BOUNDARY OF THE FT. YUMA INDIAN RESERVATION
QUECHAN TRIBE
A REPORT BY
WHITNEY M. BORLAND, P.E. COLORADO NO. 3300
June 5, 1979
Second Report, April 23, 1980
Memorandum

To: The Files  
From: Whitney M. Borland  
Subject: Boundary Northeast Corner of Ft. Yuma Indian Reservation

A portion of my memorandum of June 5, 1979, made a study of the accretions that had occurred at the northeast corner of the reservation in the vicinity of the Old Laguna Diversion Dam.

In November, 1979, the Bureau of Land Management surveyed this portion of the reservation under the title, "Extented Surveys and Accretions Surveys of Section 25, 35, and 36, T. 15 S., R. 23 E., Survey of the 1902-03 Right Bank of the Abandon Channel of the Colorado River and Informative Traverse of the Present Bank of the Colorado River." The survey was made under Group 747 California and Group 614 Arizona. Special instructions were dated October 15, 1979. Survey notes had been received and the plat (Figure 1) has been approved by the Chief of the Cadastal Survey.

Because neither the survey notes nor the plat explained how the position of the partition line was located between the reservation and public lands lying north of it in the former laguna reservoir, this memorandum is being prepared to explained the method used in fixing the partition line.

River Movement and Resulting Accretion to the Reservation.

In 1879, W. S. Benson surveyed fractional T. 15 S., R. 24 E., SBM, and meandered the Colorado River through the township. In 1895, Frank S. Ingalls surveyed the Ft. Yuma Indian Reservation. The beginning point was the middle
of the Colorado River at a meandered corner common to sections 19 and 30, T. 15 S., R. 24 E., SBM, and was to go west along the section line between the above-mentioned sections.

Thus the meandered corner mentioned in the 1884 Executive Order setting up the reservation had been put in place, but none of Benson's corners were located by Ingalls.

Benson proceeded from the north to make his surveys, whereas, Ingall's surveys were tied into the International Boundary south of the reservation. There was an error of a little over a mile between the two surveys in the north-south direction, and a smaller error in the east-west direction. Until 1960, a tie had never been made between the two. It was necessary to use these two surveys tied together in order to define the position of the Colorado River at the time the reservation was established by the 1884 Executive Order.

In 1960-61, W. W. Glenn meandered the right bank of the River. This is the most recent survey and can be used to define the present position of the river as there have been only minor changes since then.

The Laguna Diversion Dam was completed in 1909 and greatly altered the course of the Colorado River at this location. River maps made by Geological Survey in 1902-03 have to be used to show the course of the river before the construction of the dam. From 1885 until the construction of Laguna Dam, the river moved eastward, thus accreting land to the Reservation.
After completion of Imperial Diversion Dam in 1938, the Laguna dam was slowly abandoned; and, at the present time, it does not act as a dam or cause any backwater upstream from it. In order to partially decrease sediment inflow into the canal at the Laguna Diversion Dam, a guide wall was constructed upstream, together with two large sluice gates. This guide wall still is in existence and forms an isthmus which produces two sharp bends in the river.

The dam controls the position of the river inasmuch as the sluice gates are now left open, and the river flows through them. The present river in the former Laguna Reservoir is still further east of the 1902-03 location. Its present position was caused by the filling of the Laguna Reservoir with sediment. This was a gradual process, and the movement of the river is considered to be an accretive one. In order to study the division of the accreted land so formed, it is necessary to use the three river positions discussed above.

The special instructions stated that Ingall's and Benson's meanders of the right bank of the river would be tied together and would be used to define the position of the river at the time the reservation came into existence. Two normal line one to the 1902-03 channel through Ingalls' meandered corner to his section 25 and 30, and the second normal line through Benson's meandered corner of sections 9 and 16 are to be surveyed to establish reference points on the 1902-03 channel and Glenn's 1960 channel. These two normal lines are some three and one-half miles apart. The distance between them was to be used as a proportionality factor in the proportionate-shoreline method of dividing accreted land.
Benson's, Ingalls' and Glenn's are all surveys of record so the distance between the line thorough Ingalls meander corner and that established by the normal line through Benson's meander corner can be accurately determined from their survey notes. Figure 2 is the detail of the Laguna area and shows the position of the various meander lines and the 1902-03 channel.

There is no difficulty in establishing the value of the proportional factor, which is 479.44 chains divided by 294.26 chains to give 1.629285.

As discussed in the BLM manual and in various textbooks, the proportionate-shoreline method would divide the new shoreline up proportionately to that which existed in the old shorelines. Usually there is an intersection or common point, or on certain occasions, parallelism of the old and new channels. In this case, the Ingalls' meander corner to section 25 and 30 is considered a common point and is some 15.40 chains from the old right bank line in sections 30 along the reservation boundary.

Multiplying this by the proportionality factor, the new shoreline is 25.09 chains in length. However, if this is measured from Ingalls' meandered corner around the isthmus existing in the channel as surveyed by Glenn, we get a very small area (shown as a dotted line on Figure 2). The accretion to the reservation should be much larger. A sinuous channel is caused by the isthmus and the face of Laguna Dam. This reach of the channel has been pretty well ignored, and a proportionate distance is measured from the intersection of the normal line with the 1902-03 channel at A.P. 3. The 1902-03 channel is followed until it intersects Glenn's meander of the right bank in 1960-61 at A.P. 1 and then follows Glenn's channel to make a total length of 25.09 chains.
In my calculations of the proportionate ratio I found that the distance between Glenn's meander corner to section 25 and 30 and Ingalls' meander corner of the same sections had not been included in the BLM's calculations. The distance is some 3.05 chains and would increase the Glenn meander distance between points to 482.49 chains, thus changing the proportionality figure to 1.63967. This factor when multiplied by the old frontage figure of 15.40 gives 25.25 chains - 16 links longer - and would add about 10 feet to the measured frontage.

