1. Q Amount of water available at Lee Ferry
   
   (a) Under present conditions
   
   (b) Under future conditions
   
   A (a) Estimated by Bureau of Reclamation at 13,400,000 ac ft.
   
   (b) If the upper basin is limited to a beneficial consumptive use of 7,500,000 acre feet, the amount available at Lee Ferry is estimated at 9,400,000 acre feet. If the entire upstream development indicated in the Weymouth 1924 report takes place, this amount will be reduced to 7,900,000 acre feet. Such development would require more water than is allowed to the upstream basin under the compact. However, there is grave doubt whether all the projects provided for in the Weymouth report will actually be found feasible.

2. Q Amount of inflow to river between Lee Ferry and Boulder Dam.
   
   (a) Assuming no development on tributaries.
   
   (b) Water from Arizona tributaries under condition (a)
   
   (c) Water from Nevada tributaries under condition (a)
   
   A Total inflow at the present time estimated at 1,570,000 acre feet annually. Indefinite data available to furnish the figures asked for.

3. Q River losses (total) between Lee Ferry and Laguna Dam, assuming developed river.
   
   A Estimated at 1,2000,000 acre feet.

4. Q Total amount of water in the Gila and its tributaries.
   
   A The average annual run off of the Gila river just above
Florence Arizona; at Salt River, just above its junction with the Verde River; Verde river at its junction with the Salt River and the minor streams entering the Salt River just west of Phoenix total an average of 2,400,000 acre feet annually. Prior to construction of the Coolidge Dam, the average annual flow of the Gila river at Yuma was about 1,000,000 acre feet annually. Following full operations under the Coolidge Dam and the additional storage developments contemplated for an early date on the Verde and other streams, it is anticipated that the average discharge of the Gila River at the mouth will probably not exceed 300,- 000 acre feet annually. Prior to irrigation development in the Gila River water shed, the discharge at its mouth probably approximated 2,000,000 acre feet annually, indicating that past and future development in this water shed contemplate a consumptive use of roughly 1,700,000 acre feet.
Data to be collected by the American Section of the Joint Commission to determine the equitable distribution between the United States and Mexico and the use of the waters of the Colorado River. The data for the United States to apply only to that portion of the river from the Needles to the International Boundary and for Mexico from that boundary to the Gulf of California.

(1) Acreage of land now under irrigation with general description.

(2) Acreage and description of land not now irrigated but susceptible of cultivation with statement of most economical irrigation methods necessary.

(3) Value of land under (1) and value of products.

(4) Value of land under (2) and present value of products.

(5) Value of improvements on land in (1), (a) direct, (b) indirect.

(6) Value of improvements on land in (2), (a) direct, (b) indirect.

(7) Present and prospective uses of water for other purposes than irrigation.

(8) Report as to whether present irrigation systems can be changed with resulting economy in use of water or cost of operation.

(9) Amount of water which will probably be needed for (2) and (1) modified.

(10) Water flow of the Colorado River below the Needles.

(11) Power possibilities and flood protection.

(12) Probable dates of developments yet to be made.

(13) Approximate costs involved.

(14) Nature of titles to water used in Arizona, in California and in Mexico as established by law and court decisions.

(15) Duties and authority of officials who govern the regulation and diversion of water in the two states and in Mexico.

WATER RESOURCES CENTER ARCHIVES
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA
A. The Bureau of Reclamation has insufficient data to furnish this figure for each state. In the Weymouth report the figure of 1.5 acre feet per acre is given for average not consumptive use in the upper basin. Irrigated area in the upper basin in 1928 estimated at 1,700,000 acres.

7. Q. Prospective use in the above states.

A. The compact provides 7,500,000 acre feet annually for the Upper basin but where that will be used will be determined by the future investigations and agreements authorized in the Boulder Canyon act, Sections 15 and 19.

8. Q. Water duty in upper basin.

A. Past development in the Colorado River Basin has largely been contiguous to streams with favorable conditions for the return of unused waters. The average consumptive use during past development throughout the upper basin has been estimated by Weymout at 1.5 acre feet per acre. Storage construction has been negligible to date and the evaporation losses resulting therefrom may be neglected. Much of the areas remaining to be reclaimed will lie at some distance from the streams supplying the water, with therefore a greater opportunity for evaporation of return flow before it reaches living streams than is now the case. A great many reservoirs will also have to be provided to prevent disastrous shortages due to variable streams flow, and these will have large evaporation losses from extensive areas of water surface. The duty of water on the Grand Valley project in Colorado is 3.5 acre feet per acre per year at the farm.
9. Q. Water duty in the Imperial Valley.
   A. The annual reports of the Imperial Irrigation District give a duty at the farm of 3.7 acre feet per acre in 1927 and 3.51 for 1926.

