diversion for Mexico to an elevation even higher than existed before Boulder.

"As a matter of fact, investigations were under way by Mexico looking to the possibility of the construction of such works in the event a treaty was not negotiated. Substantial injury could result to the United States' interests by such actions on the part of Mexico without any control being exercised by the United States. The treaty provides that when such works are constructed simultaneously therewith, there shall be constructed those works required to protect United States lands. The extent of such works must be determined by the Commission as a whole.

"Now, it has been suggested here--and it may have seemed a logical suggestion--that Mexico can be supplied with its total amount of water for many years through the All-American Canal and the Pilot Knob wasteway. Why not do that at the present time? Why does not the treaty provide for that at the present time, deferring construction of any dam until some future date?

"There are two reasons why that was not done, so far as the treaty is concerned. One was a very practical reason. During the negotiations of the treaty, several--at least two--conferences were had with the engineers of the Bureau of Reclamation. One series of such conferences consisted of five different meetings. I attended those conferences. The question that we asked the Bureau of Reclamation, because it is the agency that is operating this lower river, was, 'How much water would it permit the United States to obligate itself to deliver through the All-American Canal for the benefit of Mexico? Those conferences were attended by several of the Bureau of Reclamation men. They hesitated at first to commit themselves to a delivery of even a rate of a thousand

second-feet. Finally they suggested that they would agree to 800,000 acre-feet up until 1960, 650,000 acre-feet up until 1970, 500,000 acre-feet until 1980, then one-half of the water destined for Mexico that might reach Imperial Dam.

"So there was a limitation placed upon the negotiators, and there was a reason for it. The Bureau felt it might need additional amounts of water in the river to keep the channel in fair condition below until the river became stabilized; but it was a condition with which the negotiators were faced. So all of the water could not be delivered to Mexico through the All-American Canal; some of it would have to be delivered by some other means.

"We did not write into the treaty all the interim quantities suggested by the Bureau. We put in the 500,000 acre-feet up until 1980 and then 375,000 acre-feet thereafter. At that point in the proceedings we again discussed with the Bureau a definite figure after 1980 rather than half of the water destined for Mexico. It was necessary for us finally to provide for the delivery of the definite amount of 375,000 acre-feet, because if Mexico should construct her diversion structure wholly within Mexico below the lower boundary, there would be a triangular area of land that could not be served by a canal diverting from such structure which is now served by the Alamo canal. That area of land would require on the order of 375,000 acre-feet.

"There was another reason why the obligation to build this structure was placed in the treaty. It was felt that long use of the American facilities for the delivery of water to Mexico might result in our being faced at some time in the future with difficulty in persuading Mexico to build a diversion structure at some place below. Since we are insisting--and the treaty so states--that Mexico must accept as a part of her water all water that comes into the stream above the lower boundary within her schedule, it certainly will require some sort of diversion below that point in order that Mexico may use that water with which we are charging her under the treaty."

Mr. Tipton answered what he called Objection No. 12 concerning ground water development in Mexico as follows at pages 1218 and 1219:

"One, which we will call objection No. 12, is ground water. The question was asked, Why was not ground water considered during the negotiations of the treaty as a resource in Mexico which should be taken into consideration? I want to call attention to one or two items. This first statement is not too material.

"Mr. Dowd described very clearly how the delta of the lower Colorado River was formed. A portion of the Salton Sea used to be a part of the Gulf of Lower California. The river flowed from one side of the delta to

the other side and over a long period of years built up that delta region. Mr. Dowd, in proof of that, stated that the Imperial irrigation district had drilled a number of holes clear down through the silt that was carried in by the river and could not find any water. There was no water available. Those wells were drilled for domestic purposes.

"Now, I do not know whether there is water in the Mexican portion of the delta region of the underground. I merely know what was testified to with respect to the Imperial irrigation district.

"Now, consideration of ground water as an asset to Mexico and the recognition of that in this treaty would be extremely dangerous. Visualize, if you will, such a provision in the treaty: that there is a ground-water supply in Mexico that is an asset to her; that we recognize it; and that by virtue of that asset we are going to deliver her less water from the surface supply of the Colorado River. It has been stated--and I agree--that all the ground water that might be available in Mexico comes from the Colorado River. It has also been suggested that by the installation of wells the return flow, whatever it might be, in the limitrophe section could be depleted. If that is true, the reverse process could take place. In other words, if it would be possible for the United States to completely dry the river at the international boundary, there would be no water available to Mexico to keep up this ground-water supply.

"Then, what would the United States be faced with? In other words, we are saying to her: 'Here is an asset. You take it and use it. By virtue of your use of it, we will reduce our delivery of surface supplies to you.'

"Then, when we completely utilize the surface supplies, the very source of that ground water disappears, and she has a claim against the United States to recharge the ground waters, and we have difficulty.

"We suggest, if you please, that it is much better to define a certain amount of water to be delivered to Mexico at the international boundary and forget it."

At page 1229 Mr. Tipton began to give the Committee information regarding water supply and the amount of water produced within each State in the Basin. Senator Wiley then commented that in order to satisfy demands during a low 10-year period he assumed the engineers were relying on proposed reservoirs in the Basin. Mr. Tipton agrees and outlines the background of the Bureau's study which indicated that in a 10-year dry cycle the outflow from Lake Mead would be 8,500,000 acre-feet.

Mr. Tipton calls attention also to the fact that ". . . the evaporation from Lake Mead . . . is a chargeable item to the allocation to the lower basin, . . ."(p. 1230).

Mr. Tipton gets into his discussion of water supply for the treaty on pages 1276-1279 as follows:

"Mr. TIPTON. . .

"I shall now go to a discussion of water supply, a very brief discussion--not brief because I do not think it is important; it is vitally important, of course. I think that practically everyone is agreed that the virgin flow of the Colorado River at the boundary between the two countries for such a period as 1897 to 1943 averaged 17,751,000 acre-feet. That includes the Gila. That virgin flow is the flow that would have been there annually had man not disturbed the flow in any way--had man not consumed any of that water.

"There will become available, and there is becoming available at the present time, water which is naturally lost in the stream. That is what we call salvage water. From the time precipitation falls on a watershed Nature begins to take its toll of that original water supply. Up at the headwaters of a stream the toll that Nature takes is some 70 percent of the water that falls on the shed. There is transpired by natural vegetation, and evaporated possibly 60 to 70 percent of the original precipitation, depending on the characteristics of the watershed. As the water reaches the streams and flows on down for many miles--in this instance from the headwaters to the boundary I think it is a matter of 1,600 or 1,700 miles--Nature continues to take her toll. The water continues to be consumed by transpiration by natural vegetation and by evaporation. When water is taken out of the stream by man and converted to beneficial use, some of the water which was lost in transit in going down the stream is converted to beneficial use. I can illustrate it, I think, in the simplest way by a transmountain diversion.

"Assume a transmountain diversion taking water from the headwaters of the Colorado River in Colorado. Assume the Colorado Big Thompson transmountain diversion which is under construction which will take from the stream an average of 310,000 acre-feet at the very head waters of the Colorado. If that 310,000 acre-feet had been left in the river and had not been diverted at that point, all of that 310,000 acre-feet would not have reached the boundary, because some of it would have been lost in transit. So, in this gradual development within the basin there will be recovered water that formerly was lost by natural processes, and that recovered water will be placed to beneficial use.

* * *

"In the testimony that is already in the record the Boundary Commission indicated in its tabular statement of water supply that it was estimated there would be a minimum amount of water salvaged from the main stream below Boulder Dam of 380,000 acre-feet. That quantity might be exceeded by a material amount. The floods no longer spread out over the valley, which permitted native vegetation to transpire excess quantities of water, and also permitted excessive evaporation.

"There is already being salvaged in the Gila River area some 470,000 acre-feet that was formerly lost in transit in the river.

"I think there is a very clear picture in the minds of the committee members of the situation on the Gila River. There were formerly very large natural losses there. That water has been put to beneficial use. The estimate of the minimum amount of water that might be salvaged for beneficial use in the upper basin would be in the order of 400,000 acre-feet. It might substantially exceed that quantity. So, the salvaged water which might be available may range as high as 1,250,000 acre-feet. In my mind it will be a minimum of 1,250,000 acre-feet per year. It might be more.

"That does not change in any fashion whatsoever the amount of virgin water at the boundary. The virgin supply is estimated at 17,750,000 acre-feet; but when that 17,750,000 acre-feet was delivered down there large losses took place, and in converting those losses to beneficial use there may be available for beneficial use in the basin at least 1,250,000 acre-feet more of water which can be added to the 17,750,000 acre-feet to represent the minimum average amount of water that could be put to beneficial use for such a period as 1897 to 1943.

"A study of the operation of present and proposed reservoirs indicates that their capacity will be sufficient to equate the estimated water supply for such period as 1897-1943, inclusive. Some shortages during ~~such a low-water period as 1931-40 will occur in the upper regions of~~ the upper basin due to the lack of available reservoir sites of sufficient size fully to equate the flow of the tributaries serving those areas.

"It is estimated however that the main-stream water supply for the lower basin will not be curtailed during such a period of low run-off as 1931-40, due to the fact that there will be reservoirs of sufficient capacity fully to equate the flow of the river, and, so far as the lower basin is concerned, due further to the fact that the upper basin is obligated to deliver to the lower basin 75,000,000 acre-feet in successive 10-year periods or an average of 7,500,000 acre-feet, which is equal to the III (a) allocation to the lower basin, and there is additional inflow between Lee's Ferry and Lake Mead.

"Senator DOWNEY. Mr. Chairman, may I have another question?

"Senator LaFOLLETTE (Presiding). Go ahead. Ask it.

"Senator DOWNEY. Mr. Tipton, would you admit the practical possibility that at a time when your Mead Lake might be empty or at least very low and there was a drought in the upper basin States of a very serious kind, that they would refuse to let any water down at all, such as they have, and defend themselves upon the basis that they did not have any annual delivery compelled but it would be a 10-year delivery? In other words, would it be possible to have almost a complete failure of the water for use in the lower basin, assuming an extraordinary and continued drought beyond anything we have known?

"Mr. TIPTON. I do not think that that would be the case, sir. I think that it must be admitted that the drought must be felt first in the upper basin because that is where the water originates, and the accounting is on the basis of progressive 10-year series. In other words, at the time the delivery at Lee's Ferry for a particular 10-year period is 75,000,000 acre-feet or an average of 7,500,000 acre-feet, from that time on until the drought is ended the upper basin must deliver 7,500,000 acre-feet each year; it is obligated to do so under the compact; and I am assuming, sir, that the upper basin will comply with the terms of the compact."

Commissioner of Reclamation, Harry Bashore, took the stand toward the end of the hearings. After a brief formal statement by the Commissioner, Senator Hayden asked Mr. Bashore, as the man charged with the operation of works on the river, whether he considered "it possible to manipulate the flow of water from Boulder and Davis Dams so as to insure that only half of the scheduled quantity of water would be available to Mexico each month and the total quantity thereby reduced to 750,000 acre-feet annually?" Mr. Bashore answered that if the reservoirs were full and runoff high we could do nothing, but if the reservoirs were low it might be possible to reduce the flow to Mexico for a short period of time with concurrent reduction in power production. He summed up his position as follows on page 1687:

"Mr. BASHORE. I do not think it would be practicable, Senator. It would be possible to attempt something like that, but the results, as I see it from here, would be very uncertain as to whether you could accomplish much or not. It would be a matter of just a few months

within which you could make it effective or not. It would not extend over a period of 3 months, and of course you would disturb the output of power.

"Senator HAYDEN. I ask these questions because it has been suggested that the American Government has entirely within its own control, by reason of Federal irrigation works, the development that would take place in Mexico, and that we possess physically the means of compelling them not to use water. It seemed to me, on the very face of it, that it is not practical.

"There is another matter that I was interested in that I would like to ask you about, and I think that will be all. That is the question of return flow to the Colorado River from central Arizona. Just to take a hypothetical case, suppose that a million acre-feet of water were diverted from the main stream of the Colorado River and taken over into central Arizona. We are now using 1,300,000 or 1,500,000 acre-feet and we added another million acre-feet to it. My rule of thumb has been that of any quantity of water applied to land can get about one-fifth of it back as return flow. I do not know whether that is a good rule or not. If we took a million acre-feet of water, certainly if it were used near the Colorado River that would be about 200,000 acre-feet of return flow.

