

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

Ciudad Juárez, Chih.,
September 10, 1970.

MINUTE NO. 238

IMPROVEMENT OF THE INTERNATIONAL FLOOD CONTROL WORKS OF THE LOWER RIO GRANDE. -----

The Commission met in the offices of -- the Mexican Section at Ciudad Juárez, Chihuahua, at 2:00 p.m. on September 10, 1970, to consider the improvement required by the international flood control works on the -- Lower Rio Grande in the light of experience gained in the flood of 1958, and that of -- 1967 which resulted from Hurricane Beulah -- and caused extensive damages in the two --- countries. -----

The Commission found that that experience, coupled with the increase in population and expansion of urban and agricultural developments in the two countries along the Rio Grande since the Flood Control Plan was adopted by it in 1933, demonstrates the need to improve the works so as to control floods of greater magnitude than those that had been anticipated. -----

The Commission reviewed the "Joint Report of the Principal Engineers on Improvement of the International Flood Control Works on the Lower Rio Grande," submitted by Principal Engineers Delbert D. McNealy and Norberto Sánchez G. under date of September 10, 1970, the English and Spanish texts of which, together with their exhibits, are attached hereto and form a part hereof. -----

The Commission agreed that there is -- need to improve the United States and Mexican floodways and their respective inlets -- in order to effect equal diversions of --- floodwaters of the Rio Grande through each of them so that flood flows reaching ----- Brownsville-Matamoros do not exceed the capacity of the river at that location; that there is need for a second diversion dam -- in the Rio Grande to assure diversion of --

(Continued on Sheet 2)

COMISION INTERNACIONAL DE LIMITES Y AGUAS
ENTRE MEXICO Y ESTADOS UNIDOS

Ciudad Juárez, Chih.,
10 de septiembre de 1970.

ACTA NUM. 238.

MEJORAMIENTO DE LAS OBRAS INTERNACIONALES PARA EL CONTROL DE AVENIDAS DEL BAJO RIO BRAVO. -----

La Comisión se reunió en las Oficinas -- de la Sección Mexicana, en Ciudad Juárez, Chihuahua, a las 14:00 horas del 10 de septiembre de 1970, para considerar el mejoramiento que requieren las obras internacionales para el control de avenidas del Bajo -- Río Bravo, de acuerdo con la experiencia obtenida en la creciente de 1958 y la de 1967, ocasionada esta última por el ciclón "Beulah", que causaron grandes daños en los dos países. -----

La Comisión encontró que dicha experiencia, unida al incremento de población y al aumento de los desarrollos urbanos y agrícolas que han tenido los dos países a lo largo del Bajo Río Bravo, desde que adoptó el Plan para el Control de Avenidas en 1933, demuestra la necesidad de mejorar las obras a fin de controlar crecientes de mayor magnitud de las que se habían previsto. -----

La Comisión revisó el "Informe Mancomunado de los Ingenieros Principales sobre el Mejoramiento de las Obras Internacionales de Control de Avenidas en el Bajo Río Bravo", presentado por los Ingenieros Principales -- Norberto Sánchez G. y Delbert D. McNealy, -- fechado el 10 de septiembre de 1970, del cual se acompañan a esta Acta y forman parte de ella los textos en español y en inglés y sus anexos. -----

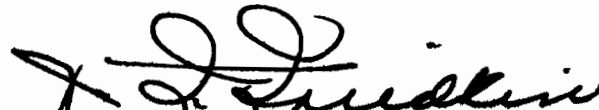
La Comisión estuvo de acuerdo en que se necesita mejorar los cauces de alivio de -- México y de los Estados Unidos y sus respectivas bocatomas, a fin de desviar gastos iguales de aguas de avenidas del Río Bravo por cada uno de ellos, de manera que los -- gastos de las avenidas que lleguen a Matamoros-Brownsville no excedan la capacidad -- del Río en ese lugar; en que se necesita -- una segunda presa de derivación en el Río --


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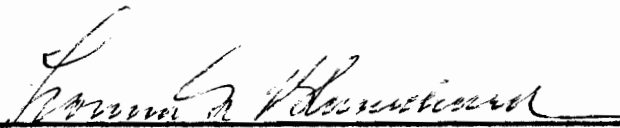
costs involved in such use be borne by the using country. -----

- 6. That each Government at its own expense proceed to construct, as soon as practical, the work of improvement of its respective floodways -- and their inlets, and to operate -- and maintain them in order that the two countries may effect equal diversions of floodwaters through -- them so that the flood flows reaching Brownsville-Matamoros do not -- exceed the capacity of the river at that location. -----
- 7. That each Government proceed to -- construct, operate and maintain at its own expense the improvement of the levees in its respective territory. -----

The meeting then adjourned. -----


 Commissioner of the United States


 Commissioner of Mexico


 Secretary of the United States Section


 Secretary of the Mexican Section

costos de operación y mantenimiento que implique esta utilización queden a cargo del país usuario. -----


- 6. Que cada Gobierno a sus propias expensas, proceda a construir, tan -- pronto como sea práctico, las obras de mejoramiento de sus respectivos cauces de alivio y de sus bocatomas y a operarlas y mantenerlas, a fin de que los dos países puedan desviar por ellas gastos iguales de aguas de avenidas, de manera que los gastos de las avenidas que lleguen a Matamoros-Brownsville no excedan la capacidad del Río en ese lugar. -----
- 7. Que cada Gobierno proceda a cons- - truir, operar y mantener, a sus propias expensas, las mejoras de los - bordos de defensa situados en su -- respectivo territorio. -----