10. Q. Water duty in Arizona
    A. On the Yuma project the duty at the farm is 3.0 acre feet per acre. On the Salt River project for the last five years for which records are available there were an average 2.87 acre feet delivered. Data on private projects not available.

11. Q. Average estimated annual flow at Yuma after dam is constructed.
    A. Impossible to supply a figure for this. Everything depends upon the rate and extent of development in the upper states, in Arizona and in California.

12. Q. Estimated water required per year to produce 3,600,000,000 kilowatt hours at Boulder Canyon Dam.
    A. Prof. Durand states that this amount of electricity (equivalent to 550,000 firm horsepower or an installation of 1,000,000 h.p. operating continuously at 55% load factor) can be secured with a mean flow of 13,000 cubic feet per second at a mean head of 430 feet.

13. Q. Based upon the old measurements at Yuma, what was the amount of water passing Yuma annually over any long period of measurement of record.
    A. Current meter measurements at sufficiently frequent intervals to permit a direct determination of the river discharge have been made since 1902. The figures for the years of
record gives an average of 16,450,000 acre feet
(1902-1927, inclusive)

14. Q. Why are the old measurements (20 odd years) said to be
inaccurate.

A. The Yuma record of Colorado River flow is the only re-
cord of considerable length for the main stream and must
therefore serve as the principal basis on which computa-
tions of river utilization are based. The methods of
measurement in vogue were covered by correspondence be-
tween the Denver and Yuma offices in August - November,
1928, from which it appears that the following methods
were employed:

(a) Prior to 1918 soundings and measurements were made
without the use of a stayline and thereafter to Jan-
uary 21, 1926, a stayline was used both for sounding
and meter measurements. The depth to bed or meter was
taken as the submerged length of cable. Since Jan-
uary 21, 1926, the static method of sounding has been
used.

(b) The danger of loss of meters from entanglement in
debris and drift made it advisable to take only sur-
face measurements of velocity during a large part of
the time. Up until 1915 meter observations were
generally made at .2 and .8 depths. At high dis-
charges, only surface or .2 depth velocities were
recorded for a few high water measurements in the
years 1903, 1905, 1907, and 1913-1915. In 1904,
1909, 1911 and 1912 the periods when only surface
or for depths velocities were determined from 35 to 300 days. In 1916 observations were of surface and .6 depth velocities. From 1917 to 1923, observations were of surface velocities except with depth of less than 5 feet. From 1923 to date observations were at .2 and .8 depths for depths exceeding 2½ feet and at .6 depths for depths of less than 2½ feet. When surface velocities were observed, the mean velocity was assumed at .9, the surface velocity.

Factors in these methods tending to produce erroneous results, and their effects, are in part as follows:

(a) As no corrections were attempted on the lengths of submerged cable in sounding and in meter work, the results would show excessive discharge.

(b) The assumption that mean velocity is .9 of the surface velocity may be in error in either direction.

(c) Meters were rated infrequently. Colorado River silt on account of its fineness, enters the bearings and head of the standard Prime meter in use on the project, causing under-velocities and producing results less than actual discharge. When a gaging station was operated for a short time at Boulder Canyon, it was found necessary to employ specially constructed meters to obtain reliable results.

15. Q. How long have measurements, claimed to be accurate, been taken at Yuma?
A. As stated above, the "static method" of sounding has been used at Yuma only since 1926. Inasmuch as the importance of the corrections introduced by this method increases quite rapidly with the velocity and the velocity at Yuma seldom rises much over 7 or 8 feet per second, the introduction of this refinement is of importance principally in the interest of uniformity of method with the stations farther upstream.

The combined effect of the factors noted in the answer to question 14 is impossible of determination. While the effect of lack of correction in submergence depths may be approximated by attempting parallel observations in the future, instrumental conditions cannot be reproduced. The following is quoted from a letter by Superintendent R. M. Priest, Dated November 19, 1923.

"During the visit of the Colorado River Board at this office the discussion of methods employed in the past was taken up by Mr. D. W. Mead, and an offer was made to make a comparison between past and present methods of sounding. This was accomplished by recomputing meter notes taken since the static method of sounding has been adopted locally. The notes being recomputed and all static and air corrections disregarded and the observed depths used rather than the corrected and vertical depths. The examples used were for discharges of 50,000 c.f.s., 75,000 c.f.s., and 199,000 c.f.s."
"In none of the three cases listed did the recomputed discharges exceed the discharges obtained through application of all necessary corrections more than one per cent."

In general it is believed by the engineers of the Bureau of Reclamation that the measurements at Yuma, while they have been modified from time to time to keep abreast with current practice, furnish a record the accuracy of which throughout the period since 1902 is fairly comparable with that of the records over a similar period of similar streams anywhere in the country.