There is an intersection between Glenn's meander and Ingalls' meander of the right bank of the Colorado River a very short distance above Ingalls' meander corner (Figure 2). This might have been used as the common point; however, it does not definitely define the partition line to section 30, nor would it remove the troublesome sinuous 1960 channel conditions upstream from Laguna Dam.

This condition would have been avoided if a two-step proportionate shoreline method had been used, accreting first to the 1902-03 channel and then to the 1960 Glenn channel. This was done in my Method E shown in my referenced report. The amount of accreted land is slightly larger in my Method E, but there is considerably more land downstream from Laguna Dam in the BLM survey which is compensating.

**Conclusion**

A fair division of the accretions to the Yuma Indian Reservation has been made. Figure 3 shows the boundary of the reservation on the latest U.S.G.S. Quadrangle map.
Before the BLM plat is finally filed in the State BLM office, there may be protests made concerning the survey. I do not feel, however, that the Ft. Yuma Indian Tribe has any reasons to make a protest.

The survey is vulnerable from two points of view. First, I know of no precedent for this type of proportionate-shoreline method, although I feel it is a fair division of accreted land.

Second, the omission of the distance of 3.05 chains as measured from Glenn's meander corner to Ingalls' meander corner of sections 25 and 30 appears to be an error in the proportionality factor that can possibly be challenged in court.

The portion of the reservation boundary defined by the 1902-03 channel from A.P. 1 to A.P. 32 becomes a fixed boundary not subject to changes in river alignment.
BOUNDARY OF THE FORT YUMA INDIAN RESERVATION

QUECHAN TRIBE

A REPORT

by

Whitney M. Borland
P.E. Colorado No. 3300

June 5, 1979
Memorandum

To:      Files
From:   Whitney M. Borland
Subject: Boundary of Fort Yuma Indian Reservation

Introduction

The Department of the Interior Secretary's Order and the Solicitor's Opinion, both dated December 20, 1978, reaffirmed the Reservation boundary as contained in the 1884 Executive Order. The Secretary's Order further required that the exact boundary be relocated and reestablished by survey. Within the boundary, there are patented lands, easements and right-of-ways owned or controlled by various public and private interests. Most of these are listed in the order and are to be segregated by survey. Probably the majority are contained in the Bard area (eastern part) of the reservation and of the recognized easements and right-of-ways, the Bureau of Reclamation will have the most. The attempted cession of part of the reservation on December 4, 1893 (ratified August 15, 1894) caused confusion as to property interests that to a degree still exist.
There are at least five major problem areas associated with the boundary and these have been brought about along the south and east boundary by movement of the Colorado River which was designated as the boundary in the Executive Order. Figure 1 is a modification of the map attached to the Secretary's Order showing in general the boundary and the problem areas.

Northeast Corner

The Executive Order indicated that the beginning point is the middle of the Colorado River due east of the meander corner common to Sec. 19 and 30 T. 15 S., R. 24 E., S.B.M. and was to go west along the section line between the above mentioned sections. A problem came to light sometime after 1900 when it was discovered that T. 15 S., R. 24 E., and T. 15 S., R. 23 E., S.B.M. had never been tied together and that if a tie were made it would contain an error of 82.15 chains north-south and 36.05 ch. east-west. T. 15 S., R. 24 E., being north (1 mile plus) and west of T. 15 S., R. 23 E. S.B.M. The U.S.G.S. River maps 1902-03 Sheet "P" indicates some confusion existed at that time as to the tie between these two townships. To accommodate the east-west error, a jog of 36.05 ch. to the east was made in the south end of the range line. The most recent B.L.M. retracement survey by Glenn completed in 1961 of Sec. 25, 35 and 36 shows the tie between the two townships.

In looking at a map showing the correct geodetic position of the two townships and the beginning point of the Executive Order, it appears the north boundary of the reservation should be 1 mile further north. Such a map appeared in circulation in the late 1950's and was called the "Benecke Map." The title was "Map of Portions of Arizona and California showing
Various Meanders of the Colorado River and Boundaries of Yuma Indian Reservation. It was prepared by a Yuma Title company and rejected by the Indian Claims Commission.

In projecting the north boundary westward along section lines, the present boundary does turn 90° south at the corner common to Sections 22, 23, 26 and 27, T. 15 S., R. 21 E., as directed in the 1884 Executive Order. Thus the order being written without benefit of a tie between T. 15 S., R. 23 E., and T. 15 S., R. 24 E., was ambiguous and in effect, described two different northern boundaries.

The intent of the persons writing the Order, together with the information they then had available, must be examined to determine the intended position of the north boundary. A letter dated November 13, 1883, from John W. Clark, Indian Agent, to the Commissioner of Indian Affairs, sets forth reasons for the new reservation and tells of a map of the proposed reservation by a "practical surveyor." The Indians would not move from the reservation east of the Colorado River without seeing a map of the new reservation indicating the good irrigable land that could be served by a canal. Figure 2, a portion of this map shows the proposed reservation as presented to the Indians. T. 15 S., R. 23 E. and T. 15 S., R. 24 E., S.B.M., are shown joining each other with no error in tie between them and the point of beginning is due east of the meander corner between Sec. 30 and 19 of T. 15 S., R. 24 E., S.B.M. Pilot Knob is mislocated on this map but the writers of the Order may have had the correct location. The west boundary now passes within one mile east of the Knob.
The policy of the Federal Government, starting about 1880, was to provide land to Indian families so they could either farm, cut timber, or raise livestock to support themselves, similar to the adjoining whites. This policy is reflected on the Map Fig. 2, in labeling the good land which was irrigable in the now Bard area and was included in the reservation. It was not the usual policy to include any known mineral deposits within a reservation. As a result, the area labeled pot hole placer was excluded and resulted in locating the north boundary in its present position.