"Mr. BASHORE. That would not be a bad guess, Senator.

"Senator HAYDEN. In the event that 1,000,000 acre-feet of water was taken to the interior of Arizona, some 150 or 200 miles from the Colorado River, how much do you think would get back to that river?

"Mr. BASHORE. That is very problematical, Senator. That question is very difficult to answer for this reason. I do not know today where Arizona will decide to use her allocations from the Colorado. She may take them in central Arizona; she may take them down from Imperial Dam into the Gila area, or she may decide to divide it up. It depends, also, on whether Arizona ever gets around to the point of enacting an underground water code for the reuse in connection with irrigation in central Arizona. With all those uncertainties, it is very difficult to answer your question definitely. It all depends on where the water is diverted, because Arizona will have a tendency to pump this water and repump it, and water brought into central Arizona will be expensive, and I can hardly conceive of people using the water very many times if it is heavily impregnated with salts.

"Senator HAYDEN. Do you think there would be some quantity returned to the Colorado River?

"Mr. BASHORE. Oh, yes; unquestionably.

"Senator HAYDEN. But it would be a type of water, because of its alkali and salt content, that would not be good to use in Arizona?

"Mr. BASHORE. That is a possibility. I am not so sure about that. If the water is diverted and used on the Gila it might be entirely possible to have very good water returning to the Colorado, because there would not be the opportunity there for repumping and reuse lower down on the project.

"Senator HAYDEN. My hypothetical question was that if we take a million acre-feet out of the river and apply it to lands in central Arizona, where the use would be at least 150 miles from the Colorado River, do you think much of it would get back to the river?

"Mr. BASHORE. Yes; I think there would be considerable that would get back to the river. Even so, assuming that you have an underground water code and people are not going to pump water unless it is pretty good water, it would be water that would be usable, but it would be water that a man could not afford to spend a lot of money pumping and also pay for his part of the diversion into central Arizona."

Senator Downey attempted to have Mr. Bashore recant on his statement that Mexico could be prevented from receiving the amount of water scheduled under the proposed treaty only at severe disturbance of power production in the United States. After several pages of questions and answers, Senator Downey settled for this statement (p. 1693):

"Senator DOWNEY . . . Let me ask you this. Rather than attempt to do something of this kind (by manipulation of storage, reduce the summer stream flow to Mexico) if this treaty is not made, do you think we should allow Mexico to build up an alleged right there for three or four or five or six million acre-feet?

"Mr. BASHORE. Absolutely not. I am certainly opposed to that."

Senator Downey then produced a table prepared by the Colorado River Board of California using estimates of streamflow prepared by the Bureau of Reclamation. The import of the table was to show that with the Mexican burden there would be an overdraft on the Colorado River of 1,000,000 acre-feet or 2,000,000 acre-feet if California's junior priorities were counted. Mr. Bashore agreed that the figures presented led to that conclusion but he requested Mr. Riter to answer for him. The following exchange then took place at pages 1697 and 1698:

"Senator DOWNEY. I would like to have him answer the first question. Is it not true that in the dry cycles the average flow over a 10-year period was only about 12,000,000 acre-feet?

"Mr. RITER. At Lee Ferry; yes, sir.

"Senator WILEY. Let us start with the proposition of a period of 7 years with an average flow of 12,000,000 acre-feet. In the previous 7-year period you might have 17,000,000 acre-feet if you are going to let it all down, but you are accumulating it. What effect will the accumulation of water back of the dams have on the ability to see that not only 8,500,000 acre-feet but an additional 2,000,000 acre-feet is available ?

"Mr. RITER. May I answer it this way---your question has several elements. First, as to the effect of reservoirs, we will attempt, in developing plans for the utilization of the waters of the Colorado River, to equate the flow. In other words, we will attempt to approach the average. Testimony has been presented already, both by Mr. Elder from California and by Mr. Tipton representing the Six State Committee, which shows that we will need in the neighborhood of 50 to 60 million acre-feet of storage capacity on the stream to completely level out the dry years and the wet years.

"Senator WILEY. How much do you have now?

"Mr. RITER. Boulder Dam has an active capacity of 20,000,000 acre-feet. There are about 4,000,000 acre-feet in the Salt and Gila Rivers and their tributaries. We have projected plans and made studies of additional reservoirs upstream from Boulder Dam which will ultimately help to equate the stream flow.

"Senator WILEY When you say 'equate', let me understand you. You mean there will be available then, under these figures not simply 8,500,000 acre-feet in this period that Senator Downey is talking about but in the neighborhood of 10,500,000 acre-feet.

"Mr. RITER No, sir. The average virgin flow of the stream at the international boundary is 17,750,000 acre-feet. If you allow for the use of the upper basin an average of 7 1/2 million acre-feet, that will leave available a virgin supply to the lower basin and to Mexico of something over 10,300,000 acre-feet--10,300,000 acre-feet. The lower basin is given the right to deplete the flow of the system 8 1/2 million acre-feet. If we deduct that, then that will leave a surplus of about 2,000,000 acre-feet, of which Mexico is being granted under this treaty 1 1/2 million acre-feet, leaving a small surplus.

"But to answer the question of Senator Downey, the basic figures of 8,500,000 acre-feet come from a study we made in determining the power possibilities at Bullshead Reservoir, which is Davis Dam, located immediately below Boulder. That was projected to reflect the conditions as of 1985 and does not reflect the ultimate conditions of the river when the full upstream use will be made in the upper basin.

"I would like to call attention also to these contracts which total 9,962,000 acre-feet. If we cut California back to her firm right of 4,400,000 acre-feet, the contracts will then total 7,500,000 acre-feet. Then if we add a million and a half for Mexico, that will be 8,500,000 acre-feet.

"Now, I would like to call attention to several things. Those contracts are for the use of water in the lower basin. The Nevada use is not going to be below Boulder Dam. A large part of it will be for uses on the tributaries. Part of that contract should be applied to the tributaries above Boulder Dam and should not be applied to water coming out of Boulder Dam.

"This is one of those questions that Mr. Bashore says we cannot interpret under the compact. In Boulder Canyon reservoirs there is some 600,000 acre-feet of evaporation loss that has not been accounted for. I do not know, gentlemen, how it is going to be charged. That is a matter which the States will have to decide. By the time we allow for this factor and for other possible uses--for instance, uses in Arizona on the Little Colorado--a considerable amount of water, under the contracts is consumed above Boulder Dam. Arizona will also use some water out of the Virgin River.

"Under the Arizona contract the amount of water used above Boulder Dam will be charged against her contract.

"So, therefore, I say, that the statement, with all due respect, is a little bit misleading, in that it assumes that the demands of water contracts will be applied entirely below Boulder Dam. There are to be some figures subtracted from this before it gets down to meet the 8,500,000 acre-feet. The exact amount I am not prepared to give you. I do not know, frankly, because that is an interpretation of the compact that has never been made. It is an interpretation that will have to be made by the States."

At page 1700 Senator Downey and Mr. Riter have an interesting exchange concerning evaporation from reservoirs:

"Senator DOWNEY. How much in the figures you gave Senator Wiley did you deduct because of evaporation in those reservoirs?

"Mr. RITER. I assume, sir, that the evaporation in the upper basin reservoirs would be part of the 7,500,000 acre-feet of depletion in the upper basin.

"Senator DOWNEY. You have not answered my question. How much actual physical evaporation do you count on in those figures that you gave Senator Wiley of the reservoirs you intend to construct in the upper basin in acre-feet?

"Mr. RITER. As I remember our figures, sir, it is in the neighborhood of 800,000 acre-feet.

"Senator DOWNEY. That 800,000 acre-feet has to come out of your maximum flow, does it not?

"Mr. RITER. I assume it would come out of the 7,500,000 acre-feet.

"Senator DOWNEY. You are going to charge the upper basin States with the evaporation in the upper basin of 800,000 acre-feet?

"Mr. RITER. If that is finally agreed to by the States.

"Senator DOWNEY. I assume we have got to stand our proportionate part of the evaporation in Lake Mead and the other reservoirs. The compact seems very plain to us. This plan of yours would immediately reduce the consumptive use in the upper basin of 7,500,000 acre-feet by 800,000 acre-feet?

"Mr. RITER. No. Evaporation loss is one element of consumptive use. I think the upper basin understands that. That has been explained to them, and I think they understand it and have agreed to it."

For several pages there is a conversation by the Senators with Mr. Riter in which it is pointed out that if all development takes place in both the Upper and Lower Basins as contemplated there is not enough water in the river. Mr. Riter expresses it this way:

"There is not enough water to meet everybody's desires. I have preached that to these seven States." (p. 1716)

The Senators then entertained some speculation as to the possibility of bringing into the Colorado River Basin surplus waters of the Columbia River system.

With this background, we turn now to the debates on the floor of the Senate when the Treaty was before that body for ratification. (Note: Until otherwise indicated, all page references hereinafter noted shall be to Volume 91, Congressional Record, 79th Congress, 1st Session.)

Senator Connally, the Chairman of the Foreign Relations Committee, introduced the treaty to the Senate. After his opening remarks he and Senator Downey have an exchange wherein Senator Connally states the opinion of the proponents as to the need for the treaty. The following takes place at page 2337:

"Mr. CONNALLY. . . . Boulder Dam is there. Regardless of its effect, or who built it originally, there now goes down the Colorado

River to the sea 10,000,000 acre-feet of water. My claim is that without this treaty Mexico may, if she can provide the facilities, employ that additional water for the expansion of agriculture and irrigation within her own boundaries, and no one can deny her that right or power. If she does that, she will create an equitable claim, at least, an equitable claim under the doctrine of prior appropriation, that she is entitled to continue the use of the water. That exact doctrine is laid down and approved in the making of treaties respecting waters of an international character.

"Mr. DOWNEY. If the Senator will yeild further, I will ask him if it was not the contention of the opponents of the treaty that Mexico can only divert and use this water in the way the Senator has indicated if the treaty is made effective, and gives Mexico the right to use diversions, structures, ditches, and dams, in the United States, which otherwise she could not use?

"Mr. CONNALLY. I did not so understand the testimony. It was contended by the opponents of the treaty that she was not capable of diverting water from the Colorado River because of the difficulty of terrain which might make it difficult to build dams. But the testimony in that respect was conflicting. I am not trying to indicate what particular works she should construct. All I am saying is that the water is there, the water goes down that river, and if she can get it without a treaty it is no one's business, and she can do what she feels like doing with it."

Senator Downey many times expressed the position that the opponents were in favor of granting to Mexico the amount of water which she was using prior to Boulder Dam. At page 2808 Senator Downey defines this as 600,000 acre-feet per year by saying:

"We in California do not claim, as a matter of equity, that the building of a dam would give us the moral right to take away from Mexico the water she was using before the dam was built. As a matter of equity and moral right, Mexico is entitled to continue to have come to her that which she was using prior to the building of the dam, which was an average of 600,000 acre-feet."

Senator Downey continues at page 2816 with an explanation of why the proponents' arguments of the need for a treaty at the time was, in his opinion, erroneous. Through an exchange with Senator Fulbright, he explains some of the background of prior negotiations with Mexico as follows:

"Mr. DOWNEY . . .

"We Americans are rather naive. We are credulous, so far as our own rights are concerned. The arguments which were stated by the chairman of the Foreign Relations Committee were the arguments principally relied on by witnesses for the State Department, in urging this treaty. If we were American businessmen or lawyers, and not naive, but thinking in terms of practical common sense, we would immediately say 'If Mexico now has it within her power, for the next 25, 50, or 100 years to use 5,000,000 or 10,000,000 acre-feet of water, worth billions of dollars, why does she not use that water to build up her right so that she can make whatever maximum claim she may wish to make, in the future?'

"Mr. President, I have already said that the record before the Foreign Relations Committee is full of inaccuracies and misstatements, far beyond anything I have ever experienced. Here again we find the whole statement of facts erroneous. It is not only 100 percent wrong, but the direct opposite is true.

"I spent 2 weeks on the delta of the Colorado River and on the facilities in the United States, by which Mexico now principally uses her water. I say to the Senate--and I challenge investigation of the statement--that Mexico cannot build up any additional use of water without this treaty. She cannot even use what she is now using without our facilities in this country--our diversion ditches, dams, and reservoirs. If Mexico could, for an almost unlimited time, use many times 1,500,000 acre-feet, and by that use establish a strong right to that amount forever, would she be here, sacrificing her interests? Of course, she would not. Nor would the chairman of the Foreign Relations Committee urge upon the Senate that we make this treaty as a favor to Mexico. If the facts are as alleged, Mexico is making a most improvident treaty, against which she should be protected.