16. Q. What amount of water passes Yuma annually as determined by the new measurements?

A. In the view of the Bureau of Reclamation engineers the records as they stand furnish the best basis for a determination of the Yuma discharge.

17. Q. Has the amount of water in acre feet passing over Laguna dam been determined for any period of years?

A. Records have not been kept of the discharge over Laguna Dam. It is presumed that the question is intended to refer to the discharge at Laguna dam. An estimate compiled in the office of the chief engineer of the Bureau of Reclamation gives an average annual discharge at Laguna dam for the period 1902-1927, inclusive, of 16,920,000 acre feet. The Weymouth report gives a figure of 16,540,000 acre feet for the period 1899-1922, inclusive.
18. Q. How is the amount asked for in question 17 determined?
   A. From the measured discharge at Yuma the inflow from the Gila is deducted, and to this result is added the diversions of the Yuma main canal which heads at Laguna dam. In the case of the Weymouth figure given above the discharge at Yuma was estimated for the years 1899-1901 in order to carry the computation back to the beginning of the low run-off cycle.
ANSWER TO QUESTIONS PROOUNDED BY THE ARIZONA COLORADO RIVER COMMISSION

1. Q. Reconstructed flow of Arizona tributaries divided into
   (a) Contribution to main stream of the Colorado.
   (b) Present use.
   A. Discharge records on tributaries are insufficient to afford this information.

2. Q. Average annual flow at Lee Ferry.
   A. The average flow for the period October 1, 1923, to September 30, 1928, from U.S. Geological Survey records is 14,586,000 acre feet.

3. Q. Reconstructed average annual flow at Lee Ferry.
   A. Assuming the term "reconstructed flow" to mean undepleted flow or measured discharge plus upstream consumptive use, the chief engineer of the Bureau of Reclamation estimates the undepleted average annual flow at Lee Ferry for years 1850 to 1923, inclusive, at 15,900,000 acre feet.

4. Q. Average annual flow at Topock.
   A. The average annual flow for the period Oct. 1, 1918, to Sept. 30, 1928, inclusive, from U.S. Geological Survey records (accuracy for 1918-1922, fair) is 16,120,000 acre feet.

5. Q. Reconstructed average annual flow at Topock.
   A. Under the assumptions stated under question 3, this amount is estimated at 17,100,000 acre feet.

PRESENT IRRIGATION DEVELOPMENT AND FUTURE POSSIBILITIES FROM COLORADO RIVER BELOW THE VIRGIN.

(Preliminary outline prepared at Yuma, Arizona, June 11, 1926, by Frank Adams, in consultation with P.J. Preston, Project Superintendent, Yuma project.)

1. General description of the areas susceptible of irrigation from Colorado River below Virgin River.

2. Extent, character, location, and ownership of lands in the United States and Mexico irrigable from Colorado River below Virgin River by gravity and by pumping (with map showing irrigable and irrigated lands, principal canal lines, etc.; also, if practicable, an aerial survey map of lands below the border.)

Data from field investigation and the following:

(a) Manuscript reports assembled in "Colorado River Basin", particularly E.B. Combs Report on Lower Colorado River Investigations (XIII - A); Report on Lower Colorado River, General, by L.M. Lawson (XVI - A); Map compiled by J. A. O'Conner (XVI-B2); and miscellaneous notes in XVI Bg, XIII-B6, XII-B7, XII-C.

(b) Water Supply Paper 295.

(c) Senate Document 142, 67th Cong., 2nd Session.

(d) Soil Survey of Imperial Valley by A.T. Strahorn and S.W. Costly, (Manuscript).

(e) Soil Survey of the Palo Verde Area, by A. E. Kocher and F. O. Youngs.

(f) Soil Survey of the El Centro Area, California, by A. T. Strahorn, et al.

(g) Soil Survey of the Brawley Area, California, by A. E. Kocher, et al.

(h) Data presented in hearings on Swing-Johnson Bill.

(i) Data that can be obtained from Imperial Irrigation District and from the Chandler and other interests operating below the border.
Miscellaneous old maps on file in Tumamoc Office, Bureau of Reclamation, chiefly file numbers 6-12-12, 4-5-10, 6-1-15, 6-12-10, and the following unnumbered maps: Colorado River Delta Laguna Dam to Tidewater, by F. L. Bellow, 1908, and Delta of the Colorado River in Lower California, by T. Hind, 1911.


Report on the Problems of the Colorado River Basin, by Bureau of Reclamation, particularly Vols. 1 and 3 (manuscript).

Historical narrative of irrigation development from Colorado River below the Virgin, with all significant dates, water filings or permits or authorizations, progress of irrigation by years to the extent data are available, agencies through which irrigation development has been accomplished, nature of financing, farm development costs, crops grown, and settlement.