Comparing the note on the proposed reservation map, Fig. 2, the point of beginning was 6 miles "below" meaning downstream (west) along the Colorado River. The north direction of "about 10 miles" is short by about 2 miles and the east direction of "about 18 miles" is short by a little over 3 miles. The conclusion is that the Executive Order portrays the present north boundary as spelled out in the practical surveyor's map submitted by Agent Clark and as shown on Figure 1.

In 1895, Frank S. Ingalls contracted (Contract No. 122) to survey the exterior boundaries and subdivide the reservation which contained nearly 50,000 acres. His instructions were very brief and the Executive Order was apparently about all he had on the boundary. A "diagram" attached to his instructions has been found with an accompanying letter dated May 14, 1895, which shows T. 15 S., R. 23 E. and T. 15 S., R. 24 E., S.B.M., adjoining each other naturally with no error in the tie between them. Ingalls started his survey, based on Poole 1855 and La Croze 1856 plats, at the corner of
townships 15 and 16 S., Range 21 and 22 E. S.B.M. To determine the north east reservation corner, he ran a line east on the township line to the range line between 22 and 23. Only mounds and pits (no posts) were found from La Croze's 1856 survey. Not finding the corner common to the four townships, he proceeded north 2 miles and located a stone monument common to sections 19, 24, 25 and 30. He then assumed that the corner common to the four townships was correct and after re-establishing the corners on township line between T. 15 S., and T. 16 S., R. 22 E., S.B.M., he ran east between T. 15 S., and T. 16 S., R. 23 E., found no trace of La Croze's corner and for the first time established the common corner between the following four sections, 34 and 35, T. 15 S., R. 23 E., S.B.M. and 2 and 3, T. 16 S., R. 23 E. S.B.M. Note this corner would have been on the left side of the river when surveyed by La Croze in 1856 because between that time and 1895 the river had moved over 1 mile south eliminating a large bend perhaps by an avulsive movement. From the township line, he proceeded north between sections 34 and 35 and proceeding northeasterly traveled along the west and north of Sections 35 and 25, he arrived at the corner described as the range line between Sections 24 and 25, T. 15 S., R. 23 E., and 19 and 30, T. 15 S., R. 24 E. S.B.M. None of La Croze's corners were found above on the range line between sections 19 and 30, T. 15 S., R. 23 and 24 E., S.B.M. although time after time, he indicates a "deligent search was made." In fact the proper retracement of La Croze's survey in T. 15 S., R. 23 E. rest on Ingalls' location or finding of a stone monument common to Sections 19, 24, 25 and 30 on the Range line between 22 and 23 east S.B.M.
From Ingalls' section corner between 24 and 25 on the range line between R. 23 E. and R. 24 E., at a distance of 5.68 ch. due east, the bank of the Colorado River was found, and a meander corner (M.C.) set which is the position of that called for in the Executive Order and is described by Ingalls as the M.C. between fractional Sections 19 and 30, T. 15 S., R. 24 E., SBM.

Note—La Croze Meander of the river in township T. 15 S., R. 23 E. stopped with a M.C. between Sections 36 and 25.

Benson surveyed township, T. 15 S., R. 24 E., S.B.M., in 1879 and meandered the river through the fractional township. His meander corner to fractional Sections 30 and 31 was 2.15 chains north and 3.27 chains east of Ingalls' M.C., however, Ingalls did not find this corner and if he had Benson's plat he would have believed it was over 50 chains further east and had been destroyed by a westward movement of the river since 1879. Actually the river at his location had moved less than 5 chains. See Fig. 10, depicting the meander lines by Benson & Ingalls and showing their respective meander corners.

It is possible that Ingalls knew of the error in the tie between the two townships but this is not probable. If he knew, he chose to ignore it. The township surveyed by Poole and La Craze in 1855 and 1856 were probably started from the International Boundary near Monument 207, Benson evidently started from the north. There is now a correction between T. 10 S., and T. 11 S., R. 21 E., which apparently was caused by these township surveys starting from different points. From the examination of the information available to the writers of the Executive Order, it is concluded that the
present north boundary as shown on Fig. 1 is the one intended and that the Executive Order contains a "honest" error in naming the meander corner to Sections 19 and 30 instead of 30 and 31 as shown on the present township plats.

River Conditions Above Yuma Narrows

At Yuma two topographic highs know as Prison Hill and Indian or Agency Hill constrict the width of the river to about 600 ft. for flood discharge and fix its location between them. Only a small portion of the largest well recorded flood in 1916 passed north of Agency Hill. The hills rise about 60 ft. above the wide valley floor upstream. During flood flows the river deepens its channel by as much as 40 ft. Degradation is about 2 ft. for every foot of rise in water surface. Before the closure of Boulder Dam in 1935, this constriction caused rapid aggradation upstream and large rapid movements of the river channel usually occurring during a flood when the river carried its heaviest sediment load. The constriction and fixing of the river location is very similar to that at Topock Gorge and at Adobe Ruins at the lower end of the Cibola Valley. Rapid aggradation and accompanying river movement occurred at all these locations.