"Mr. FULBRIGHT. Mr. President, will the Senator yield?

"Mr. DOWNEY. I yield.

"Mr. FULBRIGHT. I should like to get a little information about the prior negotiations in connection with this treaty. I believe that in 1927 or 1928 Mexico demanded 3,600,000 acre-feet as her share, and we offered approximately 1,000,000.

"Mr. DOWNEY. We offered approximately 750,000.

"Mr. FULBRIGHT. The digest states that there was also a suggested recognitiion of 250,000 to 300,000 acre-feet to compensate for loss in the main channel. The digest states that we offered approximately 1,000,000 acre-feet. At that time Mexico wanted 3,600,000 acre-feet and apparently we offered approximately 1,000,000. Is that correct?

"Mr. DOWNEY. No; again the digest is erroneous. What is referred to there is what is known as the Mead offer. The Mead offer proposed to give Mexico 750,000 acre-feet of water, with only a possibility of adding to that the amount of water necessary to take that 750,000 acre-feet from the

river, through the main canal, to the head of the laterals. The testimony of the engineer who managed the system to the effect that the additional amount would be less than 10 percent. The written records of the Mead committee are plain and unequivocal, to the effect that the Mead offer was 750,000 acre-feet plus perhaps 10 percent, or 75,000 acre-feet in addition.

"Mr. FULBRIGHT. It is true, is it not, that Mexico thought she was entitled to 3,600,000 acre-feet at that time?

"Mr. DOWNEY. Up to the time the All-American Canal was built, Mexico was claiming 3,600,000 acre-feet. I shall be glad to explain to the Senator, and to the Senate, upon what Mexico based that claim.

"When we originally irrigated the lands in the Imperial Valley in the United States, we were compelled to take our ditch through Mexico. As a condition for permitting this, Mexico demanded of us the right to take one-half of whatever water was carried through that ditch. The ditch had a capacity of 10,000 second-feet of water.

"Mr. FULBRIGHT. What does that represent in acre- feet?

"Mr. DOWNEY. One second-foot of water flowing for 24 hours makes two acre-feet. Five thousand second-feet of water would represent 10,000 acre-feet a day, or 3,600,000 acre-feet a year; but there was never that amount of water taken through the canal. Only a small fraction of it went through the canal, because the water simply was not there. The maximum which Mexico ever got out of that contract was 750,000 acre-feet of water in 1 year. But Mexico continued to hope that the United States might spend hundreds of millions of dollars on our streams, thereby making it possible to take 10,000 second-feet of water through the ditch into Mexico. She would then be able to claim half that water. So long as Mexico felt that she had a strangle hold on the people of the United States, because our ditch happened to go through Mexico, she made the claim of 3,600,000 acre-feet.

"But our American farmers threw off that parasitical burden, that servitude to Mexico. We built the All-American Canal, which runs entirely through American soil, and thus we were under no obligation to give to Mexico any water out of the All-American Canal.

"Consequently, Mexico immediately realized that she had lost her hold on us. Since that time, she has been anxiously determined to make some treaty, because from now on Mexico can do substantially no irrigation without the use of our reservoirs, our dikes, ditches, and diversion facilities in the United States. If we do not make this treaty, and if we do not wish to go out of our way to help Mexico use our facilities, built at our expense, next summer she will have a crop failure."

Senator Millikin, the main spokesman in favor of the treaty as it pertained to the Colorado River, answered Senator Downey's arguments on the Senate floor by presenting estimates of use of Colorado River water in Mexico on page 2827 as follows:

"Mr. MILLIKIN. Mr. President, I should like to discuss briefly the present use in Mexico of water from the Colorado River. The treaty, as will be recalled, provides for an allocation to Mexico of 1,500,000 acre-feet per annum, with provision for a possible additional amount of 200,000 acre-feet.

"Yesterday the distinguished junior senator from California (Mr. Downey) told us that in 1943 there had been diverted through the Alamo Canal and in 1944, partially through the Alamo Canal and partially through the All-American Canal, for Mexican use, 1,180,000 acre-feet.

"By checking in Mexico through investigations conducted by the Boundary Commission and through the interpretation of photographs, it is the opinion of those who have negotiated the pending treaty for us that this diversion of 1,180,000 acre-feet was to service approximately 190,000 acres of land. That establishes a water requirement per acre in that part of Mexico for the use to which the water is put of approximately 6 acre-feet per acre.

"Likewise, investigations and photographs in Mexico have shown that about 95,000 acres of additional Mexican lands were serviced by pumping from the Colorado River in Mexico. Assuming the same water requirement per acre--and I know of no reason why the assumption is not valid--this would equal 570,000 acre-feet. The total of those two figures would be 1,750,000 acre-feet of water from the Colorado River used in 1943 and 1944 in Mexico. As I have said, the figure which has been officially declared to be the use by the proponents of the treaty is 1,800,000 acre-feet. The disparity is immaterial.

"The Mexican section of the International Water Commission at a meeting on August 29, 1929, reported that there are 1,500,000 acres of irrigable land in Mexico which could be watered from the Colorado River with pumping lifts no greater than 80 feet. I have seen figures of irrigable acreage in Mexico which ranged from 1,000,000 acres to 1,500,000 acres. If we apply that service charge of 6 acre-feet of water per irrigated acre to the available irrigable land down there, it can be seen that Mexico could expand her use to four or five or six million acre-feet a year. The point to remember now is that Mexico is expanding her use and is enabled to do so because she now has a regulated stream from which she can obtain a regulated supply."

The Senator then describes the works on the Colorado River which perform the functions of storage, regulating and power generating. He then continues to explain the need for a treaty in the following language at page 2828:

"Mr. MILLIKIN. Exactly. The Davis Dam on this stream, to which I have been referring, has interest also because it refutes the talk we have been hearing again and again that Mexico or someone is claiming the right to stored waters behind Boulder Dam. The Mexican right, as it is established in this treaty, could be supplied completely from Davis Dam if Boulder Dam did not exist.

"Mr. President, that is the present status of the regulating and the storage and the power-generating works in that part of the Colorado River in which we are interested. It will have been observed that all that is in the lower basin of the Colorado River. Under the treaty the upper-basin States are required to deliver to the lower basin an average of 75,000,000 acre-feet of water in progressive 10-year series, and the works we have been discussing will take that water and process it and regulate it for all of its intended uses.

"The upper-basin States also have their reservoir problems. We must get reservoirs up there. I have seen one estimate that if we can secure 20,000,000 acre-feet of storage in the upper basin, this, together with that which is now in the lower basin, or which has been authorized and appropriated for there, we will have an equated stream. That is to say, we will then have a stream reflecting its long-term average flow. The droughts and the floods will be smoothed out. I have seen estimates that it would take perhaps 30,000,000 acre-feet of storage in the upper basin. But whatever it takes I think it is inevitable that we will get it.

"There are varying estimates as to what the stream will do 40 or 50 years from now. I have heard it estimated that the stream is good for 16,000,000 acre-feet. I have heard it estimated that it is good for 18,000,000 or 18,500,000 acre-feet. Not until we get far along toward complete use on this side of the line, many years distant, if then, will we have any problem as to supplying Mexico with a million and a half acre-feet of water.

"Mr. AUSTIN. Mr. President, will the Senator yield?

"Mr. MILLIKIN. I am glad to yield to the Senator from Vermont.

"Mr. AUSTIN. Is it the Senator's opinion that these works which would tend to attain that objective will not be undertaken unless we settle the question with Mexico?

"Mr. MILLIKIN. I thank the Senator for his question. I was just coming to that. We cannot achieve our development in the upper basin, to which we are entitled, and on which our whole economic life hangs, because we cannot put up those reservoirs and regulating works until we know how much water we have to process in them. We cannot know this until Mexico's share of the river has been decided.

"These plants are not built for a day. They are not built for a month or a short period of years. They are built just as the treaty is built--in perpetuity. They require huge investments. You cannot put the money into such projects on uncertain prospects. These works are necessary to

the full development of the upper basin. They are necessary to the full development of the lower basin. In the absence of a treaty there is the possibility that Mexico by arbitration might receive more than one and a half million acre-feet--might receive a much larger amount. Mexico has strenuously insisted in the negotiations on receiving 3,800,000 acre-feet. At times she has presented figures based upon available acreage for irrigation that would have raised her considerably beyond that figure. Mexico would go into an arbitration with strong claims."

At pages 3094 and 3095 Senator Millikin presents figures to show the drainage area of the Colorado River by States, the percentage contribution to the Virgin flow at the boundary by States, and the acreage irrigated in each State by Colorado River water. Senator Downey argues with Senator Millikin as to the uses of water in Mexico and the extent of canal losses on the Mead offer on pages 3096 and 3098.

Starting on page 3156, Senator Downey asserts that because of the distance from Boulder Dam to the Boundary the cost to the United States as proposed by the treaty is not just 1,500,000 acre-feet but 2,000,000 acre-feet. He also seems to argue that the treaty guarantees an instantaneous flow to Mexico as follows:

"Mr. President, at some later stage of this debate I will show clearly, and it cannot be denied, that, even under the interpretation placed upon the treaty by the State Department, the treaty will cost us not 1,500,000 acre-feet of water but 2,500,000 acre-feet of water. On the basis of the interpretation heretofore made by the State Department, and on a possible and a probable future interpretation it might cost us twice that amount.

"Let me very briefly show why that is true. It is 300 long, hot, arid miles from Lake Mead, which we have built, down to the Mexican border. If it were desired to bring 1,500,000 acre-feet of water from Lake Mead down to the Mexican border--and I think the evidence is undisputed on this point--it would be necessary to let out of that reservoir close to 2,000,000 acre-feet of water, because the water must move over 300 hot miles with consequent evaporation and seepage.

"I wish to correct that statement a trifle. The treaty provides not for 1,500,000 acre-feet but for 1,700,000 acre-feet under certain conditions. That 200,000 acre-feet will probably only be delivered about 75 percent of the time. So the treaty provides for an average allotment

of 1,650,000 acre-feet. One could not hope to get 1,650,000 acre-feet of water down to the Mexican border without letting out of Lake Mead or Davis Reservoir over 2,000,000 acre-feet of water. If the treaty is ratified, then, when the day of reckoning comes around, the upper basin States and the lower basin States will begin to understand into what a noose they have placed their necks.

"The treaty does something else. It guarantees the delivery of 1,500,000 acre-feet of water according to schedules that Mexico is to serve upon us, and under those schedules Mexico may say to the United States: 'During the month of July we want flowing down to us constantly 600 second-feet.' Senators understand that a second-foot is a measure of rate of flow, and an acre-foot a measure of volume. Six hundred second-feet flowing for 24 hours, will produce 1,200 acre-feet. So we are placing ourselves in a situation where we are going to do something for Mexico which we would not do for any of our States or for any person. We are going to guarantee the delivery of not less than 600 second-feet of water.

"Mr. President, suppose we deliver only 550 second-feet or 570 or 590 second-feet, we will clearly have breached our agreement with Mexico. We can very readily give to Mexico far more than the 600 second-feet. We will not dare to give her less or we will be liable in damages, and we should be.

"Mr. President, if we are improvident enough to assume this type of obligation and impress this servitude upon our reservoirs, in favor of a country which did nothing to develop them, we ought to be prepared to pay the bill.

"Let us see what the result will be. It is admitted that, in addition to losses by evaporation and seepage, which would amount to in excess of 15 percent in that long river flow, we will have another substantial loss. I should like to have the Senate understand that it is 300 long miles from Lake Mead, where the water will be stored and let out to Mexico, down to the Mexican border. To hear distinguished Senators argue, and to hear engineers who appeared on behalf of the State Department before the committee in favor of the treaty, one would think it would be very easy to draw 600 second-feet of water out of Lake Mead and let it flow down into Mexico.