Data from field investigation and from the following:

(a) Manuscript reports assembled in "Colorado River Basin," particularly items listed under 2-a above and XV-1-9, XV-1-48, XV-4-60 to 132, XVI-3-5, XVI-3-18, XVIII-4-91, XIX-3-6, XVI-3-46 (Board Report by Mead, Henney, and Jacobs).

(b) Items listed as 2-e, 2-f, 2-g, 2-h, and 2-i above.

(c) Office of Division of Water Rights in California, State Engineer in Nevada, and Water Commissioner in Arizona.


(e) Irrigation in Imperial Valley, 1913-1917, Engineering News-Record, 201. 81, p. 244.

(f) Irrigation in Imperial Valley, by C.R. Tait, Senate Doc. 246, 60th. Cong., 1st. Session.

(g) U. S. Bureau of Reclamation, Annual Reports.

(h) Reports re Imperial Irrigation District and Palo Verde Irrigation District on file in office of State Engineer of California.

4. Water requirements of lands irrigable from Colorado River below the Virgin.

Data from field, irrigation districts, irrigation companies, and farmers by personal interview, from records of measurements by U. S. Dept. of Agriculture and State Experiment Stations, from official reports in Yuma Office, Bureau of Reclamation, and from study of soils.

5. Present and probable future costs of irrigation development under gravity and pumping systems along the Lower Colorado.

Data from Yuma project, Imperial Irrigation District, Palo Verde Irrigation District, and other existing enterprises and individuals; reports on All-American Canal; report of Arizona Engineering Commission; reports on proposed Cibola Valley Irrigation District by C. K. Harms and R. L. Norton; report by U. S. Indian Service on Parker Valley Developments; possibly some preliminary field surveys, if found necessary to determine general canal locations and elevations for pumping lifts.

6. Land and crop values in Lower Colorado River areas.

Data from existing projects, farmers, marketing associations and other dealers, farm advisors, State Experiment Stations, etc.

7. Water Supply of the Lower Colorado based on the provisions of the Colorado River Compact and on regulation and conservation at or in the vicinity of Boulder Canyon.

Compilation from previous studies by the Bureau of Reclamation.

8. Power development on the Lower Colorado and its relation to irrigation and agricultural development along the Colorado below the Virgin River.

Compilation from previous power studies by the Bureau of Reclamation supplemented by an economic consideration of the relation of this power to the agriculture of the Lower Colorado Basin.
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Data from field investigation and from the following:


(b) Items listed as 2-c, 2-e, 2-f, 2-g, 2-h, and 2-i above.

(c) Office of Division of Water Rights in California, State Engineer in Nevada, and Water Commissioner in Arizona.


(e) Irrigation in Imperial Valley, 1915-1917, Engineering News-Record, 201. 61, p. 244.

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DEPARTMENT OF STATE  
International Water Commission  
United States and Mexico  

Use of Water from Colorado River in Mexico  
by Frank Adams  

INTRODUCTORY  

During the period April, 1926, to June, 1927, the writer made certain special investigations for the Bureau of Reclamation, United States Department of the Interior, under instructions from the Commissioner of Reclamation, and a progress report was submitted in June, 1927. The present report, dealing only with the use of water from Colorado River in Mexico, and made for the International Water Commission, United States and Mexico, under instructions from the Chairman of the American Section of that Commission, is based mainly on additional investigations during the months of April, May, and June, 1927. Although prepared under different auspices, this later report is in fact supplemental to the previous report. However, in order that this report may be measurably complete, essential information relating to the use of water from Colorado River in Mexico which was presented in the previous report will be repeated herein, either as originally presented or revised as a result of the present investigation.

Relationship between Use of Water from Colorado River in Mexico and Use of Water from Colorado River in Imperial Valley, California.

Excepting as hereinafter indicated, water for the irrigation of lands in the lower Colorado River Basin in Mexico is obtained from the Imperial Canal system along its course in Mexico from the intake in the United States a short distance above the international boundary to its re-entrance into Imperial Valley, in California, at points east and west of Calexico and Mexicali. Delivery of water from this system to lands in Mexico is one of the conditions of the concession under which such system passes through Mexico.
This concession, dated May 17, 1904, and communicated by the President of Mexico to the Secretary of State, Development, Colonization and Industry of Mexico under date of June 10, 1904, provides in article second that, of the water authorized to be carried through canals in Mexico, "Enough shall be used to irrigate the lands susceptible of irrigation in Lower California... without in any case the amount of water used exceeding one-half the volume of water passing through said canals." The grantee under this concession or contract "is subject...to the inspection of the engineer to be appointed by the Secretary of Development..." Furthermore, in article eighteenth, "The Company, grantee, is at liberty to enter into contracts and agreements with individuals and private and public corporations for the use of the water granted to it, being subject in prices to be charged to the tariff which with due opportunity shall be presented to the Secretary of Development for his examination and approval..." Under article twenty-ninth, "The Company, grantee, shall subject to the laws and rulings now in force and which in the future may be enacted for the supervision, use and benefit of the water".