Rapid accretive movement and avulsions occur with the major floods because the sediment load of the river increases roughly as the square of the discharge. The river is not able to carry its sediment load and must drop part of it as it flows through the wide valleys spreading out over its flood plain, forming inlands and braided reaches. Often one part of the valley become higher and the river will move to a lower part inturn filling that area. This process was most noticable above the Yuma Narrows.
Because marked changes occur during and after periods of high flow, the date of these flows become important in establishing when certain movements took place; especially avulsive movements. Flood flows for the Colorado and Gila are contain in Table 1 up to 1950 about 15 years after the time the effect of upstream storage had reduced flood flows and consequently rapid river movement. Figure 3 shows the position of the right bank of the Colorado River from 1856 to 1965. La Croze's meander of the right bank in 1856 show the Colorado River well to the north side of the valley with the Gila joining it immediately upstream from the Yuma Narrows. Up to 1920, the Colorado River had occupied various channel positions for a width of 2 miles.

In general, the movement was to the southeast. The 1856 survey showed a large island in Section 18 which was subdivided. The 1874 meander of the left bank by White which was 2½ miles to the southeast suggest an avulsive movement caused by the very large flood of 1862 & 1867. Ingalls' survey of 1895 shows remnants of an island in this area and the 1902-03 river maps show a large island in this location which probably developed into the "island" area of today formed by the avulsion of 1920.

On Figure 3, the position of the 1902-03 channel and that of 1917 suggest an avulsive movement and if the 1916 channel is compared to that of 1917, an avulsion seems to explain the change; especially when the flood of 200,000 c.f.s. January 22, 1916, in the Gila is considered and that in this flood its mouth moved 2 miles upstream. The right bank of the 1917 and the left bank of the 1916 channels are shown of Fig. 5. This set the stage for
the Colorado taking over the enlarged Gila channel. Note that near Yuma the 1920 avulsion was probably completed by the Colorado in 1917 taking over the abandoned Gila Channel. Warboys, in his report on the Colorado states all channel changes were gradual from 1908 to 1920. However, I believe the river in 1916 occupied one channel and after the Gila flood some 6 to 9 months later occupied a channel ½ miles south.

A well documented avulsion took place June 8, 1920, when the Colorado cut across section 17 and 18, T. 8 S., R. 22 W., a distance of about 1 mile to join the Gila. See Fig. 4. The distance to Yuma was shortened by 7 miles. The sinuosity factor was about 2.5 before the avulsion and was reduced to about 1.6 which is still high for normal stable reach of the Colorado River usually having a factor of 1.2 to 1.4. The peak flow in the Colorado was 190,000 c.f.s. on the day the avulsion took place. Prior to that time, due to the ever increasing distance around the large loop at high flow, the slope had decreased from Laguna to Yuma from about 1 ft. per mile to 0.87 ft. per mile thus increasing the tendency to aggrade. Normal slope for average discharge is a little over 1.75 ft. per mile for this reach of river. The slope of the Gila is 6 ft. per mile. Thus the velocity in the Gila is nearly twice that in the Colorado. Its scouring power is greater and its deposits on its flood plain are coarser, providing a more stable channel for the Colorado as it moved south above Yuma.

River movements events leading up to the 1920 avulsion can be followed on Figure 4 and were studied by a series of overlays using the 7½' U.S.G.S. quadrangle as a base Figure 3 in the west part of this series. Referring to Fig. 4, again the river movement was eastward from 1856 to 1902-03
through Sec. 25, T. 16 S., R. 22 E., S.B.M. and Secs. 30 and 31, T. 16 S., R. 23 E. This involved an accretive movement of a large point bar moving a distance of about 2 miles. The bend then remained relatively stable from 1903 until 1920 although downstream there was rapid movement north and south.

The other accretive movement forming the island area started in Section 15 and 16, T. 16 S., R. 23 E., S.B.M., between 1895 and 1902-03. Upstream from 1856 to 1825 there was rapid movement to the east and south in the vicinity of the township line according to La Craze 1856 and Ingalls 1895 surveys. This probably started the movement south in Section 15. In any event the large floods of the Colorado of 1907, 1909, 1912, 1914 and 1917 caused accretion on the inside of a sharp bend (a point bar) which moved the channel southward about 3 miles that resulted in the 1920 avulsion. Levees built about 1910 prevented the north end of the loop in Sections 16, 17 and 18 from moving north or west and probably contributed to the avulsion. Thus the large loop forming the "island" on Figure 4 was caused by a eastward accretive movement upstream from the Yuma Narrows and a southward movement some 5 miles east of the narrows.

River movement continued after 1920 as shown on Figure 3. The 1920 Colorado Channel had moved south about 1½ miles from the Yuma Narrows as a result of the 1916 Gila flood and now was to move in a north east direction until 1953 when the McKwan Cut was made. This constituted a man made avulsive movement leaving an abandoned channel and not making any change in ownership.
While most of the river movements were accretive there is the possibility of five avulsive movements since 1856. Two of these were of an early date and did not effect land ownership and would be recognized only as occurring within a period of one year before and after a large flood and were not documented by river surveys. The third was documented by surveys, whose accuracy is unknown, one year apart, 1916 and 1917. The case of Arizona v. Gunther and Shirley Co. (423 P2d. 352) involved patented land in Sections 23 and 24, T. 8 S., R. 23 W., G&SRM, accretive movement was found to have taken place but the time did not cover the period of 1916-17 but was for the period after 1920. The fourth avulsive movement in 1920 was well documented and was without question a natural avulsion. The fifth avulsion was the McEwan Cut 1953 and was man made.

