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EXECUTIVE SUMMARY
OF
WATER AVAILABILITY STUDY
FOR THE
GUADALUPE AND SAN ANTONIO
RIVER BASINS

Prepared for:

San Antonio River Authority
Guadalupe-Blanco River Authority
City of San Antonio

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1.0 INTRODUCTION AND BACKGROUND

As the summer of 1984 took its toll on the rivers and streams of south-central Texas, the impact of a brief but intense drought was evident. The drought resulted from a two-year period of subnormal precipitation in the region. Stream flows in the Guadalupe and San Antonio river basins, while already suffering from the drought conditions, were further reduced by the diminution of springflow, especially from the Comal and San Marcos springs. The springflow reduction was a direct result of the heavy use of the Edwards Aquifer as a primary source for municipal, industrial and agricultural uses.

While the 1984 drought was not the most severe by historical standards, it was a major concern to the people and businesses of the region. The Edwards Aquifer, the sole source of water for the cities of San Antonio, New Braunfels, San Marcos and others, was lowered significantly to 624 ft mean sea level (MSL) from the 1973 record high level of 697 ft MSL as measured in the test well in Bexar County. The historic low level in the Aquifer occurred as a result of the drought ending in 1956 with the level in the Bexar test well recorded at 613 ft MSL. During the summer of 1984, the Comal Springs discharge was reduced to a flow of 26 cubic feet per second (cfs) compared to the historical average of 299 cfs, and the San Marcos Springs dropped to a flow of 56 cfs compared to the historical average of 168 cfs. The flow of the Guadalupe River at Victoria dropped to a monthly mean of 105 cfs, barely adequate to meet the demands of existing water rights, and less than that required to sustain the productivity of the San Antonio Bay System. The San Antonio River maintained a monthly mean flow of 145 cfs, largely due to the wastewater discharges from the City of San Antonio and surrounding communities.

It is apparent that the relatively brief period of drought in 1984 accompanied by heavy usage of the Edwards Aquifer posed a serious threat to the region. In response, a three point action program was undertaken by local political leaders and the regional water agencies. A water conservation program was devised under the joint sponsorship of the cities dependent upon the Edwards Aquifer and the Edwards Underground Water District. The program was strongly supported by the San Antonio River Authority and the Guadalupe-Blanco River Authority. Second, a major study was undertaken under the joint sponsorship of the City of San Antonio and the Edwards Underground Water District to quantify the water supply required to meet the long-range needs of the area served by the Edwards Aquifer and to determine the most effective alternatives to meet the projected needs. The third response was the Water Availability Study for the Guadalupe and San Antonio River Basins sponsored by the San Antonio River Authority, the Guadalupe-Blanco River Authority and the City of San Antonio with financial assistance for the City provided by the Edwards Underground Water District. This study assesses the environmentally sound potential for surface-water resource development in the San Antonio and Guadalupe river basins and updates the cost estimates for development and transmission of water supplies to meet the requirements of the region.

Planning to meet long-range water requirements in the Guadalupe and San Antonio river basins by Federal, State and regional agencies has been a recurring activity since the mid 1930s. Major industrial development was projected for the coastal region associated with the two river basins. Some irrigation potential was recognized in the coastal plains. The growth of the San Antonio metropolitan area was recognized as a problem, especially following the most severe drought of record which occurred during the period from 1947 to 1957. Diminution of springflows in both river basins was recognized as having a significant impact on surface-water flows, especially in the Guadalupe Basin.

The potential for development of additional surface-water supplies to serve the region of south-central Texas which encompasses the Guadalupe and San Antonio river basins is well known as a result of past studies. Little additional water can be made available from river systems lying west of the San Antonio River Basin. Surface water resources within the Guadalupe and San Antonio river basins, if developed on a timely basis conjunctively with the groundwater, can meet the needs of the region for the forseeable future. The needs of the region include instream flow requirements to maintain a viable aquatic habitat and flows to the San Antonio Bay system necessary to protect the estuarine environment and maintain the productivity of the system. The major effort in the Water Availability Study was devoted to the Cuero I, Cuero II and Cibolo Reservoir sites. The Goliad Reservoir site was also studied to a lesser degree. Yields were also computed for Canyon Reservoir and the Cloptin, Lockhart, and Applewhite sites.

It became evident in the concerned discussions leading to the three point response to the drought of 1984 that little could be done to prevent serious economic disruption of the region if the drought was to continue and ultimately approach the severity of the 1950s drought. While some stored water was available from Canyon Reservoir in Comal County, it was inadequate to meet the apparent need to supplement the Edwards Aquifer and to meet the needs downstream in the Guadalupe Basin. Further, it was apparent that new transmission and water treatment facilities could not be constructed fast enough to alleviate a crisis.

It is imperative that the leadership and citizens in the affected region understand the critical nature of timely construction of reservoirs, water transmission lines and water treatment facilities to avoid serious disruption of the regional economy. The construction of water treatment and water transmission facilities will require two to three years depending upon the size and scope of the project. More important, however, is the time necessary to construct a major reservoir project which is estimated to be eight to nine years with an additional period of one to eight years to assure an initial filling of the reservoir. Initial filling is necessary before the full yield potential of the reservoirs can be relied upon.

2.0 SUMMARY AND CONCLUSIONS OF FINDINGS

2.1 ENVIRONMENTAL

Environmental analyses indicate no "fatal flaws" nor significant permitting problems at any of the potential reservoir sites studied. Mitigation of impacts will be required at any of the sites, which can be provided at least, in part, by peripheral land usage around the proposed reservoirs. No threatened or endangered vegetative, wildlife, or aquatic species are known to occur in any of the potential reservoir sites.

2.2 HYDROLOGY

Hydrologic evaluations indicate that substantial firm yields can be developed from the potential reservoir sites.

Existing water rights play an extremely important role in the future availability of water for development. Existing gaged flows do not yet reflect the full development of the existing water rights. Thus, even without additional reservoir projects, it can be expected that future flows within the rivers would decline as these water rights are developed.

Return flows by municipalities can play a dramatic role in the yield of any of the proposed reservoirs. The Goliad Reservoir benefits directly by having a dramatic increase in firm yield on virtually a one to one ratio for each gallon of water returned to the river by San Antonio. Less dramatic but equally important, return flows from San Antonio impact the ability of water-right holders below the confluence of the San Antonio and Guadalupe rivers to obtain their water rights. Return flows also impact the ability to meet the demands of the bays and estuaries, which have been defined in these studies. Future policy decisions by the City of San Antonio regarding these return flows will have a dramatic impact on decision-making regarding reservoir development.

Reductions in springflows from the Comal and San Marcos springs would have a severe impact on the ability of existing water-right holders to obtain flows which they have historically used, and would also have a severe impact upon the flows into the bays and estuaries. Likewise, the yields of Canyon Reservoir and any proposed reservoir projects would be significantly reduced by this reduction in flow, should springflows continue to diminish. Future policy decisions by the City of San Antonio and others regarding withdrawals from the Edwards Aquifer will therefore significantly impact the development of future reservoir projects.

Freshwater inflow requirements to the bays and estuaries required to maintain viable biological habitat have, for the first time, been applied to reservoir firm-yield calculations. Bay and estuary flow requirements to maintain a viable habitat can be met, and will be exceeded in most years due to uncontrolled drainage areas and flood spills. Even providing for these bay and estuary requirements, significant yields can be developed from any of the potential reservoir sites.

Table 1 provides a brief summary of the firm yields which can be developed from each of the four reservoir sites considered in these studies. A more detailed summary of each of the scenarios presented in Table 1 is given in the main report of the Water Availability Study.

Table 2 provides a brief summary of existing and permitted reservoirs which were assumed to be in place and operating under their full water-right demand in all yield analyses.

3.0 SECTION SUMMARY

The following paragraphs summarize sections of the report. This summary should provide the reader with an overview of the evaluations performed in the detailed study, and with the conclusions that can be reached from those studies.

Plate 1 provides an overall plan of the Guadalupe and San Antonio river basins. Plate 2 describes the Cuero I project, Plate 3 describes the Cuero II project, Plate 4 describes the Cibolo project, Plate 5 describes the Goliad project, and Plate 6 describes the diversion and delivery systems considered.

3.1 ENVIRONMENTAL ANALYSES

Environmental analyses were performed at the Cuero I Reservoir site, the Cuero II Reservoir site, and the Cibolo Reservoir site. In addition, studies were performed regarding instream flow requirements below each of the reservoirs, and freshwater inflow requirements to the bays and estuaries. Specific major topics include: vegetation, terrestrial wildlife, aquatic communities, bays and estuaries, and cultural resources. There were no environmental analyses conducted at the Goliad site.

3.1.1 Vegetation

The three primary reservoir sites studied are located within the Post Oak Savannah Vegetational region, the Blackland Prairies Vegetational region, and the South Texas Plains Vegetational region. Vegetational community types contained within these areas and found within each of the three primary reservoir sites include upland forest, bottomland/riparian forest, brushland, grassland, cropland, and hydric habitats.