Se levantó la sesión. -----


 Comisionado de México


 Comisionado de los Estados Unidos


 Secretario de la Sección de México


 Secretario de la Sección de los Estados Unidos

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

Ciudad Juárez, Chih.
September 10, 1970

JOINT REPORT OF THE PRINCIPAL ENGINEERS
ON IMPROVEMENT OF THE INTERNATIONAL FLOOD CONTROL WORKS
ON THE LOWER RIO GRANDE

To the Honorable Commissioners
International Boundary and Water Commission
United States and Mexico
El Paso, Texas and Ciudad Juárez, Chihuahua

Sirs:

In accordance with your instructions, we respectfully submit for your consideration this Joint Report on improvement of the international flood control works on the Lower Rio Grande in the United States and Mexico.

Background

The Commissioners of the International Boundary Commission in their joint report entitled "Preliminary Report on the Flood Control Plans, Lower Rio Grande," dated September 3, 1932, recommended:

1. That the two countries agree in general principle to the plan presented for protection of interests in both countries, including the construction of two international diversion structures in the Rio Grande, and
2. That each Section of the Commission be authorized to proceed without delay to construct, operate, and maintain such floodways as are situated in their own territory.

The two Governments proceeded with construction of floodways in their own territory, but approval of construction of the diversion structures was left pending, because there was no agreement on distribution of waters between the two countries.

The 1944 Water Treaty permitted the construction of diversion structures on the Rio Grande and, on December 18, 1950 the Commission executed Minute 196 recommending the construction of Anzaldúas Dam downstream from the Mission Inlet of the United States floodway. This structure was completed in 1960.

An extraordinary flood occurred in the Lower Rio Grande about the middle of October 1958 as a consequence of spills both at Falcon Dam on the Rio Grande and at Marte R. Gómez Dam on the tributary Rio San Juan. The maximum river flow at Rio Grande City was 104,000 cfs (2940 cms), and the capacity of the river at Brownsville-Matamoros was found to have diminished to 10,000 cfs (280 cms). Floodwaters in excess of this capacity were diverted through the floodways of the two countries, with about 55,000 cfs (1560 cms) through the United States floodways and about 25,000 cfs (708 cms) through the Mexican floodways. Because of inadequate capacity of the floodways of the two countries, and principally of their intakes, there was extensive flooding of towns and agricultural lands on both banks of the Lower Rio Grande.

To relieve problems similar to those experienced in 1958, Mexico in succeeding years constructed the San Rafael floodway, one kilometer wide, which connects the river with Culebrón Reservoir, to begin diversion of water when the flow of the Rio Grande there reaches 10,000 cfs (280 cms), and constructed a levee along the right bank of the Rio Grande from Retamal to Rio Rico, and reinforced the levees in the vicinity of Reynosa and Matamoros. In the years 1958 to 1961, the United States improved its levees on the left bank of the river.

To restore, to the extent practical, the capacity of the Lower Rio Grande, the two Governments, pursuant to Minute 212 dated December 22, 1961, through the Commission, jointly perform periodic clearing of the channel of the Rio Grande from Anzaldúas Dam to near the mouth of the river at the Gulf of Mexico, except for a reach of the river immediately downstream of the San Rafael floodway to maintain stages at the entrance of that floodway to facilitate diversions.

1967 Flood

At the end of September 1967, Hurricane Beulah swept the coasts of Texas-Tamaulipas causing storms in the Lower Rio Grande which occurred on watersheds saturated by the August rainfall, and with Marte R. Gómez Dam completely full, brought about unprecedented floods on the Lower Rio Grande.

The Rio Grande at Rio Grande City reached a maximum flow of 220,000 cfs (6230 cms) at midnight of September 22-23, 1967, as a result of the combination of the Rio Alamo flood, spills from Marte R. Gómez Dam and direct flow from the basin below Falcon and Marte R. Gómez Dams. All the flows produced by the part of the storm above Falcon Dam which reached a volume of one million acre-feet (1200 million cubic meters), were retained in Falcon Dam Reservoir.

The maximum flood flows as recorded at certain key points in September and October 1967 were:

Rio Grande at:

Rio Grande City	September 22	220,000 cfs	6,230 cms
Mission	September 26	216,000	6,120
Hidalgo-Reynosa	September 26	80,200	2,270
San Benito	September 30	25,000	710
Brownsville- Matamoros	October 1	16,000	450

Floodways in:

United States	126,600 cfs	3,590 cms
Mexico	64,600	1,830

The flood caused serious damages to urban as well as rural properties in both countries. It demonstrated the need to design and construct facilities to control floods of greater magnitude than those that had been foreseen. It demonstrated the need to improve the inlets and the channels of the Mexican and United States floodways to enable equal diversion of floodwaters by the two countries for flows in excess of the capacity of the Rio Grande at Brownsville-Matamoros. It demonstrated the need for constructing the second diversion dam in the Rio Grande to be able to assure the diversion of the water through the Mexican floodway in the same manner as Anzaldúas Dam was designed to assure the diversion of water through the United States floodway. It demonstrated the necessity of improving the levees of both countries for adequate protection of life and property.