The original grantee under this concession was the Sociedad de Riego y Terrenos de la Baja California, S. A., which was a Mexican subsidiary of the California Development Company, which first built the Imperial Irrigation System. There has been no change in this contract, which, in the opinion of the Mexican attorney of Imperial Irrigation District (Mr. Barcenas) in Mexicali, is in itself a law because submitted by the President of Mexico to the Congress of Mexico and approved by it. Following financial reorganization of the system, a new Mexican company, the Compania de Terrenos y Aguas de la Baja California, S. A., succeeded to the rights under the concession, and this Mexican company became a subsidiary of Imperial Irrigation District, which in due course has acquired ownership of Imperial Canal and its various
works, as well as ownership of all of the capital stock of the Compañía de Terrenos y Aguas de la Baja California, S. A.

Imperial Irrigation District, acting through the subsidiary "compañía", delivers water for the irrigation of lands on demand. Delivery in Mexico is made from the main canals of the system, all laterals being built by and at the expense of the Mexican water users. The canals in Mexico from which deliveries are made are the Alamo, East High Line, Mesa, Solfatara, South Alamo, Ash, Alamitos, Central Main, Woodbine, Wormwood, Cerro Prieto, West Side Main, Wisteria, and Encina. The largest use being from the Alamo, Solfatara, Wormwood, Cerro Prieto, and West Side Main.

Until March 10, 1923, and aside from small quantities of water used by a few Mexican or Indian squatters in the lower delta, a few relatively small pumping plants, and about 2500 acres being supplied by wells on the Paul Williams tract near Cuervos Station on the Inter-California Railroad, all water used from Colorado River in Mexico for irrigation has been obtained, as above indicated, from the Imperial irrigation system.

On March 10, 1923, however, the first units of a battery of siphons being installed at the upper end of Pescadero Cut by Delta Canal Company, were started in service. These siphons, and the conditions of their installation, will be referred to later.

Land Ownership South of the International Boundary

The larger part of the irrigable land in the delta south of the international boundary is owned by the Colorado River Land Company, their total present holdings approximating 800,000 acres. The original holding of which this 800,000 acres was a part contained 832,000 acres and, according to Mr. H. H. Clark, General Manager of the Colorado River Land Company, was purchased outright from the Mexican Government in 1898. Three parcels of this land had been sold up to 1927 containing in all 52,000 acres. Of this
8000 acres is owned by the Shintani Company, 8000 acres by W. C. Allen (Globe Mills Company) and 16,000 acres by the Cudahay Ranch. A beginning was made in 1927-28 in subdivision and sale of some of the 800,000 acres remaining to the Colorado River Land Company, but the amount disposed of at this writing has been very small.

Next to Colorado River Land Company the largest holding of lands south of the international boundary is that of the Compania de Terrenos y Aguas de la Baja California, S. A., a subsidiary of the Southern Pacific Company. This property is part of an approximately 100,000 acre tract purchased in early days from G. Andrade by the California Development Company (through its subsidiary Mexican Company) but retained by the Southern Pacific Company (through repurchase at auction) at the time of the financial reorganization of the system. This tract lies between the international boundary and the Hunt survey or "C. D." line and approximately from Colorado River on the east to a north and south line about four miles west of Caléxico and Mexicali. A considerable portion of this area has been sold, the portion still remaining in the hands of the Southern Pacific Company (Compania de Terrenos y Aguas de la Baja California, S. A.), approximating 31,000 acres. The larger part of the original Andrade tract (99,848 acres) was sold by the Southern Pacific Company to the Mexican Government for colonization purposes, the area thus disposed of comprising the western portion of the original tract, beginning approximately opposite monument # 216 on the international boundary.

The statements in the preceding paragraph account for most of the area between the international boundary and the Hunt or "C. D." line with the exception of the following: The Packard Tract, near Mexicali, for some time owned by the Mexican Government and colonized; the mesa and other undeveloped areas north of the Southern Pacific Company holdings.
each of Monument 217, which is Mexican Government land; the "Andrade lands" between an old and the present channel of the Alamo southerly from Monuments 210 to 212, as to which ownership is contested but which are at present in control of the Daugherty Estate of San Francisco; and the lands sold by the Southern Pacific Company, other than that sold to the Mexican Government.