No threatened or endangered plant species is known to occur in the vicinity of any of the three primary reservoir sites studied. Certain areas within each of the three primary reservoir sites should be considered ecologically sensitive, including hydric habitats and bottomland/riparian forest. Certain areas are likely to be classified as wetlands under Section 404 of the Clean Water Act; however, a precise determination of these areas has not yet been made. The primary impact on vegetation will be loss of existing terrestrial habitat resulting from inundation in the reservoir areas. The impact can be characterized by the surface area of each of the reservoirs, or approximately 41,500 acres for the Cuero I site, 26,875 acres for the Cuero II site, and 16,700 acres for the Cibolo site. The net effect will be to replace terrestrial vegetation communities with aquatic habitat.

Within the bottomland and wetland communities in the near reach downstream of the proposed dam sites, the alteration in the periodic flooding in these downstream areas could result in altered tree growth and a change in tree reproduction, and a tendency towards altered species diversity.

3.1.2 Terrestrial Wildlife

It is unlikely that a threatened or endangered species of terrestrial wildlife occurs within one of the three primary project areas. However, certain wildlife species which are considered to be threatened or endangered have a geographic range which include DeWitt, Gonzales, or Wilson counties. Many recreationally important species are known to occur in the areas, including the White-tail Deer, the Fox Squirrel, various rabbits, fur bearers, Northern Bobwhite Quail, Mourning Dove, Wild Turkey, and waterfowl. Impacts to wildlife will include loss of habitat and/or alterations in habitat caused by the projects.

3.1.3 Aquatic Communities

With respect to aquatic communities, the existing project areas are dominated by the Guadalupe River and major creeks. Sport fisheries include the spotted bass, channel catfish, and rough fish species such as gar, shad and buffalo. There are no Federally-listed threatened or endangered species which occur in any of the three reservoir project areas. The river darter and blue sucker are State-protected non-game species. The river darter occurs in Cibolo Creek at the Cibolo project area and in the Guadalupe River at the Cuero I project area. The blue sucker could occur in the Cuero I project area, however it is highly unlikely, especially since the development of dams in the river. There is no commercial fishery in any of the project areas.

Other important species include the freshwater prawn which was formerly commercially fished. Additionally, existing dams probably exclude the American eel from the Guadalupe River above the confluence with the San Marcos River. The Cuero I project would exclude eels from the dam site upstream to the existing dams, and along the San Marcos River as well. The Cuero II project would only exclude the eel from the dam site upstream on Sandies Creek, which currently provides poor habitat at best. Cibolo Creek provides, at best, marginal habitat for the eel, even if present.

The major effect of reservoir development on the aquatic resources of the three reservoir sites would be to alter the fishery from that occurring instream to a fishery typical of reservoirs. Spotted bass would be eliminated from reservoir areas, however largemouth bass would be greatly enhanced. Channel and flathead catfish would also be enhanced and sunfish species would tend to be enhanced as would buffalo, shad, gar and carp. Several species of minnows would be eliminated, to be replaced by others, while darters would be precluded from the areas inundated. The historically diverse population of fresh water mussels would be reduced. Overall, because of the much increased aquatic area, the total aquatic production will increase enormously. Additionally, game species, such as white bass and striped bass, will likely be stocked. Thus, the recreational fishery would be substantially increased.

3.1.4 Bays and Estuaries

With respect to the impact of potential reservoir development on the bays and estuaries, detailed analyses were performed. In general, reservoir development would result in reduced freshwater inflow to the estuaries. Extensive unpublished data from the Texas Parks and Wildlife Department and other agencies were gathered regarding salinity and biological sampling results. Detailed evaluations of salinity versus inflow were performed which, when compared to biological needs, resulted in the determination of high and low desirable salinity values. Recommended monthly freshwater inflows were established for each month of the year at levels which would maintain a viable biological habitat. These monthly requirements were then honored in the hydrologic model used to determine potential reservoir yields.

3.1.5 Cultural Resources

With respect to cultural resources, studies were performed using the existing literature of the Paleo-Indian, Archaic, Neo-american, protohistoric, and historic resources of Wilson, Gonzales and DeWitt counties. The Cuero I Reservoir site has been subjected to an intensive cultural resources investigation conducted by the Texas Historic Commission and the Texas Water Development Board in 1974. Portions of the Cibolo Reservoir site were studied in 1967, however no detailed studies have been conducted within the Cuero II Reservoir site. Many cultural resource sites would be impacted directly as a result of dam construction, relocation of roads, and reservoir filling. Other secondary impacts are also likely to occur. Any reservoir site selected for additional permitting and/or project development will require an intensive cultural resources survey covering 100% of all areas to be flooded or disturbed by any proposed project. Upon completion of the survey, the normal process of testing and possible subsequent avoidance, protection, or recovery of significant sites would be required. The exception could be the Cuero I Reservoir site, which is unlikely to have to be resurveyed, except for those areas not surveyed in the prior studies. It is also likely that the pipeline corridor for transporting water from any proposed reservoir to the users would also have to be surveyed for cultural resources.

3.2 HYDROLOGY

A detailed hydrologic analysis has been performed in these studies. Beginning with site selection analyses based upon prior studies and upon topographic maps of the river basins, the hydrologic analyses considered water rights, streamflows, evaporation, elevation-area-capacity data, sediment, return flows, existing and permitted reservoirs and requirements of the bays and estuaries. A very complex and detailed computer model was developed which combined both the San Antonio and Guadalupe river basins into one operating system. Corrections to streamflow were made for historical water rights diversions, after which all existing water rights were assumed to withdraw their full permitted amounts if available. Bay and estuary flow requirements necessary to maintain a viable habitat were fully honored. Other considerations included variations in return flows by the City of San Antonio and others, reductions in springflow as may be caused by future pumping of the Edwards Aquifer, and subordination/movement of existing water rights to further increase water availability. All four major reservoir sites considered in this study were utilized within the firm yield analysis, i.e., Cuero I, Cuero II, Cibolo, and Goliad reservoirs. In addition, the impacts of other projected future reservoirs, such as Cloptin Crossing and Lockhart, were taken into account.

Current pumpage of groundwater from the Edwards Aquifer is approximately 450,000 ac-ft/yr, and increasing. Table 3 provides a summary of Comal and San Marcos springflows under historical and future conditions for various scenarios. The Texas Department of Water Resources (TDWR) computer model of the Edwards Aquifer was used to evaluate the alternatives shown. As can be seen in the table, continued pumpage at current heavy levels, or even at reduced levels of 400,000 ac-ft/yr or even 350,000 ac-ft/yr, can be expected to significantly diminish springflows, especially when considering that extended drought periods which have historically occurred can be expected to recur in the future. Assuming a repeat of the 41-year period of record from 1940 through 1980, and assuming pumpage was reduced to 400,000 ac-ft/yr, the combined springflows would vary from 67,600 ac-ft in 1956 to 390,172 ac-ft in 1979. Compared to historical springflows, which varied from 75,561 ac-ft in 1956 to 462,820 ac-ft in 1975, even reduced pumpage levels would result in significant periods of time of zero flow, and would result in additional years when flow would be so low as to render significant damage to recreation, downstream water rights, and the aquatic environment.

None of the reservoirs evaluated within this study are contemplated to impound any water solely for flood control due to a change in national emphasis from structural flood control to non-structural preventative measures. However, preliminary analyses indicate that the combination of storage within the conservation pool, plus spillway attenuation, will to varying degrees, reduce flood peaks downstream of any of the reservoirs which may be built.

3.3 DESIGN

The dams and spillways were designed to safely pass the probable maximum flood. Gated spillways are contemplated for Cuero I, Cibolo, and Goliad reservoirs, while an uncontrolled concrete ogee overflow spillway is contemplated for Cuero II Reservoir.

Detailed engineering analyses were performed for the dam design, the diversion and delivery system design, and the relocations requirements for each of the three primary dam sites. A more general evaluation of the same factors was performed for the Goliad Dam site, excluding the diversion and delivery system and relocations. Plates 2 through 5 provide the pertinent data for each reservoir considered.

A diversion and delivery system for Cuero I and Cuero II reservoirs was also evaluated. This system was assumed to deliver water to the approximate location of the Cibolo Reservoir, there to be re-pumped to San Antonio. Plate 6 shows the layout of the systems required for each reservoir.

3.4 CONSTRUCTION

3.4.1 Permits

Table 4 provides a listing of Federal, State, and County permits/approvals which would be required to complete any of the potential reservoir projects. Significant additional environmental and engineering studies would be required in order to obtain these permits.