Design Flood

Meteorological studies by the United States Weather Bureau, at the request of the Commission and the Mexican Ministry of Hydraulic Resources, indicate that the rainfall which occurred during Hurricane Beulah in 1967 may be considered as 60 to 80

percent of the maximum probable precipitation. Consequently, we believe that a design flood greater than the 1967 flood should be adopted for the Lower Rio Grande.

Based on the described studies, we recommend adoption of a design flood for the Lower Rio Grande of 250,000 cfs (7080 cms) at Rio Grande City.

Consideration of Alternative Plans

We have studied alternatives to improve the international flood control works on the Lower Rio Grande: additional storage reservoirs on the tributaries of the Rio Grande below Falcon Dam; improvement of the channel of the Rio Grande; and improvement of the floodways. The investigations show that the construction of additional storage dams on tributaries below Falcon Dam would have a very limited effect for the control of floods on the Lower Rio Grande. The studies indicate that the rectification of the Rio Grande and the enlargement of its cross-section to increase its capacity would be very costly, and furthermore very complex because the river is an international boundary.

We confirm that the most feasible plan for the improvement of the international flood control works consists in:

1. Improvement of the existing floodway system in the two countries;
2. Construction of the second international diversion dam in the Rio Grande to assure necessary diversions to the Mexican floodway; and
3. To continue maintaining the capacity of the river at and below Brownsville-Matamoros.

Distribution of Floodwaters

We believe it is equitable that each of the two countries divert through its respective floodway, one-half of all flood flows of the river in excess of the capacity of the river channel at Brownsville-Matamoros. We estimate a probable reduction of the flow of the design flood by channel storage in the river of 15,000 cfs (430 cms) from Rio Grande City to Anzaldúas Dam, and another reduction of 5,000 cfs (140 cms) between Anzaldúas and Retamal. We estimate that at present the capacity of the river at Brownsville-Matamoros is approximately 20,000 cfs (570 cms),

recognizing that this capacity is subject to change. Accordingly, the required combined design capacity of the floodways of the two countries would be 210,000 cfs (5950 cms).

On the above bases, in the event of the design flood, the maximum flows in the river and in diversions to the floodways of each country (see Exhibit 1) are tabulated as follows:

LOWER RIO GRANDE
DESIGN FLOWS AND DIVERSIONS TO THE TWO COUNTRIES

<u>Location</u>	<u>Maximum Flows</u>	
	<u>Cu. Ft.</u> <u>Per Second</u>	<u>Cu.Mtrs.</u> <u>Per Second</u>
<u>Rio Grande at:</u>		
<u>Rio Grande City</u>	250,000	7,080
Reduction in flow due to channel storage	15,000	430
<u>Mission</u>	235,000	6,650
<u>Diversion to United States Floodway</u>	105,000	2,970
<u>Hidalgo-Reynosa</u>	130,000	3,680
Reduction in flow due to channel storage	5,000	140
<u>Retamal</u>	125,000	3,540
<u>Diversion to Mexican Floodway</u>	105,000	2,970
<u>Brownsville-Matamoros</u>	20,000	570

Improvement of Inlets to Floodways in Each Country

To improve the United States floodway intake and the Mexican floodway intake, we have found that the plan offering the best protection to the interests of both countries, and the most favorable one from the technical and economic viewpoint, would be:

1. The United States intake channel or channels should be located above Anzaldúas Dam near Mission, Texas, designed to the satisfaction of the Commission to begin diversion of water when river flows, at this location, exceed the capacity of the Rio Grande at Brownsville-Matamoros, taking into account the reduction in flow due to channel storage, to guarantee equal diversion

of river flows by the two countries.

2. The Mexican floodway intake should be located immediately downstream from the Retamal Canal intake, near Retamal, Tamaulipas, designed to the satisfaction of the Commission to begin diversion of water when river flows at this location exceed the capacity of the Rio Grande at Brownsville-Matamoros, and to guarantee the equal diversion of river flows by the two countries.

We believe that each country should execute and maintain at its expense the improvement of the floodway inlets, the floodways, and levees located in its own territory, under the supervision of the Commission, and acquire the rights-of-way, easements, or other legal rights for operation of such floodways. The floodways in both countries should be maintained in such physical conditions as to permit their operation at the design flow.

The Second Diversion Dam

Design Criteria. To guarantee the required diversion of the waters of the Rio Grande to the Mexican floodway, there is required the construction of a second diversion structure in the Rio Grande, located immediately downstream from the inlet to the Mexican floodway, designated in this report as the Retamal Diversion Dam (reference Exhibit 2); in the same manner as Anzaldúas Dam serves to assure the required diversion of waters of the Rio Grande to the United States floodway.

In the Joint Meetings of Engineers and Technical Advisers of the Commission held on October 9 and 10, 1968; January 17, May 7, and July 15, 1969, it was agreed that the Retamal Diversion Dam should be designed and constructed so as to restrict the flow in the river below the dam to the capacity of the channel at Brownsville-Matamoros, presently estimated at 20,000 cfs (570 cms) and which can vary with time, and that Mexico effect diversion of flows reaching the structure greater than that capacity, which diversions must be at flows equal to the flows of diversions made by the United States.