<table>
<thead>
<tr>
<th>Owner</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado River Land Co.</td>
<td>300,000</td>
</tr>
<tr>
<td>Southern Pacific Company</td>
<td>31,000</td>
</tr>
<tr>
<td>(Compania de Terrenos y Aguas</td>
<td></td>
</tr>
<tr>
<td>de la Baja California, S. A.)</td>
<td></td>
</tr>
<tr>
<td>Imperial Development Co. (Cudahy Ranch)</td>
<td>16,000</td>
</tr>
<tr>
<td>W. C. Allen (Globe Mills Co.)</td>
<td>8,000</td>
</tr>
<tr>
<td>Shintani Co.</td>
<td>8,000</td>
</tr>
<tr>
<td>Daugherty Estate</td>
<td>9,300</td>
</tr>
<tr>
<td>Land sold by Southern Pacific Company,</td>
<td></td>
</tr>
<tr>
<td>other than to the Mexican Government,</td>
<td></td>
</tr>
<tr>
<td>Mesa directly south of International Boundary</td>
<td>49,700</td>
</tr>
</tbody>
</table>

Total gross acreage.....

Irrigable Lands along Colorado River in Mexico

No accurate estimate of the irrigable area in Mexico would be possible without extensive and expensive detailed studies in the field. Numerous estimates have been made, some being as high as 800,000 acres, exclusive of the Sonora Mesa, which alone contains probably in excess of one hundred thousand acres which it would be physically possible to reach, very largely by gravity, through diversion at Laguna Dam. No field consideration has
been given to Sonora mesa, nor in fact to any of the lands in Mexico east of Colorado River. An attempt has, however, been made to obtain an approximate check on the irrigable area south of the international boundary as far as the present irrigation development has extended, and to make the best estimate possible of the irrigable area below that.

Two courses have been followed in approximating the irrigable areas south of the international boundary.

(1) For the developed section of the area south of the international boundary, that is, as far south as the Bee and Pescadero channels and the Rodriguez Levee use has been made of the 1927 crop report records of Imperial Irrigation District, and in these records the irrigable areas are those indicated as irrigable in the water applications on file in the Mexicali office; that is, in the office of Compania de Terrenos y Aguas de la Baja California, S. A. In some cases the areas are stated in the applications as gross, in others as net. The tabulation of these areas is presented as compiled by the subsidiary "compania" of the District, arranged by canals from which they are irrigated. A second tabulation is presented with the areas rearranged by principal ownerships or leases, and with some corrections made by the owners or leasees.

(2) The lands in the entire delta south of the international boundary have been platted on the map which accompanies this report and the irrigable lands indicated to the extent shown by the lease plats on file with the Colorado River Land Company, or in accordance with information obtained from owners or leasees or operating officials of Compania de Terrenos y Aguas de la Baja California, S. A., or of Colorado River Land Company and Delta Canal Company. The results of this method, obtained by planimetering, can be considered only approximate, although care has been taken to show the various classifications as accurately as the information available
permitted. For the undeveloped and unprotected portions of the Delta south of the Bess and Pescadero channels and Rodriguez Levee the boundaries of the irrigable lands are as indicated by the officials of the Colorado River Land Company and Delta Canal Company, with some corrections as suggested by the Engineer, J. Gonzales, Chief of the Commission for the First Zone of Waters of Lower California.

Table No. 2. Summary of Irrigable Lands in the Developed Sections Along Colorado River in Lower California as taken from 1927 Crop Report of Compañía de Terrenos y Aguas de la Baja California, S.A. (Subsidiary of Imperial District).

(Data arranged by Principal Canals)

<table>
<thead>
<tr>
<th>Canal</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alamo (inc. Carillo and East Side Main)</td>
<td>319,324</td>
</tr>
<tr>
<td>Solfatara</td>
<td>15,051</td>
</tr>
<tr>
<td>East High Line</td>
<td>877</td>
</tr>
<tr>
<td>Mesa</td>
<td>641</td>
</tr>
<tr>
<td>South Slamo</td>
<td>172</td>
</tr>
<tr>
<td>Ash</td>
<td>253</td>
</tr>
<tr>
<td>Alamitos</td>
<td>560</td>
</tr>
<tr>
<td>Central Main</td>
<td>957</td>
</tr>
<tr>
<td>West Side Main</td>
<td>17,315</td>
</tr>
<tr>
<td>Wisteria</td>
<td>4,204</td>
</tr>
<tr>
<td>Encina</td>
<td>1,952</td>
</tr>
<tr>
<td>Wormwood</td>
<td>3,079</td>
</tr>
<tr>
<td>Cerro Prieto</td>
<td>50,363</td>
</tr>
</tbody>
</table>

Total............ 415,006
Table No. 3. Summary of Irrigable Lands in the Developed Sections along Colorado River in Lower California as taken from 1927 Crop Report of Compania de Terrenos y Aguas de la Baja California (subsidiary of Imperial Irrigation District), in part Revised by Owners or Leases.