3.4.2 Scheduling

The scheduling requirements for construction of the three primary reservoir projects would vary somewhat. Approximately eight to nine years would be required from initiation towards development of permitting through final construction. Approximately eight additional years for any of Cuero I, Cuero II or Goliad reservoirs, and approximately 20 additional years for Cibolo Reservoir, would be required under "worst case" drought conditions for initial filling of the reservoir to occur. Should flows closer to average conditions or flood flows occur, the reservoirs could fill in as little as one year.

3.4.3 Costs

Tables 5 through 8 provide cost estimates for construction of each of the four potential reservoir projects considered. These costs are comprehensive in that they take into account right-of-way, recreational facilities, operating expenses, relocations, construction, permitting, engineering design, financing, and legal costs associated with such projects.

3.4.4 Recreation Benefits

The three primary reservoir sites were evaluated to estimate visitation rates and recreation activity patterns. It is projected that using 1980 populations, annual visitation to Cuero I Reservoir would be 1,522,673 persons per year, annual visitation to Cuero II Reservoir would be 1,715,191 persons per year, and annual visitation to Cibolo Reservoir would be 1,651,876 persons per year. It is expected that, as the region's population increases above 1980 levels, the annual visitation would increase in proportion to the population increase. Thus, reservoir visitations could be expected to be higher than the figures given above, depending upon when a reservoir would be completed.

Annual visitation is expected to vary depending upon the season, weekend versus weekday, and the type of activity. Summer month visitations are expected to comprise 45% of annual visitation at Cuero I or Cuero II reservoirs, and 50% at Cibolo Reservoir. Weekend users are expected to comprise 27% of annual visitation at Cuero I or Cuero II reservoirs, and 30% at Cibolo Reservoir. Design day loads for peak day visitation would be 15,812 persons per day at Cuero I Reservoir, 17,812 persons per day at Cuero II Reservoir and 19,060 persons per day at Cibolo Reservoir. Types of users would vary, including overnight campers, picnickers,.swimmers, boaters, fishermen and water skiers.

TABLE 1

SUMMARY OF RESERVOIR FIRM YIELDS

Scenario	Firm Yield of Reservoir or Reservoirs in Scenario (ac-ft/yr)						
	Canyon[1)]	Cuero I	Cuero II	Cibolo	Goliad	Lockhart	Cloptin Crossing
1. "Future Baseline"[1)]	37,500	--	--	--	--	--	--
2. Cuero I alone[2)]	37,500	188,000	--	--	--	--	--
3. Cuero II alone[2)]	37,500	--	107,000	--	--	--	--
4. Cibolo alone[2)]	37,500	--	--	30,000	--	--	--
5. Goliad alone[2)]	37,500	--	--	--	115,000	--	--
6. Lockhart alone[2)]	37,500	--	--	--	--	7,700	--
7. Cloptin Crossing alone[2)]	37,500	--	--	--	--	--	35,000
8. Combine Cuero I and Cuero II[2)]	37,500	219,000	Incl. in Cuero I	--	--	--	--
9. Combined Cuero I and Cibolo[2)]	37,500	185,000	--	30,000	--	--	--
10. Combine Cuero I and Lockhart[2)]	37,500	186,000	--	--	--	7,700	--

TABLE 1 (Cont'd)

SUMMARY OF RESERVOIR FIRM YIELDS

Scenario	Firm Yield of Reservoir or Reservoirs in Scenario (ac-ft/yr)						
	Canyon[1)]	Cuero I	Cuero II	Cibolo	Goliad	Lockhart	Cloptin Crossing
11. Combine Cuero I and Cloptin Crossing[2)]	37,500	173,000	--	--	--	--	35,000
12. All reservoirs, i.e., "full development"[2)]	37,500	159,000	35,000	30,000	54,000	7,700	34,600
13. Subordinate GBRA hydro rights	61,000	--	--	--	--	--	--
14. Subordinate GBRA hydro rights and reduce spring-flows to zero	30,000	--	--	--	--	--	--
15. Subordinate 50% of Calhoun Canal System Rights	37,500	241,000	--	--	--	--	--
16. "Present Policies"[3)]	15,900	--	--	--	--	--	--
17. Alternative I[4)]	24,000	151,000	--	30,000	--	--	34,000
18. Alternative II[5)]	26,000	--	--	--	--	--	--

TABLE 1 (Concluded)

SUMMARY OF RESERVOIR FIRM YIELDS

Scenario		Firm Yield of Reservoir or Reservoirs in Scenario (ac-ft/yr)						
		Canyon[1)]	Cuero I	Cuero II	Cibolo	Goliad	Lockhart	Cloptin Crossing
19.	Alternative III[6)]	27,000	207,000	Incl. in Cuero I	30,000	--	--	--

1) Only Canyon Reservoir operates under a firm yield concept. However, "Future Baseline" run includes Canyon Reservoir, Coleto Creek Reservoir, Victor Braunig Reservoir, Calaveras Creek Reservoir, Mitchell Reservoir, and Applewhite Reservoir up to their full permitted water rights. Medina Reservoir was assumed to operate in the future as it had in the past. All subsequent scenarios were run with full protection of the amounts of water obtained from each of these reservoirs under the "Future Baseline" scenario.

2) Scenarios 2 through 12, above, assume historical springflows and a continuation of San Antonio return flows at their present level of 135,000 ac-ft/yr.

3) "Present Policies" means Comal and San Marcos springflows would be reduced to zero by continued groundwater pumpage at existing or higher levels, San Antonio return flows to the San Antonio River would be 270,000 ac-ft/yr plus 60,000 ac-ft/yr for Calaveras Creek and Victor Braunig reservoirs, and no additional reservoirs would be built.

4) Alternative I means groundwater pumpage would be reduced and limited to 400,000 ac-ft/yr, San Antonio return flows to the San Antonio River would be 170,000 ac-ft/yr plus 60,000 ac-ft/yr for Calaveras Creek and Victor Braunig reservoirs, and Applewhite, Cibolo, Cloptin Crossing, and Cuero I reservoirs would be built.

5) Alternative II means groundwater pumpage would continue at existing or higher levels, Comal and San Marcos springflows would be artifically maintained at 80,000 ac-ft/yr at each spring by wells at the spring sites, and no additional reservoirs would be built.

6) Alternative III means groundwater pumpage would be reduced and limited to 350,000 ac-ft/yr, San Antonio return flow to the San Antonio River would be 170,000 ac-ft/yr plus 60,000 ac-ft/yr for Calaveras Creek and Victor Braunig reservoirs, and Applewhite, Cibolo, Cuero I and Cuero II reservoirs would be built.

TABLE 2

EXISTING AND PERMITTED RESERVOIRS OPERATED IN THE "FUTURE BASELINE" SCENARIO[1)]

Reservoirs	Normal Operating Level (ft, MSL)	Capacity (ac-ft)	Surface Area (acres)	Demand[2)] (ac-ft/yr)
Canyon	909.0	369,507	8,240	37,500
Coleto Creek	98.0	31,040	3,100	12,500
Victor Braunig	507.0	26,500	1,350	12,000
Calaveras Creek	485.0	63,200	3,624	36,900
Mitchell	N/A	2,640	875	0[3)]
Applewhite	536.0	45,250	2,500	70,000[4)]

1) "Future Baseline" is defined as the condition of the Guadalupe and San Antonio river basins assuming all existing water rights obtain, to the maximum extent possible, their full amounts, assuming Applewhite Reservoir is constructed and operated in an overdraft mode, and assuming the other reservoirs shown on this table are operated with the demands shown met each year.

2) "Demand" means demand placed on the reservoir in the computer model, whether or not it is obtained. Note that demand is obtained in all years for all reservoirs except Applewhite.

3) Assumed met with San Antonio return flows.

4) Includes 12,300 ac-ft/yr demand at the Leon Creek diversion point. Average annual amount obtained is approximately 54,000 ac-ft/yr.