Prison Grant 1894

The map attached to the Secretary's Order had an overlay with four parcels of land numbered 18, 19, 22 and 25 showing in Sections 14, 15, 22, 23 and 24, T. 8 S., R. 23 W., G&SRM. These were claimed by Arizona as parts of an 1894 prison grant. The Federal Government granted to Arizona the land between the confluence of the Gila and Colorado Rivers to a point some three miles east of the Yuma Narrows. This would be to the range line between R. 22 W. and R. 23 W., G&SRM (see Figure 5 for area of grant). The area was defined by the GLO survey of White in 1874 who meandered both banks of the Gila and left bank of the Colorado Rivers. The case of Arizona v. Gunther and Shirley Co., previously mentioned, found an accretive
movement had added to their deeded land in the east half of Section 23 and west half of Section 24, T. 8 S., R. 23 W. for the period 1929 to 1952. Prior to 1920, if it is assumed an avulsive movement took place to account for the difference in channel location of the Colorado River in 1916 and 1917, part of the prison grant would have remain as shown on Figure 5. The northern and eastern portion would have been eroded away by the accretive movement of the river in moving towards the southeast, except possibly a small corner in the southeast of Section 24 which would have been virtually wiped out in 1929. Figure 5 indicates how accretive movement shown by channel locations of 1929 and 1953 successfully reduced the area formed by the assumed avulsion, wiping out all of the prison grant and leaving only one very small area of perhaps 15 acres straddling the section line between Sec. 22 and 23, T. 8 S., R. 23 W., G6SRM and a questionable narrow strip along the Marsh Airfield in the west center of Section 22. Neither of these areas were included in the prison grant.

The southeast corner of Section 25 and northeast corner of Section 25 included in the prison grant may not have been wiped out as the left bank line of Colorado in 1929 leaves about 30 acres. However, the 1920 left bank indicates all but about 10 acres is gone. See Figure 5. The accuracy of the 1920 channel is unknown, but the 1929 channel surveyed by Warboys shows A.P.'s on the map and should be accurate.

The date of the prison grant, 1894, was 20 years after the White 1874 survey defining the area and in this period the area of the grant was reduced by an accretive movement on the northwest end of it. Thus the amount and
shape of the grant is not known at the time the area was granted to
Arizona. In any event, any small portion remaining is not now part of or
connected to the present reservation. It is concluded that the grant in no
way effects the boundary of the present reservation.

McEwan Cut

The most southern position of the Colorado River in Sections 22 and 23,
T. 8 S., R. 22 E., G&SRM, was shown by the channels of 1917 and 1920, after
the unprecedented Gila flood of 1916 had scoured a channel to the Yuma
Narrows and it was taken over in this reach by the Colorado. After 1920,
it began to move north by accretion, especially in the western part of
Section 22, now the site of the Marsh Airfield. See Figure 3. The aerial
photo of 1938 shows a badly deteriorated channel and because, by this
time, upstream storage controlled flood peaks, there was not much chance it
would be flushed by high flows. The river from 1932 through 1940 had less
than one half its normal flow at Yuma. The sediment load returned to the
river at Imperial Diversion Dam completed in 1938, increased rapidly
because there was limited storage back of it and with no flood flows and
the decrease in base flow the channel deterioration was inevitable. Two
more events decreased flows past Yuma, the completion of Pilot Knob Power
Plant and completion of the Welton Mohawk Drain.

Thus river flows were reduced to a point that the river could no longer
carry the sediment load and part of it had to be removed by dredge at a
settling basin between Laguna and Imperial Dams. In a normal year, flows
were about a million acre feet, less than 10% of flow before 1935 and has
further decreased to less than 500,000 acre feet/year in recent years. In an effort to alleviate bank erosion problems in the sediment choked channel above the Yuma Narrows and provide better flow conditions at Yuma, the McEwan Cut was made in 1953. This constituted an avulsive movement in which the reservation retained the area south of the Cut and it fixed the boundary as the center line of the abandoned channel. See figure 6.

The abandoned channel's, right bank, has been surveyed by the BLM and is shown by Brooks survey of T. 16 S., R. 23 E. and T. 16 S., R. 23 E. completed in 1961, and Averill's survey of T. 16 S., R. 22 E. and T. 16 S., R. 23 E., S.B.M. of 1941. The left channel bank was surveyed by BLM and is shown on Cannon and Pittman's survey of T. 16 S., R. 23 W. G&SRM completed in 1961. The rest of the left bank is shown on Snider's and Brook's plats but details seem to be missing. The subdivision of the land between the cut (present river channel) and the abandoned channel is shown on Figure 6, together with the centerline of the channel.

Andrade Area

The problem in this area involves nearly 200 acres of alleged patented land and accretions thereto. The United States in an attempt to settle claims to this land brought a cause of action, Civil No. 74-71-GT, in the Southern California District Court, San Diego. A memorandum opinion was given and both parties appealed, Figure 7 "Court Map" indicates the Court's decision.
This case was complicated by a large accretive movement of the Colorado River eastward and survey errors. In the preparation for this case, it appeared that California erroneously issued patents for all of the land circa 1890 except for Lot 1 of Section 36, T. 16 S., R. 21 E., S.B.M., consisting of 0.90 acres. The exact location of these lands was complicated by a difference between Poole-La Croze's township plat (1856) and that of Ingall's (1895). Upon detailed analysis, it developed that Ingall's was in error, in reestablishing some corners about 10 chains north of La Croze's but that the meandered right bank of the river by both surveys was nearly correct. La Croze errored in measuring the west line of Section 25 by about 10 chains.

Before the trial, it was my belief that either the patented land (except Lot 1, Sec. 36) had illegal vested right or that if rights were valid they were entitled to accretion to the present bank of the river. See Figure 8 for accretion study. In the Federal District Court's opinion, reliance was placed on a case United States v. 11993.72 Acres of Land etc. (116F Supp 671) (1953). In this case 30 years had elapsed between the survey date and the clearlist date. A substantial amount of accretion had taken place and the decision stated that the land described on the clearlist was not entitled to the accretion. The Andrade land was clearlisted in 1884 according to the La Croze survey of 1856. Ingall's and La Croze's meandering of the river show there was substantial accretion between 1856 and 1895 and while there was no data as to the location of the river in 1884, it is assumed to be near the 1895 meander. Thus the decision to give the tribe all of the accretion, 160 acres.
In making an overlay study of the area, it was found that Davidson's study was more nearly correct than the 7½ minute quad map or the BLM survey by Snider in 1961. However, Davidson meander line of 1856 in Section 25 appeared to be about 300 ft. south of the court map.