There was agreement that the control of flows below the dam would be done by means of an automatically operated radial gate with opening of sufficient width and

height to permit free flow of the river, without appreciable backwater, for flows of the magnitude of the capacity of the river at Brownsville-Matamoros, or less; since the river's capacity may in the future be increased beyond the adjustment range of the automatic gate, there should be provided two mechanically operated radial gates, one on each side of the automatic gate, of sufficient capacity to permit, jointly with the automatic gate, flows downstream from the structure of up to 30,000 cfs (850 cms).

There was agreement that only a single central operations house joined to both banks with walkways would be needed, and that a vehicular bridge would not be required.

Each country should provide a source of electrical energy and each Section of the Commission should have an emergency plant for operation of the structure.

There was considered the possible use of the structure by either country to facilitate irrigation operations, with the finding that such use is feasible without any need to modify the design and construction.

The automatic gate should have a device which will enable it to be kept closed for utilization of waters by either of the two countries, and an automatic device would be needed for opening of the automatic gate when the water level in the river channel above Retamal Dam reaches an elevation jointly determined by the Commission, in order to avoid damage that might be caused by the water to either of the two countries.

It was agreed that for flood operations as now contemplated, the automatic gate would open when the flood begins and the water reaches the level referred to in the previous paragraph, and the side mechanical gates would remain closed; when the flood at the structure exceeds the capacity corresponding to that of the river channel at Brownsville-Matamoros, as predetermined by the Commission, the automatic gate would begin to close, restricting the river flow below the structure to that capacity and the excess flow would be diverted through the Mexican floodway which should be equal to the flow diverted by the United States through its floodway.

The general design of the proposed structure is shown on Exhibit 2.

Estimated Costs. The total estimated cost of the Retamal Diversion Dam amounts to \$3,201,200 dollars, United States currency. This amount includes the costs of site investigations, plans of the structure, its construction, dikes to connect the structure with the existing levees, and auxiliary works necessary for execution of the project.

Division of Costs and Work Items. We believe it equitable that the construction costs of Retamal Diversion Dam, including design, should be distributed equally between the two countries. We find it practical to effect the distribution of costs through division of work items for execution by each Section of the Commission. We recommend the following division of work items which include the cost of investigations and design:

	<u>Estimated Cost in Dollars</u>
<u>Allocated to Mexico</u>	
1. The foundation slab, including the ogee section, pier anchorage bars, metal sheetpiling under the foundation, and the pipelines of the automatic gate operation system embedded in the slab.	290,700
2. The two extreme piers adjacent to the abutments above the foundation slab, including post-tensioning.	156,400
3. Excavation of the structure's entrance channel.	11,900
4. Excavation of the discharge channel, apron concrete lining, gravel and sand filter, metal sheetpiling, and rock protection at toe of apron.	233,700
5. Construction of retaining walls and abutments, including handrails.	301,000
6. Construction of upstream and downstream cofferdams in the river.	13,500
7. Excavation of diversion channel and construction of temporary bridge over the diversion channel.	124,800
8. Construction of the earth embankments for the dikes between Sta. 9+922.264 meters and Sta. 10+000 meters and those located in Mexican territory, and the gravel surfacing on the crown of the dikes in Mexican territory. (The construction joint between the earth embankments to be constructed by Mexico and the United States will be designed and located in such manner as to balance embankment volumes.)	109,300
9. Construction of the commemorative monument.	24,000
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	Subtotal 1,265,300
	Contingency 15% 189,800
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	Subtotal 1,455,100
	Engineering 10% 145,500
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	Total 1,600,600

<u>Allocated to the United States</u>	<u>Estimated Cost in Dollars</u>
1. The four central piers above the foundation slab, including post-tensioning.	267,700
2. The hoist bridges and pedestrian bridges of the structure, including handrails.	14,900
3. The operations house, including the electrical and sanitary installations.	23,300
4. Furnishing and installation of all gates, including accessories and electromechanical system for operation, except for pipelines embedded in the foundation slab.	625,600
5. Removal of cofferdams constructed by Mexico in the river.	9,000
6. Construction of earth embankment of the dike in the diversion channel and backfilling the remainder of the diversion channel.	57,700
7. Construction of the earth embankments for the dikes in United States territory except between Sta. 9+922.264 meters and Sta. 10+000 meters, gravel surfacing on the crown of the dikes in United States territory, and all the riprap on the upstream slope of the United States and Mexican dikes, as shown on Exhibit 2.	238,500
8. Two electrical substations, one in Mexico and one in the United States, the electrical installation of the structure, lighting standards, accessories for lighting of the structure and the road guardrails in the international area.	<u>28,600</u>
	Subtotal 1,265,300
	Contingency 15% <u>189,800</u>
	Subtotal 1,455,100
	Engineering 10% <u>145,500</u>
	Total 1,600,600

Construction Program. Construction of Retamal Diversion Dam should be performed by the two Governments under the supervision of the International Boundary and Water Commission and through its respective Sections.

In accordance with the division of work items, Mexico should perform the first stage of construction to include the works above described and the United States should then perform the second stage construction to include the works above described. Lastly, Mexico would construct the commemorative monument.

Operation and Maintenance of Retamal Diversion Dam. As in the case of its construction, its operation and maintenance should be performed jointly by the Commission, and the costs divided equally between the two countries.

No operations should be permitted which might interfere with or impair operations for control of floods, as determined by the Commission. Within these limitations, each country could, with the prior approval of the Commission, unilaterally operate the structure to facilitate utilization of its waters. We believe the interested country should assume the operation and maintenance costs it may incur in operation of the structure for such purpose.