(Data re-arranged by Principal Ownerships or Leases.)

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado River Land Co.</td>
<td>172,643</td>
</tr>
<tr>
<td>Delta Canal Co. (leasee of C.R.L. Co.)</td>
<td>80,000</td>
</tr>
<tr>
<td>Mexican Government colonies</td>
<td>34,056</td>
</tr>
<tr>
<td>Imperial Development Co. (Cudahay Ranch)</td>
<td>10,315</td>
</tr>
<tr>
<td>W. C. Allen (Globe Mills Co.)</td>
<td>8,998</td>
</tr>
<tr>
<td>Southern Pacific Co. (including small area</td>
<td></td>
</tr>
<tr>
<td>belonging to the C. R. L. Co.)</td>
<td>6,861</td>
</tr>
<tr>
<td>Mt. Signal Land and Cattle Co.</td>
<td>6,381</td>
</tr>
<tr>
<td>Small independent areas</td>
<td>22,663</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>342,917</strong></td>
</tr>
</tbody>
</table>

Table No. 4. Summary of Irrigable Area along Colorado River in Lower California as Planimetered from Accompanying Map.

<table>
<thead>
<tr>
<th>Area Description</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>North of Bee and Pescadero Channels and Rodrigues Levee, exclusive of mesa lands:</td>
<td></td>
</tr>
<tr>
<td>Developed to 1928</td>
<td>280,000</td>
</tr>
<tr>
<td>Undeveloped</td>
<td>70,000</td>
</tr>
<tr>
<td>Mesa lands directly South of International Boundary (Approximately 90 per cent of total)</td>
<td>30,000</td>
</tr>
<tr>
<td>Unprotected and Undeveloped South of Bee and Pescadero Channels and Rodrigues Levees, estimated at 70 per cent of gross area (315,000)</td>
<td>220,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>600,000</strong></td>
</tr>
</tbody>
</table>
Reconciliation of Discrepancies in Above Summaries

It will be noted that the total irrigable area given in Table No. 2 above is some 72,000 acres in excess of the total in Table No. 3, also that the sum of the developed and undeveloped areas given in Table No. 4 falls between the other two. It will be remembered that the source of the information in Table No. 2 is the applications for water filed with Compañía de Terrenos y Aguas de la Baja California, S. A., and that in some cases the areas are stated as gross and in others net. If the gross areas were reduced to net areas, the total obviously would be smaller and tend to approach the figure given in the second summary. As a matter of fact, the corrections used in preparation of the latter were reductions of this nature, so that the second summary should be more nearly correct than the first. Furthermore, the total of the planimetered developed and undeveloped areas as platted, 350,000 acres, is in substantial agreement with the second total. On the basis of Tables Nos. 3 and 4, therefore, 350,000 acres might be assumed as an approximately correct figure.

On the other hand the Colorado River Land Company estimates the total irrigable area, developed and undeveloped, south of the International Boundary and north of the channels of the Bee and the Pescadero at 450,000 acres, and Imperial Irrigation District states that they have had applications for water for over 400,000 acres.

It is to be regretted that the available data do not permit of a more complete reconciliation of the figures given. However, for the purposes of this report, it is believed that 400,000 acres is a safe outside figure to use, and that figure will be accepted in the final summary of this report. This is about 80 per cent of the total planimetered area of 500,000 acres within the exterior boundaries of the portion of the Delta under consideration above. The 400,000 acres should be assumed, however, as the gross irrigable
area, including land occupied by roads, canals, levees, local waste spaces, etc., normally considered to be about 15 per cent of the gross.

Coming now to Table No. 44, which covers the entire Delta in Lower California, it should be made clear that the figures for the Bee and Pescadero channels and Rodriguez Levee are also necessarily approximations, although as nearly correct as the method used in arriving at them permitted. The total figure, 600,000 acres, is, however, in agreement with independent estimates by the Colorado River Land Company.

**Areas Irrigated from Colorado River in Mexico**

Water for irrigation first reached Imperial Valley from Colorado River through the canal of the California Development Company in 1900, and, according to the report of John T. Whistle, dated November 10, 1917, appearing in the compilation entitled "Colorado River Basin" on file in the Yuma office of the Bureau of Reclamation, water deliveries in Mexico were commenced in 1901. The amount of land irrigated from the system in that year is not known, nor have any data been found regarding use during the years 1902-1907. For the years 1908 to date, however, records are available from the reports and files of Imperial Irrigation District. In addition to these records, some figures for certain years have been obtained from various published or unpublished reports. While these latter figures are not always consistent with those in the records of Imperial Irrigation District, it seems well to include them for such value as they may have.