The present position of the right bank of the river appears to be nearly correct as given by Glenn in 1961 but the location of the 1856 meander, Section and lot subdivision line is in error. The boundary of the reservation in this area is the centerline of the river and will not be changed by an appeal court decision but such a decision may change the subdivision of Section 25, 35 and 36. T. 16 S., R. 21 E., S.B.M.

**Laguna Accretion Area**

After Ingall's established the meander corner in the northeast corner of the reservation the river channel moved eastward as shown by the 1902-03 U.S.G.S. river maps. Laguna Diversion Dam was completed in March 1909 with a hydraulic height of 12 ft. A lake was formed upstream which rapidly filled with sediment, obliterating the old river channel. In 1948, the Yuma Main Canal was connected to the All American Canal and the Laguna Dam was no longer needed to divert water into the Main Canal. The California Sluice gates were closed, but with the sediment from Imperial desilting works caused aggradation in the Imperial Sluice Way because of lack of sluicing water. The Laguna California sluice gates were rehabilitated and a baffle apron placed below so they could be used to regulate flow through the present settling basin located midway between Laguna and Imperial Dams.
After Laguna was abandoned as a diversion dam it was found that the main river channel through the sediment deposited above Laguna dam moved to the east of the 1902-03 channel, see Figure 9. This movement of the river channel from it 1902-03 position to its position at the present time constitutes an accretive movement. It was gradual beginning with sediment filling the old channel and after a lapse of 30 or 40 years in which the channel, if it can be called a channel, switched back and forth across a delta like formation and finally was located near its present position. Note that since the base map, 1 minute U.S.G.S. quadrangle, Laguna Dam (Figure 9) made from aerial photos of 1953, there has been considerable accretive movement in the upper end of the former lake. The river channel from the 1976 aerial photos is shown on Figure 9 and has been used for the accretion studies.

Events causing the decrease in base flow and virtually the elimination of flood flows were due to increase in use of water for irrigation, completion of Pilot Knob Power Plant, development of upstream storage and completion of the Welton-Mohawk Drain. Gradually the operation at Imperial changed to suit the ever decreasing amount of water available to carry sediment and keep an active river channel from Imperial dam to Pilot Knob Power Plant. At the present time, a soft plugs designed to over top of 8,000 c.f.s. keeps water from the California sluice way from entering the river channel and directs it into the settling basin. A dredge here removes excess sediment and allows the water to return to the river channel just above Laguna Dam.
The river channel between Imperial and Laguna Dam carries water less than once a year. In August 1977, the soft plug was breached. The river now is used as a overflow channel for floods and emergency operation. If one considers the the settling basin and its connecting channel as the present river a man made avulsive movement of the river has to be the explanation and the 1953 channel would be selected as the boundary. Using this channel for accretion studies make very little difference in the results from using the 1976 channel.

Accretive studies have been made using the 1976 channel from aerial photographs. These studies consider using Ingall's MC of 1895 as a beginning point, for the partition or accretion line dividing the reservation land from the land north of it. The line also becomes the boundary. Method A applies the proportional shoreline method from the MC. Method B, using a due east project of the north boundary until it intersect the 1902-03 main channel right bank as a beginning point for Method C, and E uses a two step method of using the Ingall MC as a beginning point and accreting to the 1902-03 channel and then accreting to the 1976 channel. Method D would project the north boundary due east until it intersect the 1976 channel. These 5 methods are shown in detail on Figure 10 through 12.

While other method of dividing up an accreted area to riparian property owners have been used, the method preferred under normal circumstances is the proportionate shore-line and is described in the Manual of Instructions.
for survey of the Public lands of the United States (1973). This method is based on the case of Johnston v. Jones, 66 US 11 (1861). More details of various methods and examples can be found in Chapter 10 "Boundary Control and Legal Principles" (2nd Ed. - John Wiley & Sons, Inc.) by Curtis Brown.

The proportionate shore line method consists of definitely locating the bank line at the time accretive movement is considered to have started and extending the bank line until it becomes parallel to or intersects the new bank line at the time the partition lines are to be established. Using a ratio of the distances between intersection or parallelity of the old and new bank lines in a proportional equation, the intersection of the partition line with the new bank line is establish. The partition line is established as a straight line from the old property corner to the new point computed by the same ratios as obtained between intersections. Figures 9 and 11 showing intersection or points of parallelity and resulting partition or accretion lines.

A distinction should be made in the bank line established by a BLM meander survey and that taken from a topographic or aerial photo. The meander line is run as a series of short straight lines to divide the higher "fast" land from the river bed banks and is also used to compute the area of land described in deeds and patents of Riparian properties. It is run along the top of the stream or river bank to describe the sinuosity of the bank line. This is somewhat different than the waters edge show on a topographic map.
or taken from an aerial photo. This difference in definition of bank line becomes troublesome when both types of lines must be used for accretion studies where wide flood plains exist and secondary channels are present. Because the best evidence of channel or bank line locations nearest the time certain division of land are to be made, the two types of bank line definition are often used together.