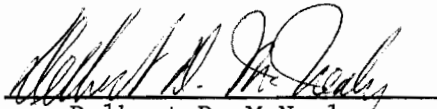
Recommendations

We recommend to the Commission:

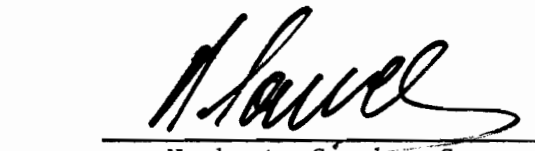
1. Adoption of the design flood described in this report, based on a maximum flow of 250,000 cubic feet (7080 cubic meters) per second opposite Rio Grande City, which decreases, by diversions to the interior floodways of each country and by channel storage, to approximately 20,000 cubic feet (570 cubic meters) per second at Brownsville, Texas-Matamoros, Tamaulipas.
2. Adoption of the plan of improvements in each country described in this report so that during floods the two countries divert through the floodways in their own territories, in equal parts, the flood flows in excess of the capacity of the Rio Grande at Brownsville-Matamoros.
3. Execution, as soon as practical, of the detailed plans for the construction of Retamal Diversion Dam pursuant to the location and general characteristics described in this report, under the supervision of the Commission.
4. Execution of the construction of Retamal Diversion Dam by the two Governments, through the Commission, as soon as it may be practical, in accordance with the equal division of work described in this report.
5. Joint execution of Retamal Diversion Dam operation and maintenance by the two countries, through the Commission, the costs to be divided equally. For such unilateral use of the structure for utilization of its waters as either country may make with the approval of the Commission, any additional cost resulting should be borne by the using country.

6. Execution by each country, at its expense, of the construction or improvement of the intake or intakes of its respective floodways, pursuant to plans approved by the Commission, and the corresponding operation and maintenance.
7. Execution by each country, at its expense, of the improvement works, and the operation and maintenance, of the floodways and levees of the Rio Grande located in its own territory; and that each country acquire rights-of-way, easements, or legal rights so that said floodways may be operated and maintained for the free passage of floodwaters and in such physical condition that they may be operated at their design capacity.