"Mr. President, that water, after it leaves Lake Mead, will traverse 300 miles. It will take 4 days to make the journey. No engineering skill can judge within 15 percent the volume of water which is required to produce a given amount of water when it is let out of Lake Mead and measured down at the Mexican border. Why is that? A second-foot of water is a cubic foot of water passing a point each second of time. The rate of flow is a most important factor. If we have a heavy wind blowing down the Colorado River, the water may move 20 percent faster than if we have a heavy wind blowing up the Colorado River. Heat or cold

makes a difference in the movement of the water. In addition, no one can say whether there will be 2, 3, or 5 percent of water wasted at the various head gates and diversion dams before it reaches Mexico. The undisputed engineering testimony is that we must allow, for the Mexican use, at least 15 percent, for the balancing and regulation feature alone, above what we grant. If we must start 2,000,000 acre-feet of water down that river in order to overcome seepage and evaporation, we must add at least another 300,000 acre-feet as a regulatory factor. If we were dealing with our own citizens, the contract would provide, for example, 600 second-feet, more or less, provided that over the course of a month it must balance. But that is not this treaty. We are proposing to commit ourselves, by a guaranteed right, supported by the national honor, to deliver this water according to schedule. Senators will find that provision in article 15. If during a certain month Mexico should call for a rate of flow--and it is in the singular and not in the plural--of 500 or 600 second-feet, we would be required to deliver it, or Mexico's crops would be damaged.

"Let us stop talking about the cost of this guaranty as being 1,500,000 acre-feet. Any prudent businessman, engineer, or lawyer--and I hope, ultimately, prudent Senators--will come to realize that it is not 1,500,000. It is 1,500,000 plus, tentatively, 200,000 plus evaporation and seepage losses, in a hot country, along 300 miles of river, plus the amount necessary to assure the fulfillment of our guaranty. The figure might easily reach 2,500,000 acre-feet."

Senator Smith of New Jersey had written to former President Herbert Hoover requesting that Mr. Hoover comment on certain matters regarding the treaty. Senator Smith then requested Senator Millikin to comment on Mr. Hoover's answering letter. The portions of the letter pertaining directly to water supply are, as found on page 3177:

"My Dear Senator: I have your letter inquiring for my answer to the statement:

"The consensus of engineers now is that the average virgin run-off of the Colorado River Basin is approximately 18,000,000 acre-feet, leaving a surplus of 2,000,000 acre-feet per year.

"The following are the answers to these assertions:

"1. THE FALLACY OF 'LONG-TERM AVERAGES'

"The figure of 18,000,000 acre-feet given you represents an average of 48 years. It is impossible to irrigate on long-term averages. The quantity available for irrigation during a drought period is dependent upon the quantity which it is practicable to carry over from flood years

in reservoirs, and this is limited as to quantity and time because of annual evaporation losses from the reservoirs. In the period covered by accurate records, 1897 to 1944, the flow in about half of the 48 years was subnormal. Some of the recurring droughts of that period lasted 10 years or more.

"The average virgin run-off of the entire system from 1897 to 1944, inclusive, including the waters of the Gila River and its tributaries, was 17,800,000 acre-feet, but of this 1,300,000 acre-feet represented the flow of the Gila River and its tributaries, reaching the main stream in a state of nature, all of which flow of the Gila River is currently utilized and virtually noneof which reaches the main stream. I am advised that the average of 1931-40, comparable to the figure of 18,000,000 acre-feet given you was less than 13,000,000 acre-feet, and that the flow of the entire system for the year 1934, for example, was only about 5,000,000.

"2. RETURN FLOW

"Reliance on return flow as a source from which the guaranty to Mexico would be made good is fallacious. The Colorado River compact allocates 'beneficial consumptive use.' Consumptive use, in general, as the treaty recognizes, is the diversion less the return to the river. If, as proponents of the treaty say, 900,000 acre-feet would be available in return flow from American projects, Arizona or the other States furnishing that return flow would be entitled, under the Colorado River compact, to increase diversions of fresh water by that quantity. Return flow is not some new source found outside of the Colorado River compact."

Senator Millikin comments on the above as follows (pp. 3177-3178):

"1. In this section Mr. Hoover discusses what he terms the fallacy of long-term averages. Studies by engineers of the United States Bureau of Reclamation and by other engineers indicate that sufficient storage can and will be provided on the Colorado River fully to equate the flow of the stream to the so-called long-term average. Mr. Hoover states that from 1897 to 1944 about one-half of the years was subnormal. This can be expected. When dealing with a series of data and the averages thereof it can be assumed that approximately one-half of the series will be above normal and one-half will be below normal.

"Mr. Hoover mentions that as a part of the long-term estimate of 17,800,000 acre-feet as the virgin run-off of the entire river system, there is included 1,300,000 acre-feet of the flow of the Gila River and its tributaries reaching the stream in the state of nature. He then states that all of the Gila River water is currently utilized and virtually none of it reaches the main stream. This is true, but the consumption that takes place on the Gila River is a charge against the allocation of 16,000,000 acre-feet made to the upper and lower basins by the Colorado

River compact. The virgin flow of the Gila River, therefore, should be included as a part of the total virgin flow of the Colorado River system. It is true that during the 10-year period 1931-40, the virgin flow at Lee Ferry was something less than 13,000,000 acre-feet and that for the year 1934 at Lee Ferry it was only about 5,000,000 acre-feet. However, again it must be stated that sufficient reservoirs will be available to equate the flow of the stream to the long-term average.

"2. Mr. Hoover states that reliance on return flow as a source from which the guaranty to Mexico would be made good is fallacious. It is understood that return flow reaching the river below Imperial Dam, estimated at upward of 900,000 acre-feet, will not be used in the United States and will go to Mexico in any event. In the recent negotiations Mexico demanded a delivery of 2,000,000 acre-feet to the Alamo Canal by way of the All-American Canal. Under such an arrangement Mexico would have received the return flow reaching the river below Imperial Dam and would not have been charged with it. Officials of the Imperial Irrigation District from time to time have suggested that all deliveries to Mexico be made through the All-American Canal. In this case Mexico would receive the return flow without the United States receiving credit for it. Therefore, reliance on return flow as a source from which the guaranty to Mexico will be made under the treaty is not fallacious."

On page 3278 Senator Connally introduced the resolution of ratification together with certain reservations of understanding as to the treaty. The reservations of concern to us in this section are numbered (j) and (k) and were worded as follows:

~~"(j) That the quantities of 1,500,000 acre-feet and 1,700,000~~ acre-feet of water referred to in subparagraph (b) of article 10, and in paragraph E of article 15, of the treaty, include, and are not in addition to, the quantity of 1,500,000 acre-feet of water, the delivery of which is guaranteed under subparagraph (a) of article 10.

"(k) The United States recognizes a duty to require that the protective structures to be constructed under article 12, paragraph (a), of this treaty, are so constructed, operated, and maintained as to adequately prevent damage to property and lands within the United States from the construction and operation of the diversion structure referred to in said paragraph."

Reservation (j) settled definitely the "ambiguity" in wording of article 10 (a) and (b) and in article 15 by making it plain that the quantities were not cumulative.

In other words, that Mexico was to get as a total quantity under the treaty 1,500,000 acre-feet of water per annum, except in special instances when there was surplus water and in that instance Mexico was to get a total quantity of only 1,700,000 acre-feet of water. Reservation (k) provided that the United States would assure itself that any structures built under article 12 (a) of the treaty, would properly protect any property in the United States.

On page 3291 Senator Murdock on behalf of himself and Senators O'Mahoney and McFarland offered as a substitute for the above quoted reservation (j) the following language:

> "(j) That the 1,700,000 acre-feet specified in paragraph (b) of article 10 includes and is not in addition to the 1,500,000 acre-feet, the delivery of which to Mexico is guaranteed in subparagraph (a) of article 10; second, that the 1,500,000 acre-feet specified in three places in said subparagraph (b) is identical with the 1,500,000 acre-feet specified in said subparagraph (a); third, that any use by Mexico under said subparagraph (b) of quantities of water arriving at the Mexican points of diversion in excess of said 1,500,000 acre-feet shall not give rise to any future claim of right by Mexico in excess of said guaranteed quantity of 1,500,000 acre-feet of water."

Senator Connally accepted the amendment to reservation (j) on behalf of the Committee. Senator Murdock explained the purpose of his substitute language on page 3291 as follows:

> "Mr. MURDOCK. Mr. President, my purpose in offering the substitute for reservation (j) submitted by the committee is to resolve a very genuine and sincere doubt in my mind, in which doubt I am joined by other Senators, as to the language contained in article 10 of the treaty which allots water to Mexico from the Colorado River. Yesterday I made a statement to the subcommittee which was considering these matters for the Committee on Foreign Relations, and presented my reservation. I believe that the language of the substitute offered by me clarifies beyond question the meaning and intent of the language of article 10. In my opinion, the most important parts of the treaty with Mexico, as it involves the Colorado River, is the question of quantity.

"Having that language fully clarified to my satisfaction and to the satisfaction of the junior Senator from Arizona (Mr. McFarland) and the senior Senator from Wyoming (Mr. O'Mahoney), it is my intention now to vote for the ratification of the treaty."

Immediately following the explanation the Senate agreed to the revised reservation (j). Because Senator Downey modified the language of the resolution introducing all reservations (p. 3367) the Senate again agreed to reservation (j) on page 3382.

Senator McFarland, a proponent of the treaty, spoke in support of consent using water supply as a basis of his support. His major speech begins on page 3298:

"Mr. McFARLAND. Mr. President, I believe that no State in the Colorado River Basin is more vitally affected by the Mexican Water Treaty than Arizona. We in Arizona have a high appreciation of the value of water and its proper and conservative use. I do not believe there is a State in the Union which has produced more with the amount of water available than has Arizona. With an average annual run-off of little more than a million and a half acre-feet in the Gila and Salt Rivers, Arizona citizens have placed into cultivation approximately 750,000 acres of land and have made the barren desert one of the garden spots of the world. In addition, Arizona has irrigated approximately 60,000 acres in the original Yuma project from the Colorado River and some other small areas along the Colorado River."

After presenting a resume' of Arizona's water development history and emphasizing that Arizona has the largest area within the Colorado River Basin, the Senator continues on pages 3299, 3300, and 3301:

"However, I am sure that we can at least agree upon this much, that the lower-basin States lose more from the allocation of water to Mexico under this treaty than do the upper-basin States. The reason is simply that under the Colorado River compact the amount of water allocated to Mexico under this treaty must first be supplied from the surplus waters, and then, if there is any deficit in the allocation, the deficit would have to be made up equally by the upper and lower-basin States. But the surplus water from which Mexico is to receive her allocation is water for which Arizona,

California, and Nevada have a contract; Arizona has a contract for 2,800,000 acre-feet of 3-A water, plus one-half of the surplus water less one-twenty-fifth which is contracted for by the State of Nevada; California has contracts for 5,362,000 acre-feet--4,400,000 acre-feet of 3-A water and 962,000 acre-feet of the surplus water, which I understand is estimated to be California's half of the surplus as provided for under the Boulder Canyon Project Act and the California Exclusion Act. The important thing is that these surplus waters which will have to be used under the compact to supply Mexico with whatever amount may be granted her, are waters which California and Arizona have expected to use.

"According to the testimony of the Government engineers, the surplus will be adequate to supply the water guaranteed under the Mexican Treaty. So it is perfectly natural that the upper basin States would be easier to satisfy with the Mexican Treaty than are the lower basin States. After all, if the engineers are correct, the upper basin States will not lose any water by the treaty, while the lower basin States stand to lose vast amounts of water.

"Mr. Harry W. Bashore, Commissioner of the Bureau of Reclamation, testified with respect to the records of the flow of the river since 1897, and stated that the average original flow at the international boundary is approximately 17,750,000 acre-feet. As agricultural and economic developments in the Colorado Basin area increased and with future developments projects, conflicts arose between the affected States as to the proper division of the waters of the Colorado River. It was these conflicts that brought about the signing of the Colorado River compact in 1922. By this agreement 7,500,000 acre-feet were apportioned permanently to the upper basin area above Lees Ferry, a point on the river near the Utah border, and 7,500,000 acre-feet were apportioned to the lower basin States. In addition, however, the lower basin States were given the right to increase their use by 1,000,000 acre-feet annually. This was done to reciprocate for the flow of the Gila River system in Arizona, representing approximately the amount of the water delivered by the Gila River and its tributaries to the Colorado. So the original allocation of water by the compact amounted to 16,000,000 acre-feet.