TABLE 3

COMAL AND SAN MARCOS SPRINGS
HISTORICAL AND FUTURE CONDITION FLOWS
(FLOWS IN AC-FT)

Year	Historical		Continuation of "Present Policies"[2]		Alternative I[3]		Alternative II[4]		Alternative III[5]	
	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos
1940	208,430	76,989	0	0	213,326	139,962	80,000	80,000	222,433	140,451
1941	260,720	132,776	0	0	217,130	135,335	80,000	80,000	229,772	136,384
1942	265,140	111,900	0	0	192,478	133,100	80,000	80,000	211,294	134,645
1943	247,490	96,332	0	0	139,246	122,439	80,000	80,000	165,423	124,778
1944	254,940	134,096	0	0	144,386	122,960	80,000	80,000	171,155	125,581
1945	270,840	138,043	0	0	150,249	126,287	80,000	80,000	182,958	129,270
1946	276,320	150,511	0	0	141,187	129,622	80,000	80,000	174,288	132,959
1947	257,900	125,416	0	0	123,188	126,860	80,000	80,000	156,393	130,169
1948	201,070	76,250	0	0	71,727	117,675	80,000	80,000	105,467	120,991
1949	212,020	86,461	0	0	38,291	109,062	80,000	80,000	72,891	112,401
1950	189,700	76,492	0	0	17,100	103,634	80,000	80,000	51,376	106,984
1951	148,860	68,618	0	0	835	97,842	80,000	80,000	28,010	101,975
1952	164,400	75,102	0	0	6,172	96,686	80,000	80,000	41,993	101,521
1953	142,670	97,859	0	0	2,726	99,657	80,000	80,000	37,112	103,485
1954	98,360	75,449	0	0	-0-	92,157	80,000	80,000	11,369	99,207
1955	66,820	61,148	0	0	-0-	79,569	80,000	80,000	43	92,366
1956	27,997[6]	47,564	0	0	-0-	67,600	80,000	80,000	-0-	83,734
1957	138,740	110,270	0	0	79,652	91,496	80,000	80,000	128,489	103,858
1958	234,080	153,440	0	0	190,989	125,994	80,000	80,000	234,416	131,962
1959	229,240	116,050	0	0	163,921	121,878	80,000	80,000	201,275	132,217
1960	241,690	141,410	0	0	161,089	126,077	80,000	80,000	196,733	129,879
1961	247,960	138,260	0	0	156,167	127,313	80,000	80,000	191,694	131,014
1962	193,380	95,850	0	0	103,580	119,093	80,000	80,000	136,452	122,613
1963	150,800	78,710	0	0	52,576	108,380	80,000	80,000	86,544	111,669

TABLE 3 (Concluded)

Year	Historical		Continuation of "Present Policies"[2]		Alternative I[3]		Alternative II[4]		Alternative III[5]	
	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos	Comal	San Marcos
1964	138,560	70,180	0	0	38,192	103,355	80,000	80,000	74,132	106,821
1965	209,230	123,020	0	0	68,548	109,252	80,000	80,000	105,254	112,849
1966	193,430	111,360	0	0	66,574	111,771	80,000	80,000	104,672	115,534
1967	136,450	77,650	0	0	51,522	107,872	80,000	80,000	89,276	111,619
1968	246,750	143,060	0	0	81,147	110,373	80,000	80,000	118,500	114,146
1969	212,380	117,820	0	0	101,508	115,468	80,000	80,000	137,995	119,155
1970	226,650	144,570	0	0	110,335	116,867	80,000	80,000	147,598	120,610
1971	159,810	91,850	0	0	111,541	115,490	80,000	80,000	149,349	119,272
1972	264,550	116,650	0	0	125,829	115,665	80,000	80,000	163,143	119,477
1973	294,010	158,200	0	0	206,668	127,351	80,000	80,000	237,999	130,979
1974	283,820	133,770	0	0	210,467	132,843	80,000	80,000	232,411	135,541
1975	295,430	167,390	0	0	233,096	137,158	80,000	80,000	253,537	139,473
1976	280,110	153,140	0	0	204,208	138,157	80,000	80,000	224,980	140,250
1977	289,690	161,550	0	0	226,579	137,586	80,000	80,000	247,265	139,682
1978	239,880	87,410	0	0	205,822	134,659	80,000	80,000	224,664	136,615
1979	292,730	144,950	0	0	251,508	138,664	80,000	80,000	268,200	140,505
1980	207,240	95,950	0	0	208,972	137,263	80,000	80,000	226,128	139,036
AVERAGE	212,153	111,305	0	0	118,744	117,328	80,000	80,000	147,392	121,504
TOTAL AVERAGE (Both Springs)		323,458		0		236,072		160,000		268,896

1) Historical pumpage varied. Current pumpage is approximately 450,000 ac-ft/yr.
2) Continued total reliance on groundwater with 2040 demands.
3) Alternative I assumed pumpage was reduced to 400,000 ac-ft/yr, with a repeat of historical recharge assumed.
4) Alternative II similar to continuation of Present Policies, except springflows artificially maintained by pumping.
5) Alternative III assumed pumpage was reduced to 350,000 ac-ft/yr, with a repeat of historical recharge assumed.
6) No flow from June 13 to November 3.

TABLE 4

REQUIRED FEDERAL AND STATE COMPLIANCES ASSOCIATED WITH PROPOSED PROJECT PERMITS/APPROVALS[1]

Environmental Factor	Required Approval or Compliance/Authority	Agency[2]
Environmental Protection (multidisciplinary)	National Environmental Policy Act (NEPA).	USEPA, other Federal and State agencies
Historical and Archeological Sites (Federally funded or permitted project or on Federal land)	National Historic Preservation Act of 1966, as amended; Archeological and Historic Preservation Act of 1974; Reservoir Salvage Act of 1960; Executive Order 11593 - Protection and Enhancement of the Cultural Environment; Historic Sites Act of 1935; Archeological Resources Protection Act of 1979; Protection of Historic and Cultural Properties Criteria; Antiquities Act of 1906;	SHPO, ACHP, NPS, THC
	Antiquities Code of Texas.	TAC
Wetlands Protection and Floodplain Management	Executive Order 11990 - Protection of Wetlands; Executive Order 11988 - Floodplain Management; EPA's Statement of Procedures on Floodplain Management and Wetland Protection (5 Jan. 1979); Flood Insurance Act of 1968; Flood Control Act of 1970; National Flood Disaster Protection Act of 1973; River and Harbor Act of 1899, as amended; Clean Water Act of 1977, as amended; Watershed Protection and Flood Prevention Act, as amended.	USEPA, USCE, FEMA
Fish and Wildlife	Fish and Wildlife Coordination Act of 1958; Coastal Zone Management Act of 1972, as amended; Estuary Protection Act; Marine Protection Research, and Sanctuaries Act of 1972, as amended.	USFWS, TPWD
Endangered Species Protection	Endangered Species Act of 1973, as amended.	USFWS, TPWD
Wild and Scenic Rivers	Wild and Scenic Rivers Act of 1968. Executive Order 11514 - Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory.	NPS

TABLE 4 (Concluded)

Environmental Factor	Required Approval or Compliance/Authority	Agency[2]
Agricultural Lands	EPA's Policy to Protect Environmentally Sensitive Agricultural Lands (8 Sept. 1978).	USEPA, SCS
Other Concerns	Land and Water Conservation Fund Act of 1965, as amended;	NPS, TPWD, EPA
	Noise Control Act of 1972;	EPA
	Clean Air Act, as amended;	
	Resource Conservation and Recovery Act;	USEPA
	Safe Drinking Water Act;	USEPA, TDH
	Secretary's Memorandum No. 1827 Revised: Statement of Land Use Policy;	USDA
	Rural Electrification Act of 1936;	REA
	Requirements for Construction, Maintenance, Operation, and Safety;	TDWR, Dam
	Approval of Public Drinking Water Supply Systems (Texas Sanitation and Health Protection Act; TDH Rules and Regulations for Public Water Systems; TDH Drinking Water Standards);	TDH
	National Energy Act of 1978;	State and/or County
	Oil and Gas Pipeline Relocations.	Individual Companies

1 Federal and State permits/approvals (Table 12.1-1) require compliance with regulations listed herein for approval.

2 See Table 12.1-1 for abbreviations.

TABLE 5

COST ESTIMATES

CUERO I RESERVOIR

Dam & Reservoir Description	Cost	Diversion & Delivery Description	Cost
Dam and Reservoir		Diversion and Delivery	
Mitigation	$ 17,157,352	Intake Structure System	$ 5,017,400
Lands and Rights-of-Way	81,411,185	Pumping Station	5,486,600
Permitting	1,005,000	Transmission Pipelines	81,625,000
Earthen Embankments	42,396,975	Outlet Structure	311,400
Spillway and Outlet Works	50,393,925	Lands and Rights-of-Way	570,911
Administration Facilities	370,000		
Recreation Facilities			
Lands and Rights-of-Way	1,053,675		
Facilities	20,383,031		
Relocation[1]			
Roads and Bridges	30,087,960		
Utilities and Pipeline	3,377,000		
Rail Roads	3,402,000		
Cemeteries	600,000		
Subtotal	$251,638,103		$ 93,011,311
Contingency and Engineering	50,327,621		18,602,262
Financing	8,756,250		4,381,125
Legal			
Permitting	1,200,000		200,000
Financing	243,750		118,875
ROW Acquisition	5,350,850		373,700
Total Costs	$317,516,574		$116,687,273
O&M			
Labor, Materials, Service, Equipment	$ 1,682,773		$ 235,586
Power (Delivery to Cibolo Site)			8,005,000
Total Annual O&M	$ 1,682,773		$ 8,240,586

[1] Land and ROW costs for Relocation are included in described costs.