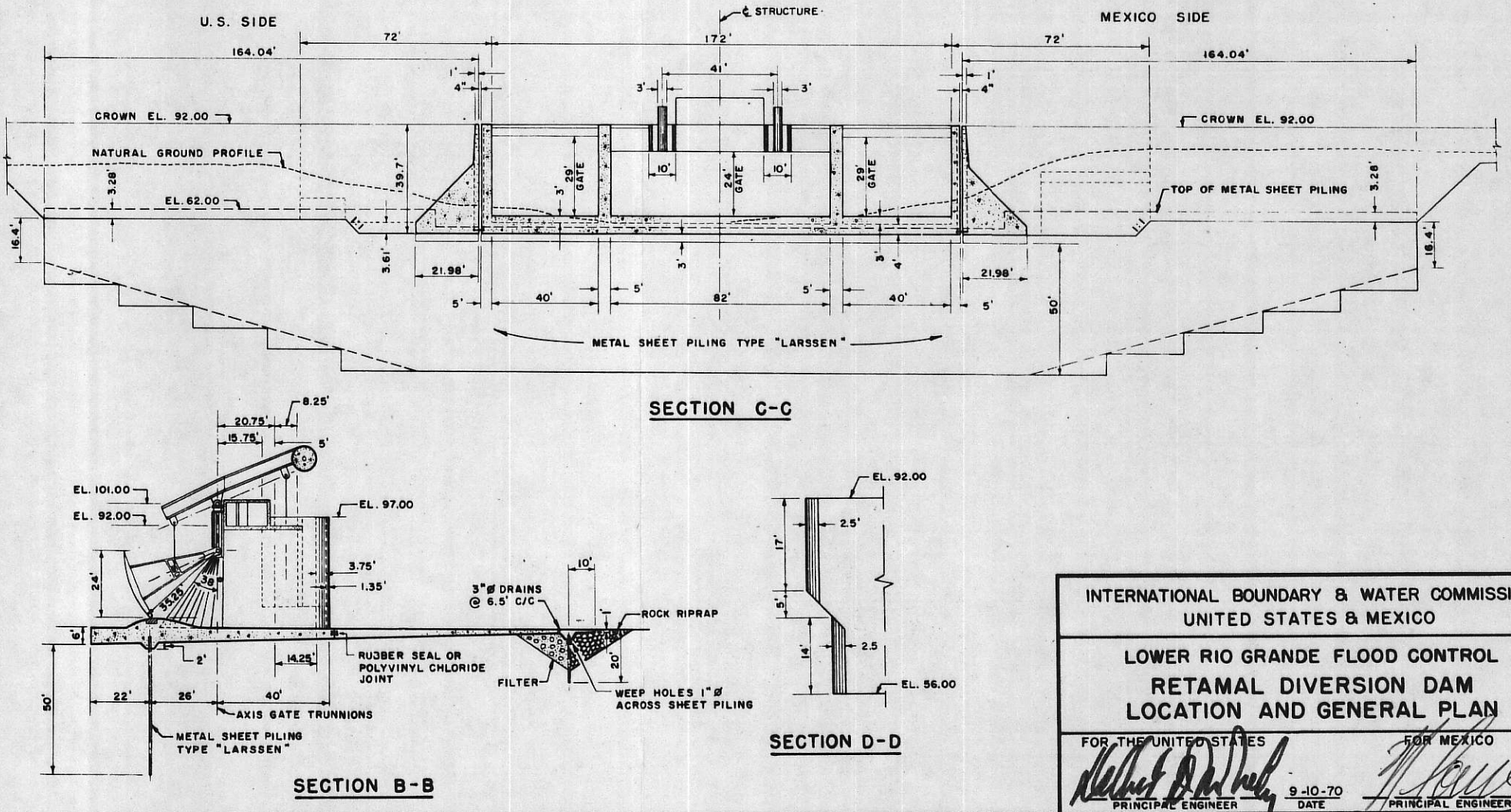
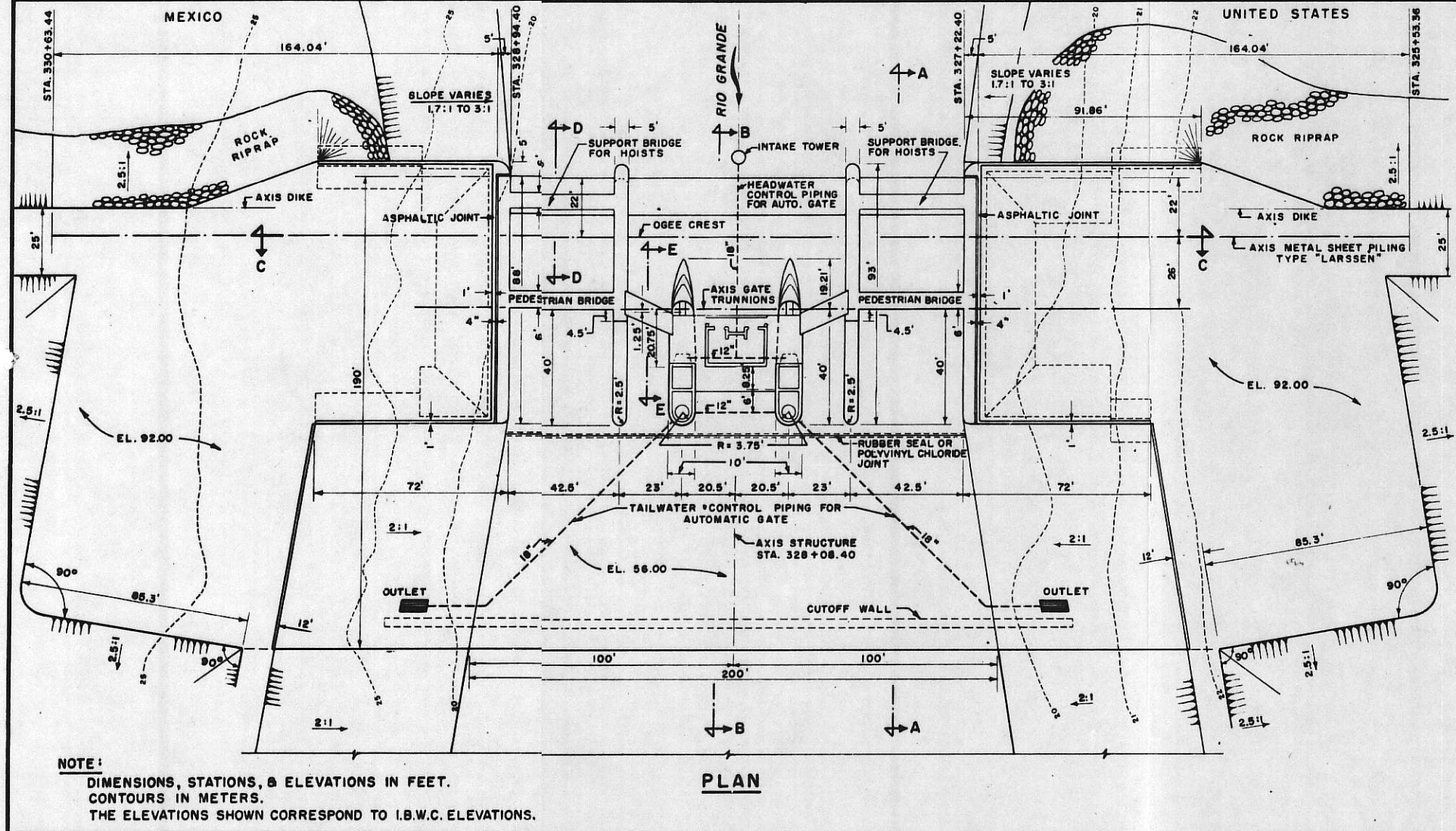