"This proposed Mexican Treaty would give Mexico the right to use 1,500,000 acre-feet of water, which would, under Mr. Bashore's figures, practically complete the allocation of all the waters of the Colorado River. The engineers' figures may vary a little as to estimates of water available. But, if we accept Mr. Bashore's figures, California cannot expect more than the original 4,400,000 acre-feet of consumptive use, nor Arizona more than 2,800,000 acre-feet of consumptive use, plus the waters in the Gila River system, and when we view the immediate and prospective needs of central Arizona to supplement the water supply for the lands already in cultivation and hundreds of thousands of acres of additional lands which could be placed into cultivation, it must be clear why the citizens of Arizona are seriously concerned.

"Of course, some of the engineers, including Mr. Tipton, estimate there will be some surplus. We in Arizona certainly hope so, because I believe it is obvious that the 2,800,000 acre-feet of water allocated to us will not begin to meet the needs of Arizona. This much is clear and beyond dispute--if there is to be a surplus it will be small indeed. Therefore, to be completely realistic and practical, we should in our consideration of the treaty and its effect on the States of the Colorado Basin, accept the concensus that whatever surplus there may be will be of no material concern.

"Let us analyze the provisions of the treaty and the objections made to it to determine whether it is desirable that it be approved. I am, of course, confining my remarks to the provisions of the treaty in regard to the Colorado River, for Texas and New Mexico are in accord in their approval of the provisions as they relate to the Rio Grande River.

"Mr. President, in analyzing the proposed treaty with Mexico to determine whether the Senate should advise and consent to its ratification, it is my opinion that the first and most important question is how much water Mexico is entitled to from the Colorado River. The Foreign Relations Committee of the Senate had long and exhaustive hearings upon this subject.

"An Attorney General of the United States, Judson Harmon, in a letter in the year 1895 stated that the United States owed no obligation to a lower riparian state; that a state exercised exclusive sovereignty over the waters within its own borders. However, it was recognized by all of the witnesses in the hearing before the Foreign Relations Committee, both those opposing and supporting the treaty, that Mexico, as a matter of equity and comity, is entitled to some of the waters of the Colorado River. There were those who contended that Mexico should be limited to the maximum use before the construction of the Boulder Dam, but all agreed that the Republic of Mexico is entitled to some water.

"The question then naturally arises, if, because of comity between nations the United States must permit water to go down the Colorado River for use in Mexico, by what yardstick should we measure the waters to which Mexico is equitably entitled? Personally, I believe that in equity the proper yardstick to use is the determination of how much, under the laws of prior appropriation, the laws of the States involved, would Mexico be entitled to receive under the facts as they exist. It is, of course, admitted that this question must be settled by treaty or by arbitration.

"I will discuss the matter of arbitration a little later. It is conceded that the maximum use of water by Mexico at the time the Boulder Dam was built was 750,000 acre-feet a year, delivered at her laterals, and, I believe the testimony shows that over a period of time--the preceding years--the average was about 600,000 acre-feet. At any rate, under the law of prior appropriation, we must admit that Mexico had appropriated to beneficial use 750,000 acre-feet of water, delivered at her laterals. It is contended by some that Mexico should be limited to this amount of water under any

treaty negotiated between our respective nations. On the other hand, there was testimony to the effect that Mexico diverted and used 1,805,000 acre-feet in the year 1943. If this amount was diverted by Mexico in the year 1943, the next question is whether under the law of prior appropriation Mexico established a right to the use of this amount of water.

"The argument has been made that Mexico could not have diverted this amount of water had it not been for the building of the Boulder Dam. The Government engineers testified they could. This is an engineering question. As to the availability of water, that is also an engineering question. I would refer to the testimony of Mr. Tipton. . .

"Mr. President, the substance of Mr. Tipton's testimony is to the effect that Mexico could have diverted and carried on successful irrigation requiring the diversion of more than 1,500,000 acre-feet of water prior to the construction of Boulder Dam, with uses in the United States as they were immediately prior to Boulder. Other engineers testified there was sufficient water of the Colorado River after the building of Boulder Dam for Mexico to establish a right to 1,800,000 acre-feet in the year 1943.

"If water was available, was there anything in the building of the Boulder Dam which prevented Mexico from establishing a right to the use of this water? I do not believe that anyone would seriously contend that the building of the Boulder Dam, the Parker Dam, and even the Davis Dam, which was authorized before this treaty was negotiated, would appropriate sufficient waters to prevent lower users from establishing a definite water right to 1,800,000 acre-feet of water, even assuming that the construction of these dams carried with it an appropriation of all the waters for all of the lands for which they were intended to irrigate. This is so because of the 7,500,000 acre-feet of water allotted to the upper basin States, only 1,952,000 acre-feet have been placed to beneficial use, and when the present construction is completed for the diversion of waters in the upper basin States, the total diversion will be 2,624,000 acre-feet, which leaves a remaining amount of 4,876,000 acre-feet which no one could contend had been appropriated under the law of prior appropriation. Of course, there are plans to put these waters to beneficial use, just as we have plans to put all the water in the lower basin States to beneficial use, but Mexico was not a party in the Colorado compact and would not be bound by it. Therefore, so far as Mexico is concerned even if we conceded that the building of the lower dams was an appropriation of all of the waters to which we are entitled under the Colorado River compact, there still is not an appropriation of the balance of the waters in the upper basin States as against someone not a party to the compact.

"So I believe it is plain that if Mexico were a State in the United States, its users would have, under the doctrine of prior appropriation, established a beneficial use of this amount of water. This is on the premise that we

accept testimony of the engineers that the waters were available from the normal flow of the river, since the whole of the Colorado River has not been appropriated and put to beneficial use."

At pages 3310 and 3311 Senator McFarland reads to the Senate the figures presented by Mr. Lowry and Mr. Riter during the Committee hearings regarding return flow. These figures may be found earlier in this discussion. Senator McFarland still has some reservations about the return flow from Central Arizona.

"It should be emphasized, however, there is no return flow to the Colorado River from the central Arizona projects. The virgin flow of the Gila River at Gillespie Dam is estimated by the Reclamation Service to be 1,753,000 acre-feet. It is admitted by all that none of this water reaches the Colorado River except a little in flood flashes. We use and reuse this water and what little water is released from the Gillespie Dam is lost by evaporation and seepage.

"Testimony was also given that the records kept on the Salt River show that when we have had wet years, and even with the water which came in from rainfall below Gillespie Dam, the loss is practically 50 percent which bears out the testimony of Mr. Riter that there would be a loss of at least 50 percent if water were allowed to go on down the Gila River into the Colorado without the river being channelized. For a distance of approximately 150 miles from the Gillespie Dam to the Colorado River the water flows in a sandy river bed where there is also a large amount of evaporation, particularly in the summer months. So it is a question of how much water Arizona will want to allow to go on down the river; whether our users will prefer to use water of a little higher salt content rather than lose half of the water.

"However, this is a question for Arizona to decide. As pointed out by the engineers representing California, we may try to save some of this return flow from the lower Gila project as well as the Yuma project. But I cannot see how the other States of the basin are concerned with this problem because we in Arizona are entitled to consumptive use. Naturally if, for example, as to the 2,800,000 acre-feet, we allow 500,000 acre-feet, for example, to reach the Colorado River, we will of course divert 500,000 acre-feet more in its place."

Senator Downey interjected into the debates at this point his proposal that the Imperial Irrigation District might gather its return flow before it reaches the Salton Sea and pump the water back to the Colorado River (see page 3311).

Senator McFarland explains on page 3312 the reasons for reservation (k) as introduced earlier by Senator Connally for the Committee, as follows:

> "This brings us to the question of whether a diversion dam should be allowed to be constructed in the limitrophe section of the river.
>
> "The people of Yuma have for many years fought the building of a dam in this locality and now fear damage from seepage and flood in the event one is constructed. The treaty provides in article 12 that 'Regardless of where such diversion structure is located, there shall simultaneously be constructed such levees, interior drainage facilities and other works, or improvements to existing works, as in the opinion of the Commission shall be necessary to protect lands within the United States against damage from such floods and seepage as might result from the construction, operation, and maintenance of this diversion structure. These protective works shall be constructed, operated, and maintained at the expense of Mexico by the respective sections of the Commission, or under their supervision, each within the territory of its own country.'
>
> "With this section in the treaty coupled with the reservation which my colleague (Mr. Hayden) and I presented and which the committee has accepted providing that the United States recognizes a duty to require that the protective structures provided for under article 12, paragraph (a) be so constructed, operated, and maintained, as to adequately prevent damage to property and lands within the United States, from such construction and operation. By this reservation the Mexican Government is given notice of the dangers to property and lands in the United States from these structures. I feel the Yuma people can rely on our Government's seeing that no damage will occur. Surely we can rely on the promise of our Government."

There seemed to be no problems among the Senators regarding this reservation (k) as there was no more debate on it. The Senate agreed to reservation (k) on page 3382.

Senator Wiley throughout the hearings on the treaty maintained a seemingly critical attitude toward the treaty. A significant phase in the debates occurred when he took to the floor in favor of the treaty. In his speech, which begins at page 3313, Senator Wiley summarized in succinct form the arguments. His summary of facts pertaining to water supply is as follows on page 3314:

"(a) At present the Colorado, with the Boulder Dam, has more than sufficient water in it to take care of the present needs of the seven States.

"(b) Prior to the building of the Boulder Dam, Mexico did not put to use more than 600,000 to 700,000 acre-feet of water from the Colorado. Since the building of the dam, she has put to use approximately 1,100,000 acre-feet.

"(c) At present there flow into the Gulf of Mexico something like 10,000,000 acre-feet, wasted.

"(d) The Reclamation Department of the Government in 1922 had set up figures, which I shall quote later, showing future demands in the Colorado Valley under Government contracts and an estimate of available water supply. This would show some 2,000,000 feet shortage during dry cycles. This estimate was revamped by a witness who calculated the discrepancy at approximately 800,000 feet.

"(e) The construction of the Boulder Dam and the construction of other dams in the upper and lower basins will make it possible to equate the flow of water and, as civilization grows in the basin, to distribute the water in accordance with the Colorado compact.

"I might say that it was not contradicted that if this treaty shall become the law of the land, it will facilitate this work in the Colorado River Basin, making thousands of acres available for new settlement and the utilization of the waters of the Colorado."

Senator Wiley then proceeded to outline the merits of the treaty especially from the point of view of the United States as a whole rather than regional or State-wide interests. His statement on pages 3314-3316 is as follows:

"(c) In the Colorado River Basin, it definitely settles the meaning of the language in the Colorado compact, relating to a future treaty with Mexico. It endangers no one's water rights or possible rights for many years to come.

"(d) It will bring about quicker consummation of planned projects in the United States and that means development in certain arid sections.

* * *

"It will not in the slightest degree threaten any of the investments made by California. That is an important consideration. I have reached that conclusion after having gone into the matter. In fact, it will definitely let everyone know just where they are at. California today is only using about 2,000,000 acre-feet. Under the compact, she has a right to 4,400,000 acre-feet. There are outstanding contracts for 5,400,000 acre-feet, and I feel that under the equated flow of the river these contracts will be taken care of when and if they are needed and the water is needed. There will be water to spare--at least, for many years to come.

"(f) Something has been said to the effect that the negotiators of the compact estimated a greater water supply in the Colorado River than present records indicate exist. At that time; that is, when Mr. Hoover was in the picture, the negotiators estimated the supply to be 20,000,000 acre-feet--yes; up to 22,000,000 acre-feet. It is my understanding that estimates of the United States Bureau of Reclamation ending in the year 1920 and estimates made by the Bureau at the present time do not revise downward the Bureau's estimate of the water supply of the Colorado River since the compact was negotiated.

"The distinguished senior Senator from California presented a report of February 23, 1922, by the United States Bureau of Reclamation. In table 9, on page 37 of that report, the flow of the Colorado River at Yuma is estimated at an average of 17,550,000 acre-feet per annum for the period of record ending 1920. The flow at Boulder Dam is estimated at 16,407,000 acre-feet. The Bureau at present estimates the mean annual virgin flow of the river at Yuma at 17,751,000 acre-feet per annum, which is about 200,000 acre-feet more than it estimated this flow to be at the time the 1922 report was prepared. The virgin flow at Boulder Dam, as estimated now by the Bureau of Reclamation, is 17,331,000 acre-feet. This is 861,000 acre-feet more per year than the estimate which appeared in the 1922 report. Engineers for the Bureau of Reclamation and other engineers estimate that sufficient storage will be provided on the river under ultimate conditions fully to equate the flow of the stream to the long-time average. Therefore, the results of the records of run-off for the period 1931-40, inclusive, have not justified any reduction in the figure of safe water supply.