TABLE 6

COST ESTIMATES

CUERO II (LINDENAU)

Dam & Reservoir Description	Cost	Diversion & Delivery Description	Cost
Dam and Reservoir		Diversion and Delivery	
Mitigation	$ 10,572,776	Intake Structure System	$ 5,017,400
Lands and Rights-of-Way	60,089,895	Pumping Station	3,123,000
Permitting	483,000	Transmission Pipelines	47,026,000
Earthen Embankments	19,648,800	Outlet Structure	311,400
Spillway and Outlet Works	13,489,100	Lands and Rights-of-Way	480,386
Administration Facilities	370,000		
Recreation Facilities			
Lands and Rights-of-Way	837,000		
Facilities	22,245,176		
Supplement Pumping to Cuero II (from Guadalupe River)			
Intake Structure	5,017,400		
Pumping Station	18,992,093		
Transmission Pipeline	8,424,000		
Outlet Structure	311,400		
Lands and Rights-of-Way[1]	65,909		
Relocation[2]			
Roads and Bridges	24,319,265		
Utilities and Pipeline	2,826,259		
Flood Protection			
Protection Levee	450,000		
Pump Station	5,000,000		
Subtotal	$193,142,073		$ 55,958,186
Contingency and Engineering	38,628,415		11,191,637
Financing	6,808,000		2,920,500
Legal			
Permitting	1,000,000		200,000
Financing	192,000		79,500
ROW Acquisition	4,910,750		311,900
Total Costs	$244,681,238		$ 70,661,723
O&M			
Labor, Materials, Service, Equipment	$ 1,756,193		$ 184,524
Power (Delivery to Cibolo Site)	--		5,067,000
Power (Delivery from Guadalupe River)	1,173,000		--
Power (Flood Protection)	2,402		--
Total Annual O&M	$ 2,931,595		$ 5,251,524

[1] Includes Acquisition costs.

[2] Land and ROW costs for Relocation are included in described costs.

TABLE 7

COST ESTIMATES

CIBOLO (LOWER)

Dam & Reservoir Description	Cost
Dam and Reservoir	
Mitigation	$ 3,447,290
Lands and Rights-of-Way	33,301,629
Permitting	865,000
Earthen Embankments	32,112,200
Spillway and Outlet Works	33,857,000
Administration Facilities	370,000
Recreation Facilities	
Lands and Rights-of-Way	841,750
Facilities	21,422,532
Relocation[1]	
Roads and Bridges	22,460,910
Utilities and Pipeline	1,456,331
Flood Protection	
Protection Levee/Drainage	2,945,000
Pump Station	5,000,000
Subtotal	$158,079,642
Contingency and Engineering	31,615,928
Financing	5,351,875
Legal	
Permitting	1,000,000
Financing	148,125
ROW Acquisition	4,261,500
Total Costs	$200,457,070
O&M	
Labor, Materials, Service, Equipment	$ 1,639,791
Power (Flood Protection)	2,402
Total Annual O&M	$ 1,642,193

1 Land and ROW costs for Relocation are included in described costs.

TABLE 8

COST ESTIMATES
GOLIAD[1]

Dam & Reservoir Description	Cost
Dam and Reservoir	
Mitigation[2]	Unknown
Lands and Rights-of-Way	$ 54,600,000
Permitting	882,500
Earthen Embankments	17,504,750
Spillway and Outlet Works	49,168,250
Administration Facilities	370,000
Relocation[3]	
Roads and Bridges	10,152,825
Utilities and Pipeline	2,315,751
Subtotal	$134,994,076
Contingency and Engineering	26,998,815
Financing	4,866,500
Legal	
Permitting	1,000,000
Financing	133,500
ROW Acquisition[4]	4,431,000
Total Costs	$172,423,891
O&M	
Labor, Materials, Service, Equipment	$ 4,272,000
Total Annual O&M	$ 4,272,000

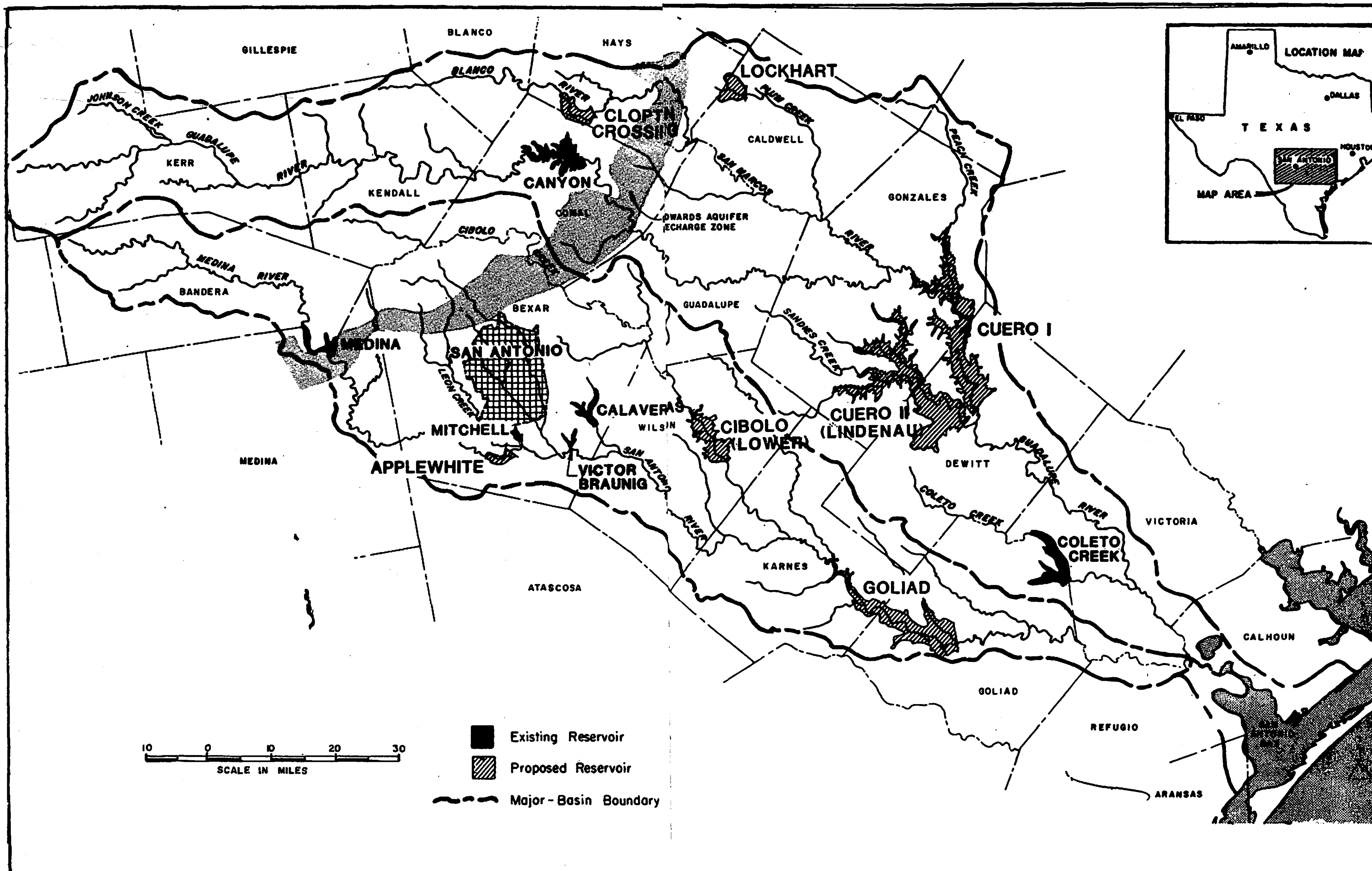
1 Costs for the Goliad Reservoir are based upon a preliminary cost versus reservoir level for three alternative elevations.

2 Mitigation costs are beyond the scope of this project.

3 Land and ROW costs for Relocation are included in described costs.

4 ROW Acquisition costs are estimates only.

LIST OF PLATES



NO.	REVISION	BY	DATE

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
DATE: DEC. 1985

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ESPEY, HUSTON & ASSOCIATES, INC.