**Imperial Irrigation District Records of Use of Water from Colorado River in Mexico.**

From 1900 to June 22, 1916, when the Imperial Canal system passed from the Southern Pacific Company, which purchased it (on February 8, 1916) from the Receiver of the old California Development Company, to Imperial Irrigation District and to the Compania de Terrenos y Aguas de la Baja California, S.A.,
the "New Mexican Company" whose stock is owned by Imperial Irrigation District.

Imperial Canal was operated by the California Development Company in so far as it lay within the United States, and by its subsidiary Mexican company (the "Old Mexican Company"), the Sociedad de Irrigacion y Terrenos de la Baja California, S. A., in so far as it lay within Mexico. From June 20, 1905, to December 15, 1909, both the California Development Company and the old Mexican Company were under the complete management of the Southern Pacific Company, owing in the first instance to a certain loan of $200,000 by that company to the California Development Company. From December 13, 1909, to February 6, 1916, the entire canal system was operated by a Receiver appointed by the Superior Court of Imperial County, California. During the brief period February 8, 1916, to June 22, 1916, the property was owned by the Southern Pacific Company through purchase from the receiver of the California Development after protracted litigation largely involving the settling of controversies between the creditors of the California Development Company. Since June 23, 1916, the entire system has been controlled and operated by Imperial Irrigation District, acting directly as to property within the United States and through its subsidiary company, the Compania de Terrenos y Aguas de la Baja California, S. A. as to property in Mexico.

The above rental of the various changes in the control of the Imperial irrigation system is made because of the light it may throw on the records of use of water in Mexico as set forth in the table below obtained from Imperial Irrigation District. Obviously the lack of continuity of control and operation of the irrigation system must have been reflected in the records of deliveries and acre of water. However, the data in the following table have been gathered together by Imperial Irrigation District from the records of the various administrations having had charge of the system and they have not, so far as is known, been questioned.
Table No. 5. Areas irrigated in Imperial Valley in Mexico

1908-1927

<table>
<thead>
<tr>
<th>Year</th>
<th>Areas, acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1908</td>
<td>6,935</td>
</tr>
<tr>
<td>1909</td>
<td>9,051</td>
</tr>
<tr>
<td>1910</td>
<td>14,920</td>
</tr>
<tr>
<td>1911</td>
<td>14,953</td>
</tr>
<tr>
<td>1912</td>
<td>21,599</td>
</tr>
<tr>
<td>1913</td>
<td>33,761</td>
</tr>
<tr>
<td>1914</td>
<td>39,500</td>
</tr>
<tr>
<td>1915</td>
<td>41,000</td>
</tr>
<tr>
<td>1916</td>
<td>57,500</td>
</tr>
<tr>
<td>1917</td>
<td>77,500</td>
</tr>
<tr>
<td>1918</td>
<td>118,550</td>
</tr>
<tr>
<td>1919</td>
<td>136,560</td>
</tr>
<tr>
<td>1920</td>
<td>190,000</td>
</tr>
<tr>
<td>1921</td>
<td>120,000</td>
</tr>
<tr>
<td>1922</td>
<td>150,000</td>
</tr>
<tr>
<td>1923</td>
<td>180,000</td>
</tr>
<tr>
<td>1924</td>
<td>185,022</td>
</tr>
<tr>
<td>1925</td>
<td>215,912</td>
</tr>
<tr>
<td>1926</td>
<td>192,555</td>
</tr>
<tr>
<td>1927</td>
<td>156,168</td>
</tr>
</tbody>
</table>
Miscellaneous Records of Use of Water from Colorado River in Mexico

The All-American Canal Board dated July 22, 1919, states that probably less than 10,000 acres were irrigated below the border in 1910, while 22,000 acres is the figure given for that year in a "Statement of Physical and Related Facts Relating to the Colorado River" which accompanies a report of a United States Reclamation Service consulting Board dated June 7, 1911. By 1913, according to E. C. LaRue in Water Supply Paper No. 395, the Mexican irrigated area had increased to 50,000 acres, and by 1915, according to the L. H. Lawson Report of July, 1916, included in "Colorado River Basin" it had increased to 75,000 acres. In 1919, as stated in the report of the All-American Canal Board dated July 22, 1919, the area was "more than 100,000 acres".

It will be noted that all of the figures relating to areas irrigated in Mexico just given are below those furnished by Imperial Irrigation District with the exception of the larger of the two figures given above for 1910 (i.e., 22,000 acres) and the 1913 figure of 50,000 acres mentioned in Water Supply Paper No. 395. Since these data are fragmentary and since past use is of only minor historical importance, it is believed that the differences may be assumed to be immaterial and the figures furnished by Imperial Irrigation District accepted, at least until challenged and proven erroneous.