Accretion study Method A had to make use of two meander lines from surveys of different dates, Ingall's (1895) and Benson's (1879). Because they were very close together and roughly paralleled at the beginning of the partition line, there use seems justified reference Figure 11. In this study the bank line of 1976 was curved gradually to past through the California sluice gates at Laguna. This interpretation was justified by the BLM plat survey by Glenn, 1961, showing the meander lines of both bank of the river and not showing the old dike which formed the settling basin when Laguna was used as a diversion dam. On Figure 11, the lower intersection point of the right bank given by Ingall's 1895 meander line and the 1976 channel falls just above the sluice gate. The upper point is taken at Imperial Dam where the 1895 meander and the California Sluice way will pass the river flow up to 42,500 c.f.s. Figure 11

The Method B study Figure 9 shows the north boundary extended due east and intersecting the 1902-03 channel as given on the U.S.G.S. river maps of that date. The partition line starts at this point of intersection. The other end intersects the 1976 channel right bank. This location is found by a proportionality defined by a lower intersection of the two channels
above the center of Laguna and the upper point defined by the intersection of the two channels a little over a mile below Imperial Dam. In many ways this study is more clear-cut than the others. Bank lines are defined by an accurate topographic map (1902-03) and a good aerial survey. All of the river channel and flood plain are shown where as with the meander line only a field interpretation of the bank line is given. The actual channel in 1895 may have been close to the 1902-03 position with a low flood plain between it and Ingall's MC.

Method C is a two step accretion study. First starting at the partition line at Ingall's MC and extending it to the right bank of the 1902-03 channel. Then doing another accretion study with the right banks of the 1902-03 and 1976 channel. The results are shown on Figure 10.

Method E is the same as C a two step approach except the two secondary channels are used to define the right bank of the 1902-03 channel. On Figure 12, both intersection points with Ingall's and Benson's meander line are shown together with the results of the study and with Method B also shown for comparison. This method gave less area than Method B but more than A or C.

Method B' was similar to B except that to determine the proportionality, the 1902-03 secondary channel in the reservoir was used. This resulted in slightly less area 9.16 acres and moved the partition line downstream about 275 ft. from that of B.
Table 2 summarizes the accretion studies and gives the amount of land that has accreted to the right bank of the Colorado River as shown on the 1976 aerial photos since Ingall's meandered the right bank in 1895. Method B is recommended adding some 182 acres to the reservation. In this method the north boundary is extended due east to the 1902-03 channel. From that point the proportionate shore line method of accretion is applied to extend the partition line to the present bank of the river. Reference Figure 9 and 10.

Trace of Reservation Boundary

Beginning at Ingall's MC in T. 15 S., R. 24 E., S.B.M. Now being between Sections 30 and 31, the line runs west following section lines 2 miles north of the township line between T. 15 S. and T. 16 S., S.B.M. In 1957 Lewis and Pearson resurveyed the north reservation boundary in T. 15 S., R. 23 E., S.B.M. from the corner common to sections 23, 24, 25 and 26 west to the range line between ranges 22 and 23 E., S.B.M., under group 413, California. Apparently most of the north reservation boundary was surveyed under the same survey group number 419, California including the northwest corner located at a point common to Sections 26, 27, 34 and 35, T. 15 S., R. 21 E., S.B.M. Glenn in 1960-61 resurveyed Sections 25, 35 and 36 under Group 459 and established the tie between the two townships T. 15 S., R. 23 E. and T. 15 S., R. 24 E. The resurvey and marking of the north boundary should not be too difficult because of these fairly recent resurveys.

The west reservation boundary in T. 16 S., R. 21 E. was originally surveyed by Poole and La Croze 1856 and while considerable resurvey work has been
done by Warboys and other in connection with the Andrade case it appears
Ingall's survey might be the only one on record covering the whole west
boundary since La Croze, 1856. Warboy in 1932 resurvey the boundary in
T. 16 S., R. 21 E., S.B.M.

The International Boundary forming the lower south boundary to the Colorado
River will not be a problem as it is well marked between California and
Mexico.

Beginning at the Colorado River and the International Boundary the
Reservation boundary follows the middle of the river to the Yuma Narrows.
The boundary is subject to change if the Colorado River moves.

Through T. 16 S., R. 21 E., S.B.M., the right bank was recently meandered
by the resurvey of Sections 24, 25, 35, and 36, by Snider and Murphy in
1961 under Group 459, California. Although the section and subdivision
lines are in error the meander line appears to match the present course of
the river. The left bank on a plat indicates it has also recently been
meandered but this office does not have a record of it. It would appear
that if the left bank meander notes can be found that the median line or
reservation boundary can be computed and suitable markers set.

Through T. 16 S., R. 22 E., S.B.M., Averill in 1949 made a resurvey of
accretions meandering the right bank under Group 365, California. The
survey included part of Section 26, all of 28, 29 and 36. The left bank is
shown on his plat but does not indicate the line is a meander line. Thus
it appears that to establish the present boundary the entire left bank
would have to be meandered and a portion of the right bank in Section 27 and all of Section 26. From the Bridge upstream through the abandoned 1953 Channel the boundary will be fixed.

In T. 16 S., R. 23 E., S.B.M., resurvey of accreted land and meander of the right bank made in 1949 under Group 365, California, can be used in establishing the boundary line. Here the boundary is fixed through the abandoned 1953 Channel and around the large loop of the abandoned 1920 Channel. Thus there is a short length of channel of about 1 mile subject to channel movement between the two abandoned channels. See Figure 6 and 13. Figure 13 shows the reservation from the Yuma Narrows to near the township line at T. 15 S. and T. 16 S., S.B.M. This map also show the recent subdivision of accreted land in the reservation. Part of the boundary line shown is the center of the present channel as shown on the 7½ minute U.S.G.S. quadrangle maps which used aerial photos of 1961 and 1962.