"(g) Something has been said about there being an excess of demand over supply in the upper basin. It will be remembered that in 1922 the allocation was for 7,500,000 acre-feet per annum to the upper basin. While at that time there was no thought of transmountain diversion, there is thought of that now. However, to offset that, it has now been found that there is a lesser amount of acreage susceptible of irrigation within the natural basin of the Colorado River than was estimated in 1922.

"(h) Under the Colorado River compact, there is the obligation of the upper basin to deliver to the lower basin not less than 75,000,000 acre-feet in any 10-year period. As the upper basin develops and storage dams are created, the United States Bureau of Reclamation estimates that there will be constructed in the upper basin some 38,000,000 acre-feet of storage in order to increase irrigation development in that basin, and to generate hydroelectric energy. To generate the electricity, the water must be released, just as something over 10,000,000 acre-feet are released at Boulder now to generate the electricity which California buys. The operation of such reservoirs for the generation of electricity will so equate the flow of the stream that the upper basin delivery at Lee

Ferry will always be made. This should banish any doubt as to the ability of the upper basin in the years to come to fulfill its obligation under the Colorado River compact.

"(i) We have no disagreement with those who, looking into the future, say that the Colorado River is a natural resource of the United States and will become of greater and greater importance and value as times goes on. It is for that very reason that a treaty should be consummated at this time. I call the Senator's attention to a table found in the Reclamation report, Problems of Imperial Valley and Vicinity, Senate Document No. 142, Sixty-seventh Congress, second session, 1922 (Fall-Davis Report). A table which appears on page 38 of this Senate document shows the estimate made by the Bureau of the ultimate acreage that would be irrigated below Boulder Canyon:

"TABLE 12--Estimated ultimate demand

(All lands below Boulder Canyon)	Acres
United States	1,220,000
Mexico	800,000
Total	2,020,000

"A break-down of the Mexican acreage is given in table 3 on page 32 of the Senate document, as follows:

Mexico:	Total ultimate acreage
Under Imperial Canal	255,000
Under All-American Canal	30,000
Delta south of Volcano Lake and Bee River	250,000
Sonora	265,000
TOTAL	800,000

"On page 75 of the report, the following statement appears:

> 'Storage required: It is expected that some storage will be required for full development of the lands under the Imperial Canal in California and Mexico. The question of water supply and storage requirements of this project must be considered in conjunction with the subject as a whole on the Colorado River, and it is being so considered in the general water-supply report being prepared on the lower Colorado River in connection with the investigations required under the Kinkaid Act.'

"It may be noted that the report of the Bureau of Reclamation of the Problems of Imperial Valley and vicinity considered that 800,000 acres ultimately would be irrigated in Mexico, and that some storage would be required for this purpose. Under the present duty of water in the Mexican area, the 800,000 acres of land would require a diversion from the river of 4,800,000 acre-feet of water. The aggregate acreage under the two items to which the footnote in the above table applies is

285,000 acres. Under the present diversion duty in Mexico this acreage would require a diversion from the river of 1,510,000 acre-feet.

"It must be remembered that the Colorado River is an international stream and that the United States cannot do with it entirely as she sees fit. The effect of the treaty will be to confine Mexican development to a much smaller acreage than that which the Bureau report of 1922 estimated would ultimately be irrigated, and to permit a material increase in the acreage and the use of water in the United States over the estimate made in that report. The Bureau report of 1922 estimated that the water demand for the ultimate acreage in the entire basin in both countries would be 12,531,000 acre-feet. Under the treaty, the use of Colorado River water by the United States alone can be in excess of 16,000,000 acre-feet per annum.

"(j) It has been contended also that the language in the compact which referred to a treaty to be made with Mexico was indefinite and therefore the amount should not be over 750,000 acre-feet. That is based on the suggestion that Mexico was at that time using only some 500,000 to 600,000 acre-feet per year. The distinguished Senator from Colorado has shown how Mexico was using more than that--that this amount was delivered to the laterals of the Alamo Canal and did not include canal losses, desilting water, and carriage water. We must bear in mind that the acreage irrigated in Mexico by the Alamo Canal in 1943 and 1944 was 191,700 acres and 197,900 acres, respectively, and that the diversion through the Alamo Canal for 1943 and 1944 was 1,100,000 acre-feet."

* * *

"(q) The treaty obligates Mexico to construct a diversion structure at some place below the upper boundary. It may be partly on American soil or it may be wholly on Mexican soil. There is no provision that obligates Mexico to construct a diversion dam wholly or partly on American soil.

"(r) The treaty also provides that at the time Mexico does build a diversion structure, regardless of where it is constructed, simultaneously there shall be constructed whatever works are necessary to prevent the flooding and seeping of American lands. Without this treaty, Mexico is under no inhibition with respect to a dam wholly in her own territory.

Senator McCarran introduced into the debates a letter he had received from Commissioner of Reclamation Harry Bashore in response to a series of questions the Senator had propounded to the Commissioner. Senator McCarran had the exchange of correspondence printed as Senate Document 39 and also read the material into the Congressional Record at pages 3369, 3370 and 3371. Excerpts from the Record where Senator McCarran read the letter are of interest:

"COLORADO RIVER

(Under conditions of ultimate development)

"ANNUAL SUPPLY, REQUIREMENTS, AND DEFICIT DURING LOW FLOW PERIODS (SUCH AS 1931-40)

I. Annual Supply

"Question 1. Average flow at Lee Ferry.

"The figures furnished the Senate Foreign Relations Committee assumed an average flow at Lee Ferry of 7,500,000 acre-feet. It is assumed that this means that in a low-flow decade like 1931-40, the total delivery by the upper basin would be the compact requirement of 75,000,000 acre-feet.

"Answers and discussion: . . . The assumption is correct that by using an average flow of 7,500,000 acre-feet this means that in a low-flow decade like 1931-40 the total delivery by the upper basin would be the complete requirement of 75,000,000 acre-feet.

* * *

"Question 2. Plus: Inflow from springs and tributaries, Lee Ferry to Boulder Dam.

"The figures furnished the Senate committee show 800,000 acre-feet. What justification can you give for this figure during a period of low flow, such as the decade 1931-40?

"Answers and discussion: . . . The figure of 800,000 acre-feet was determined by comparing the recorded flows of the Colorado River at Lee Ferry and below Boulder Dam, correcting the latter figure by storage changes in Lake Mead and estimated past reservoir losses to reflect the inflow to Lake Mead. This flow was then corrected by the present use of water between Lee Ferry and Boulder Dam to reflect conditions as they would be without any irrigation development below Lee Ferry.

"Question 3. Less: Losses, Lee Ferry to Lake Mead.

"The figures given the Senate committee omit this item. What reservoir and other evaporation losses between Lee Ferry and Boulder Dam should be assumed?

"Answer and discussion: . . . In the question, the committee refers to 'reservoir and other losses', which the table refers to 'losses'. It is presumed that what is meant is the natural stream losses, since item 4 covers losses from reservoirs. On the assumption that question 4 is intended to cover reservoir losses, the answer to question 3 is determined in the following manner; We did not compute the natural stream losses. Since the determination of the inflow in item 2 is the net difference in recorded flows between Lee Ferry and Boulder Dam, that figure represents the net gain which is the inflow to the river in excess of channel losses.

"Question 4. Less: Reservoir losses on Lake Mead and other reservoirs between Lee Ferry and Boulder Dam.

"Your figures omit this.

(a) What reservoir losses on Lake Mead itself should be assumed?

(b) On what area, and how many acre-feet per acre of reservoir surface per year?

"Answer and discussion: . . . The table asks for reservoir losses on Lake Mead and other reservoirs between Lee Ferry and Boulder Dam. In making this determination the reservoir losses having been computed as the increased losses due to reservoir construction over and above the natural losses that did or would exist prior to the building of the reservoirs. The following table shows our computation of these losses:

(Table shown on following page)

"Question 5. Net amount available for release from Boulder Dam without drawing down storage.

"Your figures omit this.

* * *

"To arrive at the physical quantity of water available for releases at Lake Mead, should not losses between Lee Ferry and Lake Mead, and the reservoir losses on Lake Mead itself, be deducted? If this is done, what is the actual physical amount available for delivery from Lake Mead, without any draw-down on storage?

"Answer and discussion: . . . This is the sum of the average flow at Lee Ferry and the net gain, Lee Ferry to Boulder Dam, minus the estimated reservoir losses between Lee Ferry and Boulder Dam. The figure is 7,569,000 acre-feet.

"Question 6. Plus: Inflow between Boulder Dam and the Gila.

"Your figures omit this.

"(a) How much inflow between Boulder Dam and the Gila do you assume?

"(b) From what streams?

"Answer and discussion: . . . The principal stream in this area is the Williams River, which has a recorded discharge in the 10-year period of 125,000 acre-feet.

"Question 7. Less: River losses below Boulder Dam.

"Your figure is apparently 600,000 acre-feet.

"Answer and discussion: . . . This figure resulted from questioning during the hearings on the proposed Mexican treaty by Senators DOWNEY and JOHNSON on the California exhibit, which showed river losses below Boulder Dam of 600,000 acre-feet and that we stated we took no issue with them. The figure of 600,000 acre-feet represents the net difference in future flow between Boulder Dam and Imperial Dam. In other words, this is the net loss over and above the inflows described in question 6. To arrive at the absolute loss, the net river loss should be added to the figure derived for question 6. Accordingly, in completing the table above, items 6 and 7 have been combined and a figure of 600,000 acre-feet used to represent the net river loss.

Name of reservoir	Average evaporating area in 1,000 acres				Annual rate of loss in feet				Annual loss in 1,000 acre-feet		
	Originally		Following reservoir development		Originally		Following reservoir development		Originally	Following development	Charge to reservoir
	Water	Land	Water	Land	Water	Land	Water	Land			
Marble Canyon----------	1.5	8.2	9.2	0.5	6.0	1.0	5.0	1.0	17	47	30
Bridge Canyon----------	.6	17.0	15.6	2.0	7.0	1.0	5.0	2.0	21	82	61
Lake Mead----------	8.0	155.0	130.0	33.0	7.0	.8	6.0	1.2	180	820	640
Total, Lee Ferry to Boulder Canyon----	10.1	180.2	154.8	35.5	------	------	------	------	218	949	731

"Question 8. Total net amount physically available for delivery without drawing down Lake Mead storage.

"What is the total remainder available for use, without draw-down on Boulder Dam storage?

* * *

"Answer and discussion:

. . . This is the figure, derived as suggested, in item 5, minus the net river loss of 600,000 acre-feet, which results in an answer of 6,969,000 acre-feet.

"Question 9. Nevada contract (face amount, 300,000 acre-feet).

"The Nevada contract calls for a delivery of a total of 300,000 acre-feet. You stated your assump tion of the Colorado River compact as requiring reservoir losses to be charged as though they were consumptive uses, against the contract.

"(a) What, then, is the amount of the reservoir loss to be deducted from the 300,000 acre-foot gross figure used in the Nevada contract; and

"(b) What becomes the net consumptive use under the Nevada contract?

"Question 10. California contracts (face amount, 5,362,000 acre-feet).

"Next, as to the California contracts, totaling 5,362,000 acre-feet:

"(a) Is it not true that the Boulder Canyon Project Act and the California Limitation Act provide that the California contracts are to be measured by diversions less returns to the river?

"(b) Would they, therefore, be subject to any charge for reservoir losses?

"Question 11. Arizona contract (face amount, 2,800,000 acre-feet).

"Assuming the foregoing tc be true, let us go next to the Arizona contract, for 2,800,000 acre-feet plus half the surplus.