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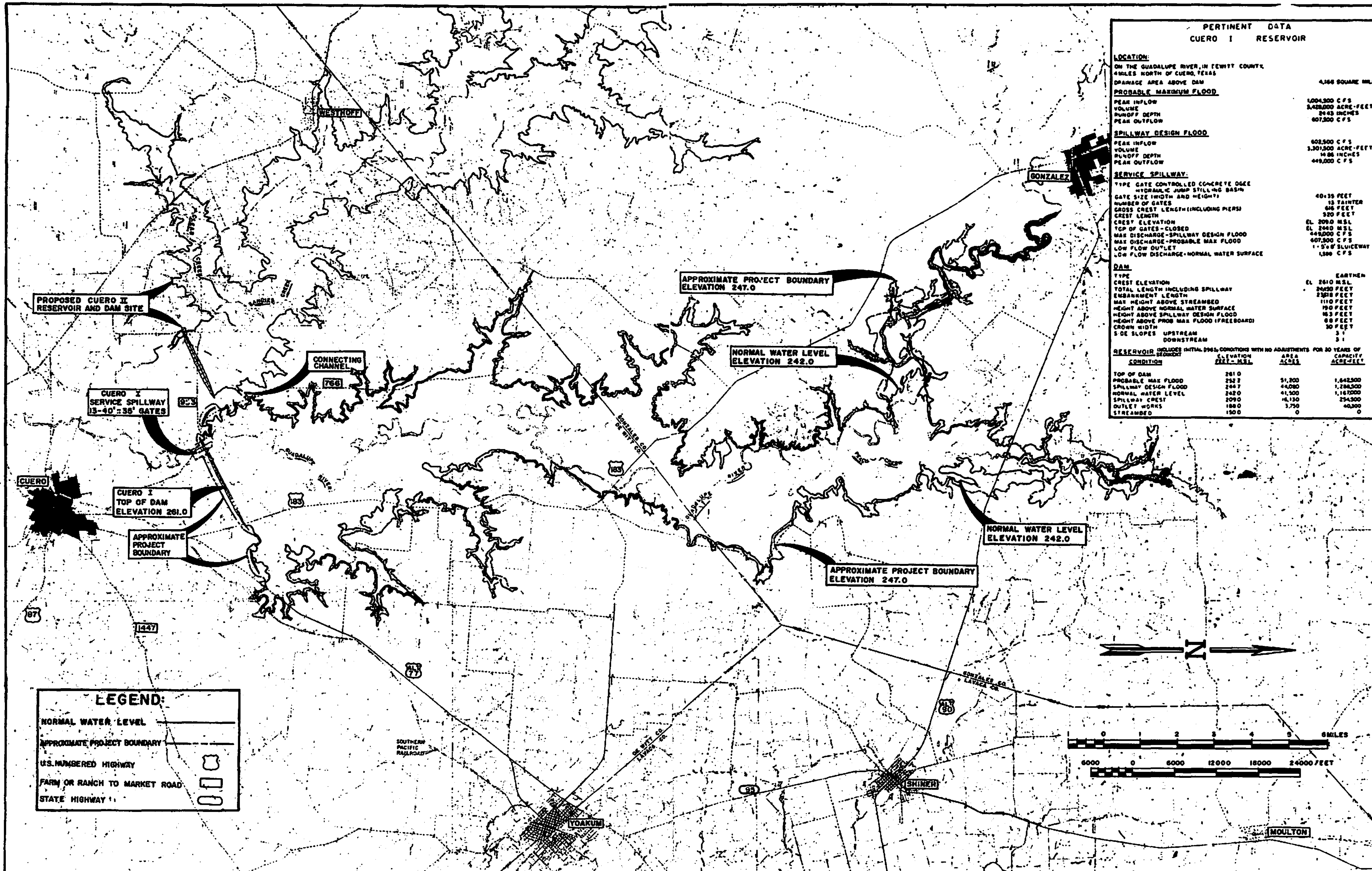
GUADALUPE-BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

GUAD. RIVER & SAN ANTONIO WATERSHEDS

BASIN PLAN

PLATE 1

FILE NO 5931



PERTINENT DATA
CUERO I RESERVOIR

LOCATION:

ON THE GUADALUPE RIVER, IN DEWITT COUNTY, 4 MILES NORTH OF CUERO, TEXAS

DRAINAGE AREA ABOVE DAM	4,166 SQUARE MILES
PROBABLE MAXIMUM FLOOD	
PEAK INFLOW	1,004,300 C F S
VOLUME	3,428,000 ACRE-FEET
RUNOFF DEPTH	20.43 INCHES
PEAK OUTFLOW	607,300 C F S
SPILLWAY DESIGN FLOOD	
PEAK INFLOW	602,500 C F S
VOLUME	3,301,500 ACRE-FEET
RUNOFF DEPTH	14.86 INCHES
PEAK OUTFLOW	449,000 C F S
SERVICE SPILLWAY:	
TYPE GATE CONTROLLED CONCRETE OGEE HYDRAULIC JUMP STILLING BASIN	
GATE SIZE (WIDTH AND HEIGHT)	40 x 35 FEET
NUMBER OF GATES	13 TAINTER
GROSS CREST LENGTH (INCLUDING PIERS)	616 FEET
CREST LENGTH	520 FEET
CREST ELEVATION	EL 209.0 MSL
TOP OF GATES-CLOSED	EL 244.0 MSL
MAX DISCHARGE-SPILLWAY DESIGN FLOOD	449,000 C F S
MAX DISCHARGE-PROBABLE MAX FLOOD	607,300 C F S
LOW FLOW OUTLET	1 - 5' x 8' SLUICEWAY
LOW FLOW DISCHARGE-NORMAL WATER SURFACE	1,100 C F S
DAM	
TYPE	EARTHEN
CREST ELEVATION	EL 261.0 MSL
TOTAL LENGTH INCLUDING SPILLWAY	24,430 FEET
EMBANKMENT LENGTH	23,810 FEET
MAX HEIGHT ABOVE STREAMBED	111.0 FEET
HEIGHT ABOVE NORMAL WATER SURFACE	19.0 FEET
HEIGHT ABOVE SPILLWAY DESIGN FLOOD	16.3 FEET
HEIGHT ABOVE PROB MAX FLOOD (FREEBOARD)	8.8 FEET
CROWN WIDTH	30 FEET
SIDE SLOPES UPSTREAM	3:1
DOWNSTREAM	3:1

RESERVOIR (INCLUDES INITIAL (1985) CONDITIONS WITH NO ADJUSTMENTS FOR 50 YEARS OF SEDIMENT)

CONDITION	ELEVATION FEET - MSL	AREA ACRES	CAPACITY ACRE-FEET
TOP OF DAM	261.0		
PROBABLE MAX FLOOD	252.2	51,200	1,642,500
SPILLWAY DESIGN FLOOD	244.7	44,080	1,288,500
NORMAL WATER LEVEL	242.0	41,500	1,167,000
SPILLWAY CREST	209.0	16,130	254,300
OUTLET WORKS	188.0	3,750	40,300
STREAMBED	150.0	0	0

NO.	REVISION	BY	DATE

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
DATE: DEC., 1985

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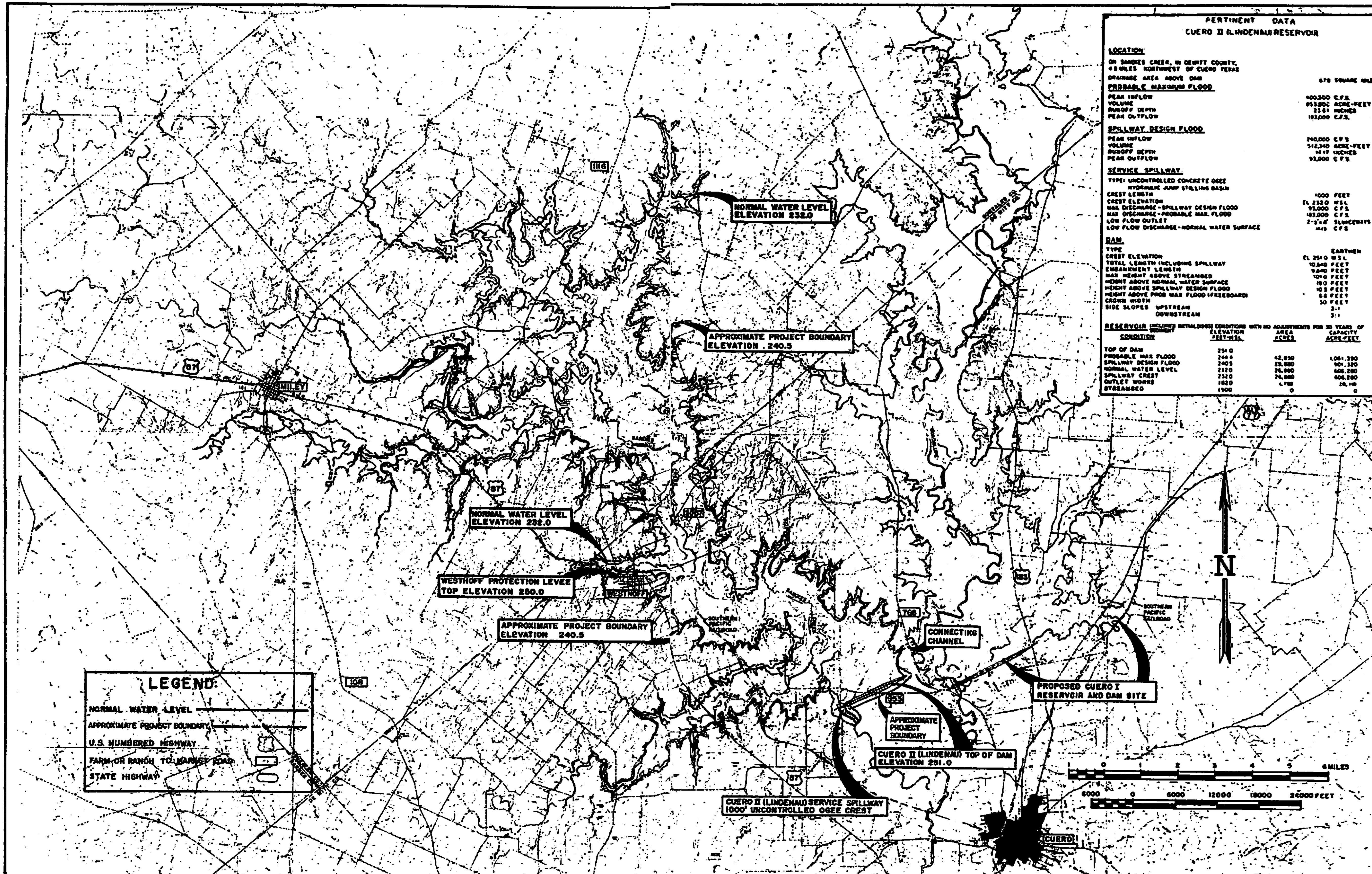
GUADALUPE – BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