The left bank in part of T. 16 S., R. 23 E., S.B.M., is covered by Arizona surveys using the Gila and Salt River Meridian. In the Island area it was resurveyed and the bank meandered by Pittman and Murphy in 1961 under Group 355 for T. 8 S., R. 23 W., G&SRM. This is for the west half of the island area. For the east half of the island T. 8 S., R. 22 W., G&SRM, the survey of accreted land and meander of the left bank was by Averill in 1949 under Group 258, Arizona. Note that Averill's survey of the west half of the island in 1949 under Group 258, Arizona was cancelled but his meander of the low water 1920 channel may be correct. All recent surveys of the
abandoned 1920 channel are based on Warboys survey of the 1920 low water channel made in 1929 under Group 152 Arizona. The reservation boundary around the island loop is permanent. From the junction of the state line with the center of the river in Section 24, T. 16 S., R. 23 E., S.B.M., upstream (north) the reservation boundary follows the middle of the present river to Laguna Dam and the partition line defining accretions to the reservation above that dam. The boundary being ambulatory is subject to channel change.

The right bank in T. 16 S., R. 23 E., S.B.M. has been meandered in 1961 by Brooks under Group 459 in Sections 2 and 10. The left bank in T. 7 S., R. 22 W., G&SRM appears not to have been meandered except in Sections 13, 14 and 15 by Yunt in 1961 under Group 355 Arizona. In T. 15 S., R. 23 E., S.B.M., the right bank was meandered by Glenn completing the survey in 1961 of Sections 25 and 35 under Group 459. If the recent meander reasonably indicate the present channel position they can be used to establish the median line of the channel to define the boundary. All other present bank lines will need to be meandered or possibly taken off of recent aerial photos to establish the median line for the reservation boundary.

The reservation boundary after following up the center of the present channel to Laguna Dam will follow the middle of the channel to a partition line that will have to be determined. The recommended partition line is that of Method B which connects with the 1902-03 channel due east of Ingall's 1895 meander corner.
Conclusions

1. Ingalls placed his meander corner at a point within less than 3 chain error to that intended by writers of the 1884 Executive Order. The Order is in error in calling for the M.C. to be common to Sections 19 and 30 because the townships T. 15 S., R. 23 E. and T. 15 S., R. 24 E., S.B.M. are offset by 1 mile. The M.C. is common to sections 30 and 31. The present north boundary is correctly shown on the map accompanying the Secretary's Order of December 20, 1978.

2. The Colorado River before building of Boulder Dam in 1935 changed its course many times above the Yuma Narrows and has given rise to many land ownership disputes. After Ingalls 1895 survey of the Boundary, accretive movement added land to the reservation but this was more than offset by the avulsion of 1920 which permanently fixed the boundary around the loop.

3. A grant of land between the Colorado and Gila Rivers to the Arizona Prison at Yuma has been mentioned from time to time in connection with an alleged avulsive movement of the river between 1916 and 1917. Even if the block of land remained in State ownership it would have been nearly all eroded away by subsequent river movement. None of the possible remaining land (less than 20 acres) is within or borders on the Indian reservation.

4. The McEwan Cut caused a man made avulsive movement of the river and did not change land ownership. The reservation permanent boundary is fixed as the centerline of the 1953 abandoned channel.
5. The cause of action Suite Civil No. 74-71-GT (Andrade Case) has been appealed. In the Federal District Court about 160 acres of accreted land was awarded the tribe.

6. In the old Laguna reservoir area several accretion studies were made. Method B seems most fair and consisted of extending the northern reservation boundary due east to the 1902-03 channel and then drawing by proportionate shore-line method a partition line to the present river channel. This would add 182.31 acres to the reservation.

Whitney M. Borland
P.E. Colo., No. 3300
"RESERVE ASKED FOR BY THE INDIANS"

Beginning at Pilot Knob Peak about six miles below Yuma, thence running North about (10) ten miles, thence East about (18) eighteen miles, to a point on the Colorado River at point of Mountains, thence down the Colorado River to a point due East from Pilot Knob Peak, thence West to point of beginning."
Prison Grant
1894

Possible Remaining Portion of Prison Grant

FORT YUMA
Base Map, Yuma East 7½ Quad
Prison Grant to Arizona, 1894. Assumed Avulsion of 1916 - 1917 and River Movement to Date.
Scale: 1 Inch equals 2,000 Feet

WMB 5-79
**LEGEND**

- LaCroze 1857
- Ingalls 1895
- Present Channel
- Quechan Tribe
- Bump Title Lands
- Hanlon Title Lands
- 160 Acres to the Tribe
- Reservation Boundary

**CIV. NO. 74-71-G.T. (5/21/77)**

United States Of America vs.

Southern Pacific Transportat Company, et. al.

**Andrade Area**

**Court Map**

Showing Decision

(5/21/77)
Fig 12

Ft. Yuma Indian Reservation
Laguna Area
Accretion Using Ingalls' M.C.
Meander Lines of 1903 & 1935
with Secondary Channels of 1902-03
Method E
Scale 1" = 2000 ft
From Means Report May 1893

Since meandering of the stream was much greater in large flows than in small, interest centers around so-called flood years. Stream measurements commenced in 1902; prior to that time information is fragmentary.

Based upon available information it is probable that large floods occurred in the following years: 1862, 1867, 1878, 1881, 1907, 1909, 1912, 1914, 1920 and 1921.
Summary of Laguna Area Accretion Studies

<table>
<thead>
<tr>
<th>Accretion Study Method</th>
<th>Partition Line Begins at</th>
<th>Proportional Ratio</th>
<th>Dist. along Rt Bank from Intersection 1902-03 1976</th>
<th>Area Acres</th>
<th>Figure No.</th>
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<td>A</td>
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<td>1.450</td>
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<tr>
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<td>--</td>
<td>--</td>
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Distances and Areas from enlarged 7½ minute Quadrangle "Laguna Dam" 1953 aerial photography Scale 1" = 1,000 Ft. used as base map.