"(a) What reservoir losses would you deduct there; and

~~"(b) What would the net deliveries become?~~

"Answer and discussion: Questions 9, 10, and 11 discuss, respectively, the Nevada, the California, and the Arizona contracts with a determination as to how the reservoir losses have been proportioned. The subject of reservoir losses is one on which there is not uniform agreement among the States as to how they should be proportioned. In the various discussions of the Committee of Sixteen there seems to be uniform agreement that reservoir losses in the upper basin should be charged against the upper basin allocation under the compact of 7,500,000 acre-feet. Among many engineers and lawyers there is a feeling that similarly in the lower basin the main stem reservoir losses should be charged against the compact water allotted to the lower basin. In the Arizona contract there is a provision in article 7 (d) which reads, in part, as follows: '. . . and such obligation shall be subject to such reduction on account of evaporation, reservoir, and river losses as may be required to render this contract in conformity with said compact and said act.'

"Neither the Nevada nor the California contracts contain clauses concerning charge for reservoir evaporation loss. The final outcome is one of those unsolved questions on the river. However, at this time it should be recalled that the wording of the supplemental statement, inserted in the hearings on February 21, 1945, read as follows:

> 'In reconstructing this table I have assumed that reservoir losses in the lower basin are charged against the water contracts and this means that the actual amount delivered under those contracts will be reduced by proportionate reservoir losses. I recognize that this reflects an interpretation of the Santa Fe Compact and that it is in no way binding on anybody and it is presented merely as an analysis.'

"In the absence of agreement on the manner of charging reservoir losses--

* * *

"it is difficult to suggest how such loss would be distributed. In this study it is assumed that Lake Mead loss would be distributed on a proportionate basis among the Nevada, Arizona, and California contracts. Since the Marble Gorge and the Bridge Canyon Reservoirs are located entirely within Arizona it is assumed that these reservoir losses would be charged entirely to Arizona. Assuming that such basis is agreed to by all, the following charges of reservoir loss would be made under the contracts:

	Acre-feet
Nevada contract, 3/75 of Lake Mead loss	26,000
California contracts, 44/75 of Lake Mead loss	385,000
Arizona contract, 28/75 of Lake Mead loss	239,000
All of the Bridge Canyon and the Marble Canyon losses	91,000
Total	330,000
Total, all contracts	731,000

"Net delivery under contract: Under items 9,10, and 11, if it should be held and agreed to that beneficial consumptive use includes reservoir losses and these reservoir losses are charged against the contracts as indicated herein, then the so-called remaining net demands would be--

	Acre-feet
Nevada	274,000
California contracts	4,987,000
Arizona contract	2,470,000

"Question 12. Proposed Mexican treaty (face amount, 1,500,000 acre-feet).

"This treaty guarantees 1,500,000 acre-feet at the border.

"(a) How much water would you have to release at Boulder in order to deliver 1,500,000 acre-feet to Mexico at the border?

"(b) Under the proposed treaty, would there be any charge against the Mexican allocation on account of reservoir losses or losses in the stream in transit?

"(c) If not, would not all of the reservoir losses have to be borne by the American users, even that portion which would have been chargeable to the 1,500,000 acre-feet delivered to Mexico, if that quantity had been delivered to an American user?

"Answer and discussion: . . .

"(a) If, for the purpose of this analysis, the small amount of unused Gila water is neglected (testified to previously in the hearing to average 100,000 acre-feet annually), there would need be released from Boulder Dam, earmarked for delivery to Mexico, 1,500,000 acre-feet of water annually.

"(b) The treaty measures the Mexican allocation as water in the boundary portion of the river, hence there would not be any charge against the Mexican allocation on account of reservoir losses or losses from the stream in transit.

"(c) The question is correct in its statement that under these conditions all of the reservoir losses will have to be borne by the American users, even that portion which would have been chargeable to the 1,500,000 acre-feet delivered to Mexico, if that quantity had been delivered to an American user.

"Question 13. Total requirements.

"You show in the figures given the Senate committee a total of annual requirements of 9,962,000 acre-feet. Revising this to charge against this figure the aggregate of the reservoir losses, which you say you assume are chargeable under the compact, what would this total of 9,962,000 acre-feet shrink to?

"Answer and discussion: . . . Revising the figure of 9,962,000 acre-feet for the estimated reservoir losses of 731,000 acre-feet (shown in item 4) the net demand would shrink to 9,231,000 acre-feet.

"III. ANNUAL DEFICIT

"Question 14. Deficit (difference between item 8, 'Total net amount physically available for delivery,' and item 13, 'Total requirements').

"You have a total supply physically available for delivery, after deducting reservoir and stream losses, of -- acre-feet, per item 8 above. Deducting from this the total of the contract and treaty requirements, what is the total deficit?

"Answer and discussion: . . . The deficit without storage drawdown from Lake Mead (item 13 minus item 8), would be 2,262,000 acre-feet.

* * *

"Question 15. Portion of deficit to be made good by draw-down on Lake Mead storage.

"This deficit would be met either by drawing down Boulder Dam storage or by failing to deliver the contracted quantities, or both.

"(a) You intend to draw down on Lake Mead storage 1,500,000 acre-feet according to the statement given the Foreign Relations Committee. Can you explain why you think it safe to go that high in your drafts on storage?

"(b) In 10 years such as 1931-40, drawing down storage at that rate, would not 15,000,000 acre-feet of storage be exhausted?

"(c) What of a 14-year period like 1931-44, instead?

"(d) What is the total active storage of Lake Mead; i.e., the gross capacity minus dead storage, flood control, and other reservations?

"Answer and discussion: . . .

"(a) The figure of 1,500,000 acre-feet annual draw-down during a low 10-year period such as 1931-40 was assumed as this is the amount of storage necessary to make the total yield of the stream in the low period equal to the long-time average yield. As explained in the Bureau of Reclamation testimony of February 20, 1945, the ultimate plan for development of the water resources of the Colorado River provides sufficient storage capacity both in the upper basin and in the lower basin to fully equate the stream flow, that is, to make the usable yield of the stream in low periods equal to the long-time average usable yield.

"(b) In the 10 years, such as 1931-40, drawing down storage at the indicated average rate would result in exhaustion of 15,000,000 acre-feet of storage in 10 years.

"(c) With regard to the question about a 14-year period such as 1931-44 instead. The run-off in the years after 1940 was above average; hence, in that period it is believed that there would be some recovery of Lake Mead storage.

"(d) The total storage capacity of Lake Mead is 32,359,000 acre-feet. This is allocated as follows:

	Acre-feet
Flood control	9,500,000
Live storage for regulation	19,652,000
Dead storage below intake	3,207,000
Total	32,359,000

"The testimony given by the Bureau of Reclamation used a round figure of 20,000,000 acre-feet for the active capacity of Lake Mead. In this connection it should be borne in mind that, as additional upstream storage is provided on the Colorado River, the Bureau of Reclamation plans contemplate that the flood-control reserve at Lake Mead will be reduced by about 5,000,000 acre-feet.

"Question 16. Remaining deficit, i.e., overdraft, or shortage on deliveries.

"How much is the remaining overdraft or shortage of deliveries under American contracts, after making the annual draw-down on Lake Mead storage, which you assume?

"Answer and discussion: . . . The remaining overdraft, or shortage on deliveries, under the American contracts, after making the annual storage draw-down of 1,500,000 acre-feet would be 762,000 acre-feet.

* * *

"Mr. MILLIKIN. Will the Senator please repeat the last net figure?

"Mr. McCARRAN. I shall be glad to do so, and I shall read the whole answer and discussion, as follows:

"Question 16, re 'Overdraft, or shortages on deliveries.

"This shows the shortage on deliveries, taking into consideration everything before the Mexican allocation and guaranty is complied with.

"The remaining overdraft or shortage on deliveries--

"Says the Commissioner--

"under the American contracts, after making the annual storage draw-down of 1,500,000 acre-feet--

"Which is the Mexican treaty--

"would be 762,000 acre-feet.

"Mr. MILLIKIN. That would include, would it not, 962,000 acre-feet to which California makes claim, in excess of her firm water rights under her contracts and her self-limitation statute?

"Mr. McCARRAN. I do not so understand, because her claim, as I understand it, has never yet received the dignity of being adjudicated.

"Mr. MILLIKIN. Earlier in his statement, where he indicates the various contracts, I think he does reflect the 962,000 acre-feet which California has claimed and which has no basis under the firm allocations of water between the States.

"Mr. McCARRAN. Yes; but I do not understand the statement to reflect it in the 762,000 acre-feet figure.

"Mr. MILLIKIN. Mr. President, will the Senator yield for a correction?

"Mr. McCARRAN. I yield.

"Mr. MILLIKIN. Awhile ago I said that during the exceedingly dry period of 1941-42 we in the upper basin had put in 108,000,000 acre-feet at Lees Ferry. I should have said we let down 101,000,000 acre-feet.

"Mr. McCARRAN. Well, a few million acre-feet do not make much difference in connection with the treaty.

"I read further:

"SUMMARY--COLORADO RIVER

"(Under conditions of ultimate development)

"ANNUAL SUPPLY, REQUIREMENTS, AND DEFICIT DURING LOW FLOW PERIODS (SUCH AS 1931-40)

"This analysis assumes reservoir losses Marble Gorge and Bridge Canyon charged entirely to Arizona and Lake Mead Reservoir losses prorated three seventy-fifths Nevada, forty-four seventy-fifths California, and twenty-eight seventh-fifths Arizona.

* * *

"I. Annual supply

	Acre-feet
"1. Average flow at Lee Ferry	7,500,000
"2 and 3. Net inflow from springs and tributaries in excess of natural losses, Lee Ferry to Lake Mead	800,000
"4. Less reservoir losses on Lake Mead, Bridge Canyon, Marble Gorge between Lee Ferry and Boulder Dam	731,000
"5. Net amount available for release from Boulder Dam without drawing down Storage	7,569,000
"6 and 7. River losses below Boulder Dam in excess of inflow between Boulder Dam and Gila	600,000
"8. Total net amount physically available for delivery without drawing down Lake Mead storage	6,969,000

"II. Annual Requirements

(Reservoir losses deducted)

"9. Nevada contract (face amount 300,000 acre-feet)	274,000
"10. California contracts (face amount 5,362,000 acre-feet)	4,987,000
"11. Arizona contract (face amount 2,800,000 acre-feet)	2,470,000
"12. Proposed Mexican treaty (face amount, 1,500,000 acre-feet)	1,500,000
"13. Total requirements	9,231,000

* * *

"III. Annual deficit

"14. Deficit (difference between item 8, 'Total net amount physically available for delivery,' and item 13, 'Total requirements')	2,262,000
"15. Portion of deficit to be made good by draw-down on Lake Mead storage	1,500,000[1]
"16. Remaining deficit, i.e., overdraft, or shortage on deliveries	762,000

[1] In explanation of Lake Mead draw-down of 1,500,000 in 1931-40 period; this is annual storage release required to make supply in low period equal long-time average supply. Plans contemplate sufficient storage on river to accomplish this."

Senate Document 249, 79th Congress, 2d Session, which was a speech by Northcutt Ely before the Colorado River Water Users' Association on the Mexican Treaty, presented what Mr. Ely called "The assumptions of the Mexican negotiators". Beginning on page 6 we find:

"1. AS TO THE IRRIGABLE AREA IN MEXICO

* * *

"Now for one of the Mexican negotiators, Ing. Adolfo Orive Alba, Chairman of the National Irrigation Commission, corresponding to our Commissioner of Reclamation (with the difference that our Commissioner Bashore testified that he was not consulted until after the treaty was signed). Ing. Orive Alba said, in a formal statement printed August 1, 1945:

'Now then, before negotiating the treaty a precise estimate was made of the net area in Mexican territory irrigable with water from the Colorado River under economically practicable conditions. Accordingly, this estimate found that there was an area of 200,000 net irrigable hectares (494,200 acres) equivalent to a gross area of 300,000 hectares. This gross area of 300,000 hectares (741,300 acres) is less than that estimated as irrigable by our engineers during the international conferences of 1929 to which we referred at the beginning of this report. The difference between these two estimates is that in the latter, great areas, considered in the estimate of 1929, are eliminated as being useless for agricultural operations due to the large amount of salts that the lands contain. For example, the basin of the Laguna Salada and the lands adjacent to the Gulf were eliminated. There were also eliminated some other areas of lands of poor quality where heavy pumping would be required. (Italics supplied.)"

* * *

"2. AS TO THE LAND AND WATER ALREADY PUT TO USE IN MEXICO.