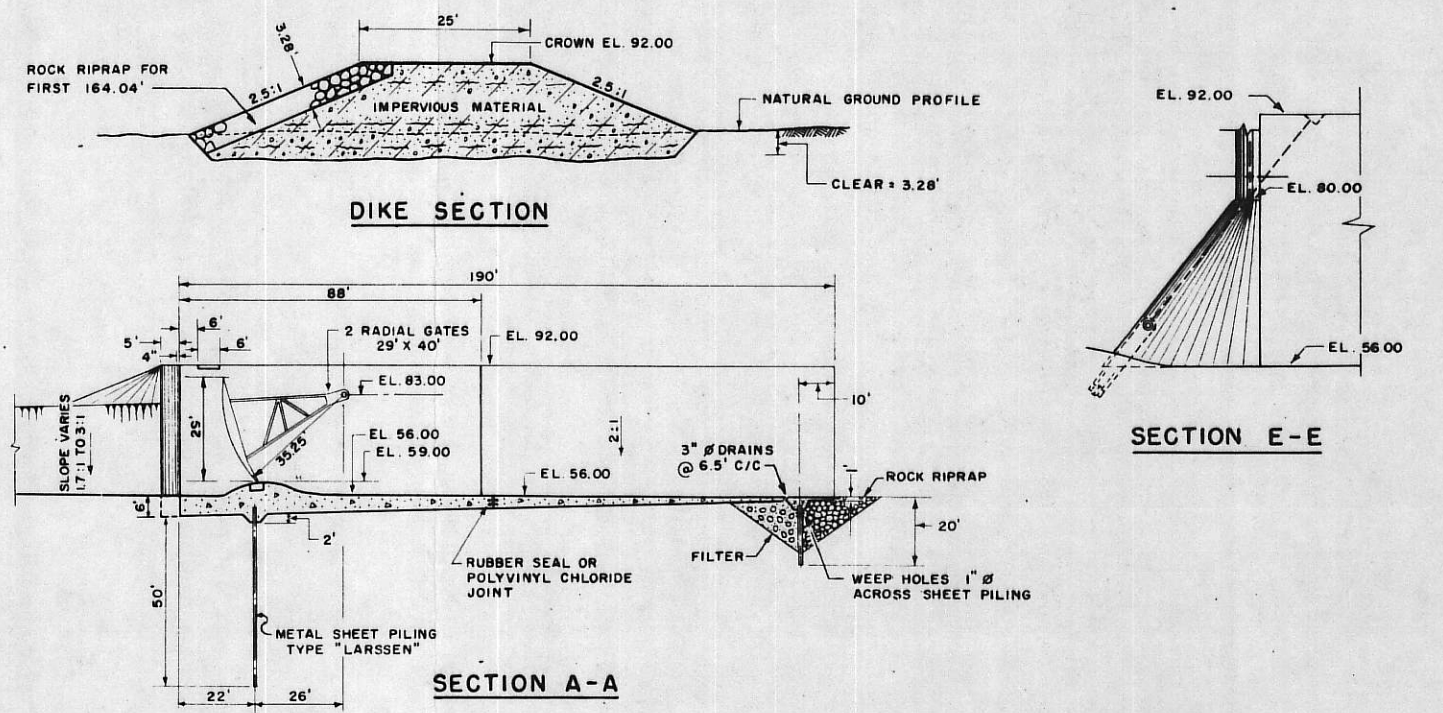
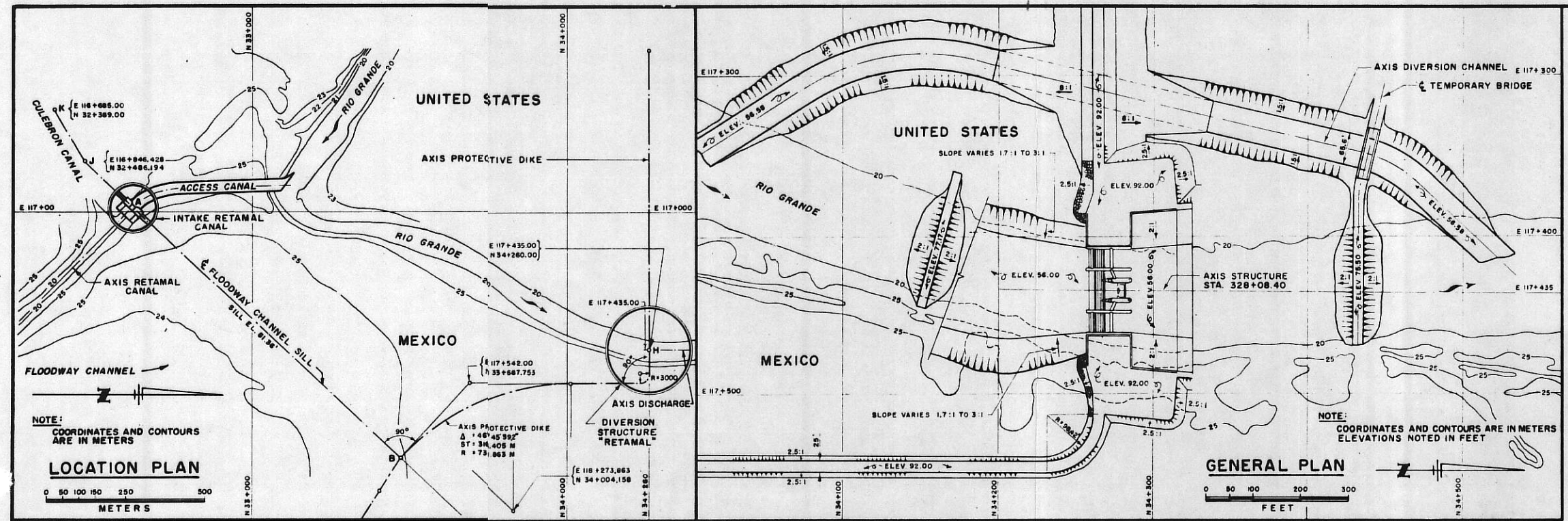
Respectfully,



Delbert D. McNealy
Principal Engineer
United States Section



Norberto Sanchez G.
Principal Engineer
Mexican Section



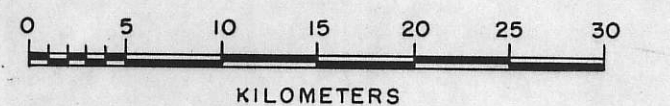
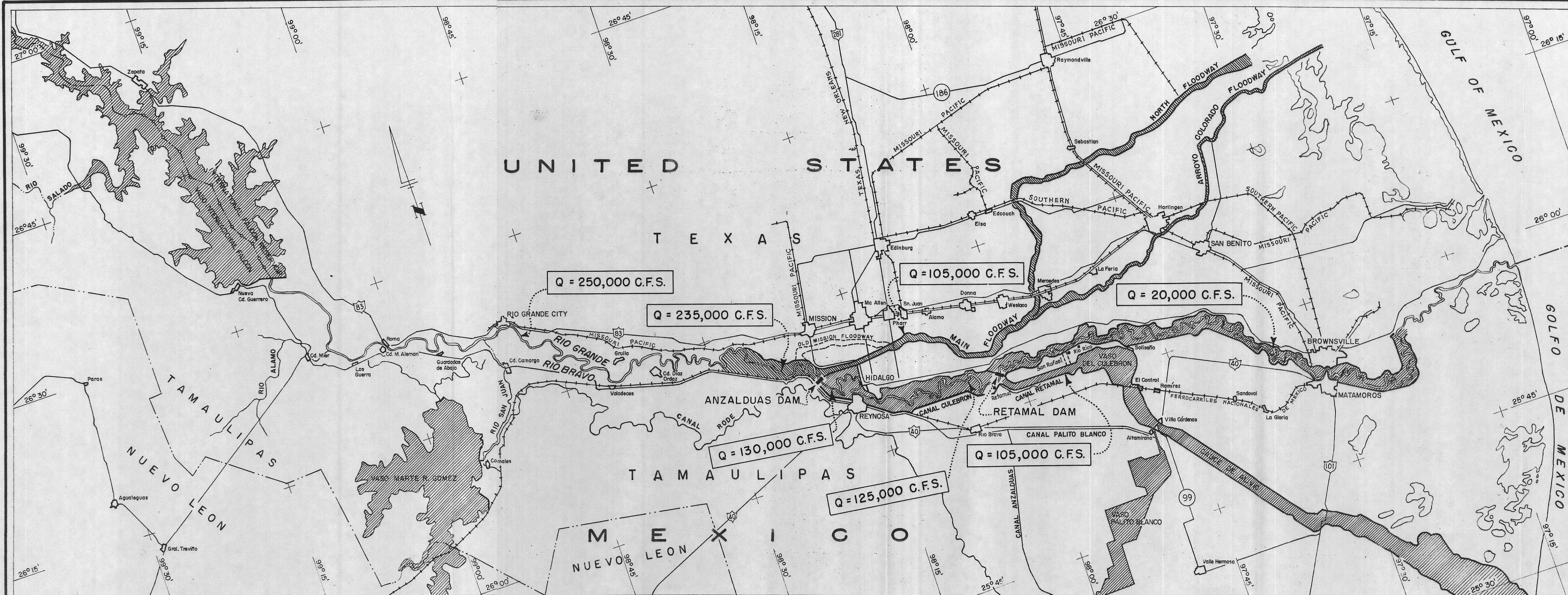
INTERNATIONAL BOUNDARY & WATER COMMISSION
 UNITED STATES & MEXICO

LOWER RIO GRANDE FLOOD CONTROL
 RETAMAL DIVERSION DAM
 LOCATION AND GENERAL PLAN

FOR THE UNITED STATES: *Albert D. DeWitt*
 PRINCIPAL ENGINEER

FOR MEXICO: *[Signature]*
 PRINCIPAL ENGINEER

9-10-70
 DATE



SCALE 1:400,000

INTERNATIONAL BOUNDARY & WATER COMMISSION
UNITED STATES & MEXICO

LOWER RIO GRANDE FLOOD CONTROL
GENERAL PLAN
DESIGN FLOOD FLOWS

FOR THE UNITED STATES FOR MEXICO

Michael D. Reedy 9-10-70 *Harold*
PRINCIPAL ENGINEER DATE PRINCIPAL ENGINEER

9/10/70

DISTRIBUTION OF MINUTE NO. 238 (and attached Joint Report)

IMPROVEMENT OF THE INTERNATIONAL FLOOD CONTROL WORKS OF THE LOWER RIO GRANDE

Signed Original (English)	To Department
1st carbon (signed)	A/CR for Minute Book
2nd carbon (signed)	Mexican Section
3rd carbon (signed)	To Department
Xerox Copy	*To Secretary
" "	A/CR Extra
Xerox Copy	To Commissioner
" "	To PE/P
" "	To PE/W
" "	To Comptroller
Signed carbon copy (Spanish)	Filed in A/CR
Xerox copy made for	*Secretary

One additional striking of English Joint Report (Original and 5 carbons) delivered to Mexican Section.

One additional striking of Spanish Joint Report (Original and 5 carbons) turned over to C & R for distribution.

LFB:mlm - 2
cc: Secy.