* * *

"But Ing. Adolfo Orive Alba, whom we have previously introduced, reporting to the Mexican Senate, compared the amount of water Mexico was previously using, and the amount she would use under the treaty as follows:

'By means of the treaty the critically fortuitous condition of the crops of 120,000 hectares (296,500 acres) farmed at present is eliminated (area times 4.1 feet = 1,215,650 acre-feet present annual use; see explanation infra).

'The treaty permits of increasing the cultivated area to the total of the area that can be cultivated economically, that is, to 200,000 net hectares (494,200 acres). (Emphasis, and calculation in parentheses, added.)

"As to future uses, he says in more detail:

'Now then for the irrigation of the net 200,000 hectares (494,200 acres) in accordance with the coefficient of irrigation observed as an average since the commencement of agricultural work in the Mexicali Valley (1.25 meters or 4.1 feet), a volume of 2,500,000,000 cubic meters (2,026,700 acre-feet) would be needed.

'This volume can be obtained with the amount guaranteed by the treaty of 1,850,000,000 cubic meters (1,500,000 acre-feet) in the minimum years or 2,097,000,000 (1,700,000 acre-feet) in the majority of the years plus the water that is pumped from wells--similar to those existing on the laguna--which will more than supply the deficiency between the quantity required and the quantity guaranteed by the treaty.

'If the coefficient of irrigation in Mexicali Valley should be increased notably, it will be necessary to make a greater use of the abundant (freaticas) water which exists in the subsoil of Mexicali Valley. If, on the contrary, as we hope, by a greater preparation of our farmers the coefficient of irrigation diminishes, it will be practically possible to irrigate the whole of the 200,000 net hectares (494,200 acres) existing with the volume guaranteed by the treaty. (Emphasis supplied).'"

* * *

"3. AS TO QUANTITY OF WATER WHICH MEXICO COULD PUT TO USE WITHOUT A TREATY

* * *

"Ing. Fernandez MacGregor, Mexican member of the International Boundary and Water Commission, and opposite number of our Mr. Lawson, issued a prepared statement answering a critic of the treaty, saying:

'Of the opponents Lic. Manzanera del Campo was the only one who did not limit himself to showing that Mexico has an

undeniable right to the waters of the Colorado River (a thing in which we are entirely in accord with him) but went further to fix a quantity of this right in the annual volume of 2,380,000 acre-feet. . . .

'To make plain to Lic. Manzanera del Campo that the volume of Colorado River water assigned to Mexico by the treaty, and which as a minimum is 1,850,234,000 cubic meters per year, has much more value for our country than that which he calculates, the National Irrigation Commission, at my request, had prepared a graph to which Lic. Enriquez referred briefly, but due to the pressure of time, it was not possible for me to explain. In this I have shown the annual discharge (gastos) from this stream in the form in which the same would occur month by month and year by year if the regulatory works constructed in American territory did not exist. This graph shows clearly that in the irregular form in which the flows would occur, Mexico, instead of receiving benefits would repeatedly sustain damage; as a rule when the water was available, it would descend in veritable floods which would destroy everything; and on other occasions in the months of the greatest scarcity and the greatest necessity, the channel would be dry.

"Instead, the waters that Mexico will receive in accordance with the treaty will be received regulated by the American works, and at the appropriate time for their application to the lands. For this purpose there is established in the treaty, procedure by means of which the Mexican section of the International Boundary and Water Commission will present each year, in advance, to the American section of the same Commission monthly tables for delivery of the water which our lands are going to need for the following year; and, what is more, there is a stipulation that these tables can be varied 20 percent, plus or minus, 30 days in advance, in the event that the forecasts that shall have been made are not exact. . . .'

'In the same graph to which I referred it is shown clearly that even supposing that not a single drop of water of the Colorado River were retained in American territory, the irregular form in which the discharge would arrive in our country would not permit any important area of land to be irrigated; that is to say, supposing that there is accepted as correct the conclusion to which Lic. Manzanera del Campo arrives, not only would we be unable to increase our irrigation system on the Colorado River in Lower California and Sonora up to 200,000 hectares in round figures, as we are going to do when the treaty enters into effect, but probably the area already irrigated would have to be reduced considerably. . . .

'I make the above statements as a Mexican, as a public officer conscious of my duty, having had the good fortune (after having dedicated 21 years of my life to the study of this problem) to have the honor to sign the treaty of February 3, 1944, together with Dr. Francisco Castillo Najera, present Secretary of Foreign Relations; a treaty which, in my opinion, constitutes a prime example of what two friendly countries can do when with all good will and understanding they sit down at the conference table to resolve their problems. The Treaty resolves in a satisfactory and equitable form the problem that confronts the two Governments on their international rivers (El Nacional, September 23, 1945). (Emphasis supplied.)

"Lic. Ernesto Enriquez, an eminent Mexican authority on international law, who participated in the negotiations, testified:

'6. In practice, the treaty not only is convenient, but is indispensable to us. The United States of America can get along without it; our country cannot. Moreover, the favorable results of a judgment of arbitration that Mexico might win would not give in the end results as good as those obtained through this international instrument.

'7. If the treaty were not ratified, it would be almost impossible to hope that for many years we would be able to negotiate another; and in this the matter of time has always been adverse to us (Excelsior, 1945),(Emphasis supplied.)

"At another point, Lic. Enriquez was reported by the official newspaper of the Mexican Government as follows:

'A judgment in arbitration, said Enriquez, on treating this aspect of the agreement, would not give to Mexico the advantages that she obtains with the water treaty now signed. The arbitrator only has faculties to declare what quantity of water would belong to Mexico and to the United States, respectively. He never would be able to determine what works ought to be built in the limitrophe sections of the rivers, with the object of obtaining a better use of the flow. Enriquez stated his opinion that possibly with respect to the Colorado there would be conceded to Mexico an award greater than that which the present treaty assigns to her, but that quantity would have to be received in accord with natural flow conditions of the river. Mexico could not pretend to use without compensation of any sort the costly works for management and regulation made in the United States. Consequently, if our country did get more water, it would receive it not in the months of low stage of the river, but divided according to the natural flow of the river, and therefore, in the summer, which is when water is really most valuable for irrigation, its portion would be much less than that which it can have available in accordance with the treaty, which

permits it to demand the water in greater quantity, according to its necessities in the months of greatest consumption (El Nacional, August 7, 1945). (Emphasis supplied).

"The same official newspaper reports the following exchange between the chairman of the committee, Lic. Garcia de Alba, and one of the opponents, Lic. Manzanera del Campo (El Nacional, September 13, 1945):

'Senator Garcia de Alba, presiding, initiated the period of interrogation by asking Lic. Manzanera del Campo: Which will be most beneficial to Mexico, to receive 2,300,000 acre-feet of wild, unregulated (bronca) water, or in place thereof, 1,500,000 acre-feet of regulated (quantitativas) waters, at the times when they are necessary, such as during the months of low stages in the river? Manzanera del Campo responded categorically that it was obvious that he would prefer the controlled waters.'

"Before leaving this point of who needed the treaty, Mexico or the United States, let us turn again to the informative report of Ing. Orive Alba.

"After referring to the construction of Boulder Dam and the All-American canal Orive Alba states (p. 12):

'We Mexican engineers, when we saw that these gigantic works were being executed, understood that there approached the critical moment for Mexico in which the lands of the Mexicali Valley ran the danger of returning to their condition of one of the most inhospitable deserts in the world through lack of water, since our country would have to depend on taking water, in the manner that it might best be able to do it, from the Colorado River by using occasional surpluses that might flow through said river.

'In 1942 the All-American canal entered into operation; that is it was no longer necessary to carry the water of the Colorado River through Mexican territory in order to irrigate American lands and therefore it was not possible for Mexico to take part of the 50 per-cent of the water in the Alamo Canal to which it had the right, and this canal remained abandoned for the exclusive service of Mexico, which already had in cultivation that year more than 120,000 hectares (300,000 acres) in Mexicali Valley.

'The situation in 1942 showed us how well founded were our fears because that year, during several of the hottest weeks, there came from the great American dams constructed on the Colorado River only a small volume which did not permit of filling the require-ments of irrigation in Mexico. And with this came the clamor of the public landholders, the small owners, and colonists of our Colorado River irrigation district, who saw their crops lost for lack of water. But there is even more for at the end of the summer, there

came from Boulder Dam a great flow of water which overflowed in México, inundating cultivated lands and ruining the crops of other thousands of hectares.

'That is, even when it is true that the total volume of the surpluses which flow through the Colorado River will still be very great in many years, its current is from now on so irregular that it can be stated that, while during some weeks the Mexican lands of the Mexicali Valley can be dying of thirst, in the following weeks they may be choked and submerged by the inundations provoked by discharges from the American dams.

'Under these conditions the agriculture of the Mexicali Valley is in desperate condition. In order to better it, without the treaty, it has been necessary for the Mexican Government, in the years 1943 and 1944 and the present year, to be constantly requesting of the American Government that the discharges be now increased, that tomorrow they be diminished, that part of the water be furnished through the All-American Canal, etc.

"This critical situation makes clear how unfounded is the opinion of some of our citizens who believe that Mexico should not be preoccupied in the case of the Colorado River and that the treaty was not needed, as it could always take the abundant water which inevitably flows in the Colorado River. We insist that, effectively, in the case of the Colorado River as in the case of the Mexican tributaries of the Rio Grande, there will always be surpluses which will flow in the beds of said rivers but these surpluses cannot be used in irrigation due to their eminently irregular regimen in present years and much less in future years. The only solution for using them would be to regulate them by a storage dam and we must remember that at the beginning of this exposition we said that in Mexico ~~there is not the slightest possibility of storing the surplus water of~~ the Colorado River, a possibility which exists for the surplus waters that flow in the Rio Grande.

'For this and many other reasons we who know the problems of the Mexicali Valley in its painful reality have always been convinced that there was no other solution than that which a treaty gives which guarantees water from the Colorado River for the irrigation of its lands.

"The treaty which is under consideration resolves this problem (Orive Alba; El Universal, August 1, 1945; U.S. Senate Doc. No. 98, 78th Cong., pp. 14, 15).'

"At another point this eminent Mexican authority, having told of Mexico's 'desperate condition' without a treaty, painted the following contrasting picture of her happy situation under the treaty (El Universal, August 1, 1945; U. S. Senate Doc. No. 98, 79th Cong., pp. 14, 15):

'It is necessary to note that as Mexico did not have any place to regulate the waters of the Colorado River in order to distribute them day by day, during each year, according to the needs of irrigation, it was necessary to arrange by means of the treaty for the United States to deliver that water to us regulated to our wishes within certain limitations which do not impose on us any sacrifice for any plan of cultivation that is followed in Mexicali Valley. For this service of regulation of that water, our country does not have to pay a single cent. Besides this, on account of the topographical conditions of the lands to be irrigated on both banks of the Colorado River, it was necessary to arrange that the water of the Colorado River be delivered to us when desired by Mexico, compatible with the needs of the lands to be irrigated at three different points.

'1. At Pilot Knob, in order to irrigate the high lands which are found adjacent to the Colorado River on its right bank.

'2. At San Luis, Sonora, in order to irrigate the high lands which are found on the left bank of the Colorado River.

'3. At the Colorado River, in order that by means of the construction of an international dam at the site where Mexico may desire it the rest of the lands on both banks of the river can be irrigated.

'Mexico even has the possibility, if it so desires, of obtaining construction by Arizona of a canal which would carry waters of the Colorado River from a diversion dam constructed on the section of the river bounding the lands of Sonora.

'These are the advantages obtained by the treaty which cannot be relegated to a second place, but which for our country have fundamental importance because if it were not for them we would not be able even to use the annual volume that the treaty assigns to Mexico. (Emphasis supplied.)'

The foregoing is an index and summary of the testimony before the Senate Committee on Foreign Relations and the debates on the floor of the Senate pertaining to water supply as it relates to the various provisions of the Mexican Water Treaty. There were several sub-issues included in this discussion, such as water availability, water use in Mexico, water use in the United States, return flow, need for and stipulations to permitting a diversion dam for Mexico and alleged ambiguous language in allocating water.

It is obvious that the latter two were resolved to the satisfaction of all Senators, because clarifying provisions were included as reservations (j) and (k) to the consent resolution. From the nature of the other problems it was not required that the Senate make findings of fact pertaining to the controversial items. Evidently the majority of the Senate were satisfied that there was sufficient water available to make possible the ratification of the treaty without undue hardship to interests in the United States.