CUERO I DAM

RESERVOIR TOPOGRAPHY

PLATE 2

FILE NO. 5931



PERTINENT DATA
CUERO II (LINDENAU) RESERVOIR

LOCATION:

ON SANDIES CREEK, IN DEWITT COUNTY, 4.5 MILES NORTHWEST OF CUERO TEXAS

DRAINAGE AREA ABOVE DAM	678 SQUARE MILES
PROBABLE MAXIMUM FLOOD	
PEAK INFLOW	400,300 C.F.S.
VOLUME	853,800 ACRE-FEET
RUNOFF DEPTH	23.61 INCHES
PEAK OUTFLOW	183,000 C.F.S.
SPILLWAY DESIGN FLOOD	
PEAK INFLOW	240,000 C.F.S.
VOLUME	512,340 ACRE-FEET
RUNOFF DEPTH	14.17 INCHES
PEAK OUTFLOW	93,000 C.F.S.
SERVICE SPILLWAY:	
TYPE: UNCONTROLLED CONCRETE OGEE HYDRAULIC JUMP STILLING BASIN	
CREST LENGTH	1000 FEET
CREST ELEVATION	EL 232.0 MSL
MAX DISCHARGE - SPILLWAY DESIGN FLOOD	93,000 C.F.S.
MAX DISCHARGE - PROBABLE MAX. FLOOD	183,000 C.F.S.
LOW FLOW OUTLET	2-5'x8' SLUICEWAYS
LOW FLOW DISCHARGE - NORMAL WATER SURFACE	415 C.F.S.
DAM	
TYPE	EARTHEN
CREST ELEVATION	EL 251.0 MSL
TOTAL LENGTH INCLUDING SPILLWAY	10,840 FEET
EMBANKMENT LENGTH	9,840 FEET
MAX HEIGHT ABOVE STREAMBED	101.0 FEET
HEIGHT ABOVE NORMAL WATER SURFACE	19.0 FEET
HEIGHT ABOVE SPILLWAY DESIGN FLOOD	10.5 FEET
HEIGHT ABOVE PROB MAX FLOOD (FREEBOARD)	6.6 FEET
CROWN WIDTH	30 FEET
SIDE SLOPES UPSTREAM	3:1
DOWNSTREAM	3:1

RESERVOIR (INCLUDES INITIAL (1985) CONDITIONS WITH NO ADJUSTMENTS FOR 30 YEARS OF SEDIMENT)

CONDITION	ELEVATION FEET-MSL	AREA ACRES	CAPACITY ACRE-FEET
TOP OF DAM	251.0		
PROBABLE MAX FLOOD	244.4	42,030	1,061,390
SPILLWAY DESIGN FLOOD	240.5	35,880	901,320
NORMAL WATER LEVEL	232.0	26,880	606,280
SPILLWAY CREST	232.0	26,880	606,280
OUTLET WORKS	182.0	4,780	28,110
STREAMBED	150.0	0	0

NO.	REVISION	BY	DATE

DESIGNED BY:
DRAWN BY:
CHECKED BY:
APPROVED BY:
DATE: DEC., 1985

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GUADALUPE-BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

CUERO II (LINDENAU) DAM

RESERVOIR TOPOGRAPHY

PLATE 3

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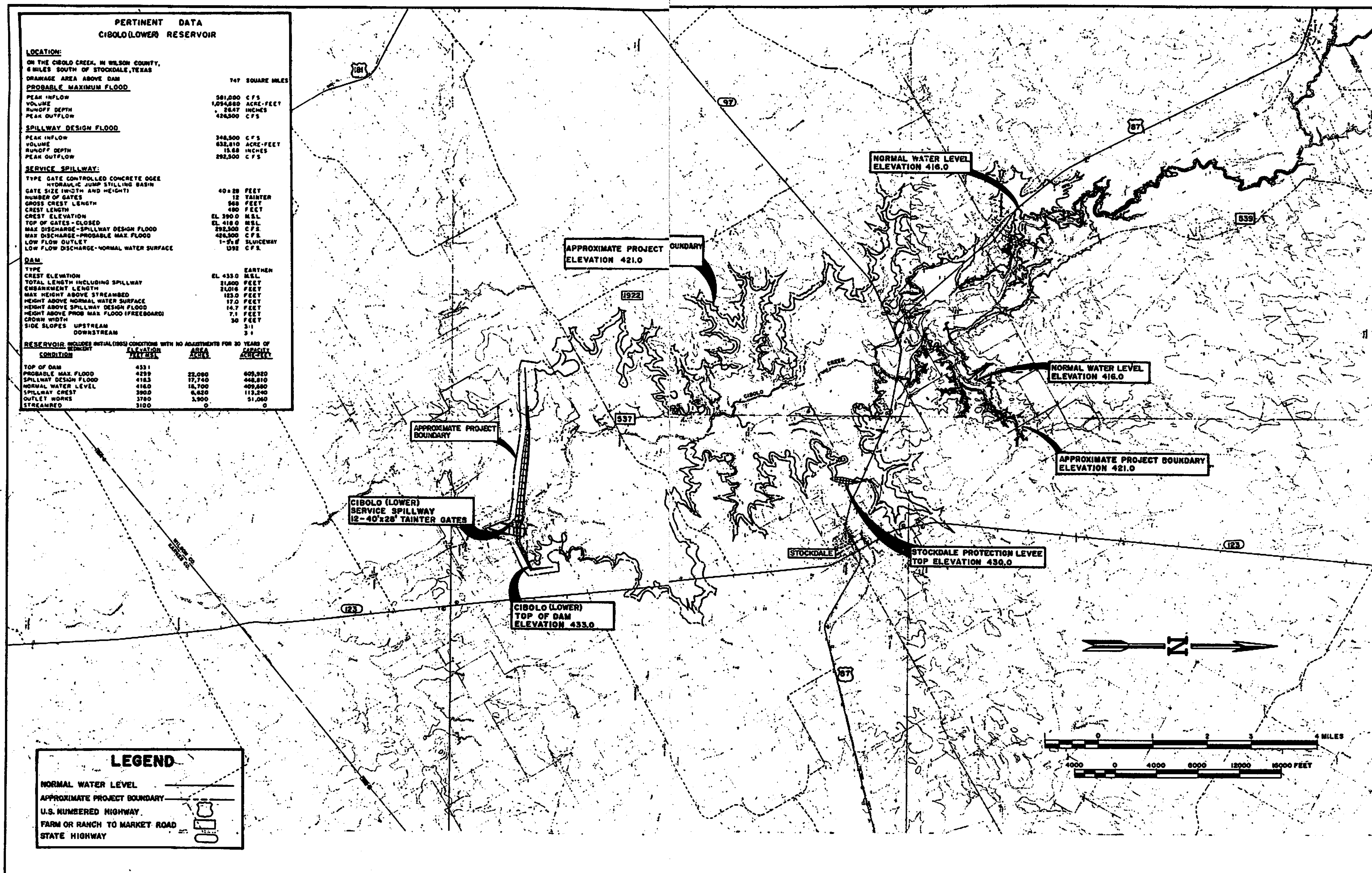

PERTINENT DATA
CIBOLO (LOWER) RESERVOIR

LOCATION:

ON THE CIBOLO CREEK, IN WILSON COUNTY, 6 MILES SOUTH OF STOCKDALE, TEXAS

DRAINAGE AREA ABOVE DAM	747	SQUARE MILES
PROBABLE MAXIMUM FLOOD		
PEAK INFLOW	581,000	CFS
VOLUME	1,054,680	ACRE-FEET
RUNOFF DEPTH	26.47	INCHES
PEAK OUTFLOW	426,500	CFS
SPILLWAY DESIGN FLOOD		
PEAK INFLOW	348,500	CFS
VOLUME	632,810	ACRE-FEET
RUNOFF DEPTH	15.88	INCHES
PEAK OUTFLOW	292,500	CFS
SERVICE SPILLWAY:		
TYPE GATE CONTROLLED CONCRETE OGEE HYDRAULIC JUMP STILLING BASIN		
GATE SIZE (WIDTH AND HEIGHT)	40 x 28	FEET
NUMBER OF GATES	12	TAINTER
GROSS CREST LENGTH	568	FEET
CREST LENGTH	480	FEET
CREST ELEVATION	EL. 390.0	M.S.L.
TOP OF GATES - CLOSED	EL. 418.0	M.S.L.
MAX DISCHARGE-SPILLWAY DESIGN FLOOD	292,500	C.F.S.
MAX DISCHARGE-PROBABLE MAX. FLOOD	426,500	C.F.S.
LOW FLOW OUTLET	1-5'x8'	SLUICEWAY
LOW FLOW DISCHARGE-NORMAL WATER SURFACE	1392	C.F.S.
DAM:		
TYPE		EARTHEN
CREST ELEVATION	EL. 433.0	M.S.L.
TOTAL LENGTH INCLUDING SPILLWAY	21,600	FEET
EMBANKMENT LENGTH	21,016	FEET
MAX HEIGHT ABOVE STREAMBED	123.0	FEET
HEIGHT ABOVE NORMAL WATER SURFACE	17.0	FEET
HEIGHT ABOVE SPILLWAY DESIGN FLOOD	14.7	FEET
HEIGHT ABOVE PROB MAX FLOOD (FREEBOARD)	7.1	FEET
CROWN WIDTH	30	FEET
SIDE SLOPES UPSTREAM		3:1
DOWNSTREAM		3:1

RESERVOIR: INCLUDES INITIAL (1985) CONDITIONS WITH NO ADJUSTMENTS FOR 30 YEARS OF SEDIMENT

CONDITION	ELEVATION FEET MSL	AREA ACRES	CAPACITY ACRE-FEET
TOP OF DAM	433.1		
PROBABLE MAX. FLOOD	429.9	22,080	603,920
SPILLWAY DESIGN FLOOD	418.3	17,740	448,810
NORMAL WATER LEVEL	416.0	16,700	409,680
SPILLWAY CREST	390.0	6,620	113,240
OUTLET WORKS	378.0	3,900	51,060
STREAMBED	310.0	0	0

NO.	REVISION	BY	DATE

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APPROVED BY:
DATE: DEC., 1985

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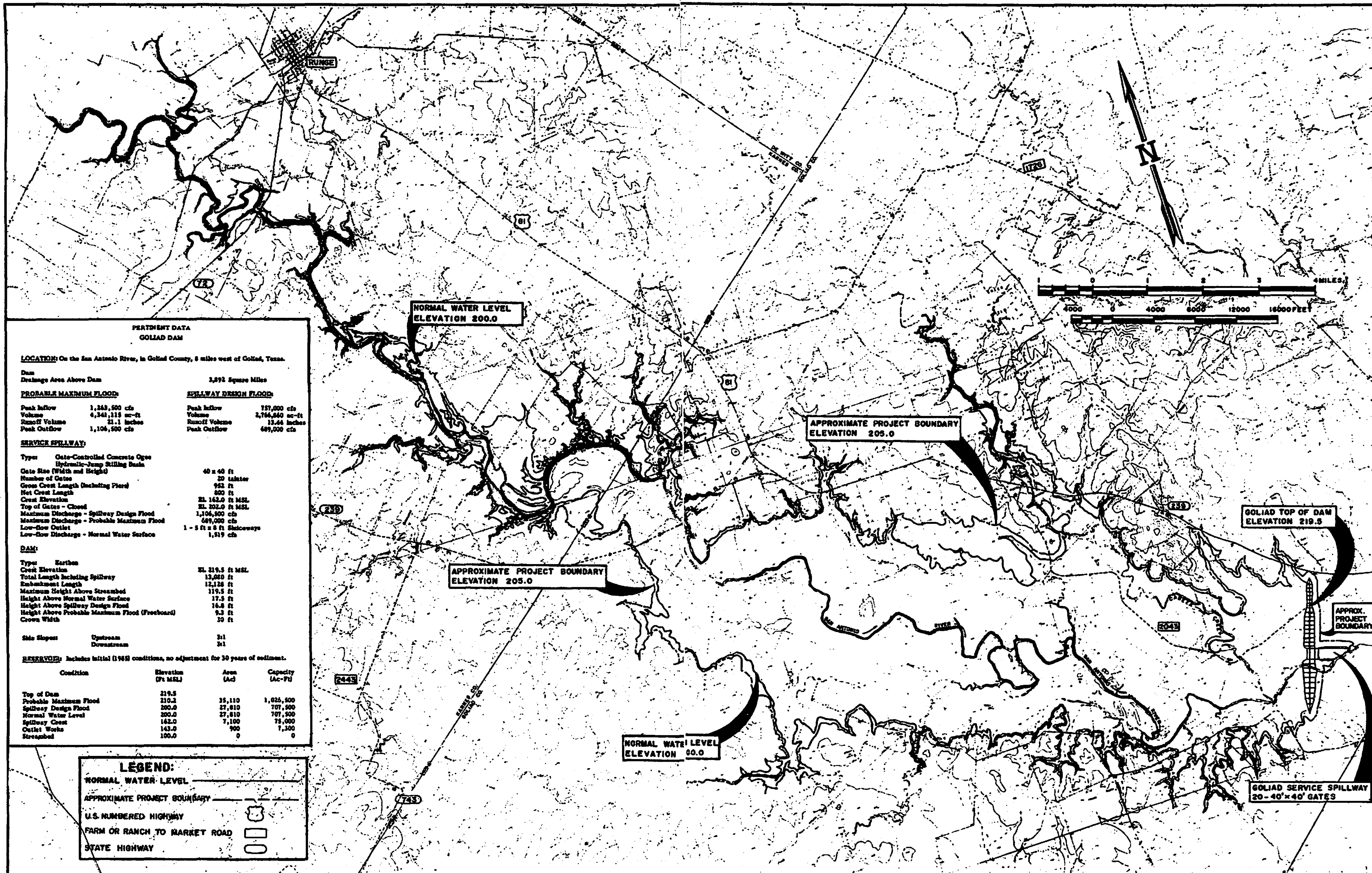
GUADALUPE - BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

CIBOLO (LOWER) DAM

RESERVOIR TOPOGRAPHY

PLATE 4

FILE NO. 5931



PERTINENT DATA

GOLIAD DAM

LOCATION: On the San Antonio River, in Goliad County, 8 miles west of Goliad, Texas.

Dam

Drainage Area Above Dam — 3,892 Square Miles

PROBABLE MAXIMUM FLOOD:		SPILLWAY DESIGN FLOOD:	
Peak Inflow	1,263,500 cfs	Peak Inflow	757,000 cfs
Volume	4,341,115 ac-ft	Volume	2,766,840 ac-ft
Runoff Volume	21.1 inches	Runoff Volume	13.44 inches
Peak Outflow	1,106,500 cfs	Peak Outflow	689,000 cfs

SERVICE SPILLWAY:

Type: Gate-Controlled Concrete Ogee Hydraulic-Jump Stilling Basin	
Gate Size (Width and Height)	40 x 40 ft
Number of Gates	20 tainter
Gross Crest Length (Including Piers)	952 ft
Net Crest Length	800 ft
Crest Elevation	El. 162.0 ft MSL
Top of Gates - Closed	El. 202.0 ft MSL
Maximum Discharge - Spillway Design Flood	1,106,500 cfs
Maximum Discharge - Probable Maximum Flood	689,000 cfs
Low-flow Outlet	1 - 5 ft x 8 ft Sluiceways
Low-flow Discharge - Normal Water Surface	1,519 cfs

DAM:

Type: Earthen	
Crest Elevation	El. 219.5 ft MSL
Total Length Including Spillway	13,080 ft
Embankment Length	12,128 ft
Maximum Height Above Streambed	119.5 ft
Height Above Normal Water Surface	17.5 ft
Height Above Spillway Design Flood	16.8 ft
Height Above Probable Maximum Flood (Freeboard)	9.3 ft
Crown Width	30 ft
Side Slopes: Upstream	3:1
Downstream	3:1

RESERVOIR: Includes initial (1985) conditions, no adjustment for 30 years of sediment.

Condition	Elevation (Ft MSL)	Area (Ac)	Capacity (Ac-Ft)
Top of Dam	219.5		
Probable Maximum Flood	210.2	35,110	1,026,500
Spillway Design Flood	200.0	27,810	707,500
Normal Water Level	200.0	27,810	707,500
Spillway Crest	162.0	7,100	75,000
Outlet Works	143.0	900	7,300
Streambed	100.0	0	0

NO.	REVISION	BY	DATE

DESIGNED BY:

DRAWN BY:

CHECKED BY:

APPROVED BY:

DATE: DEC., 1985

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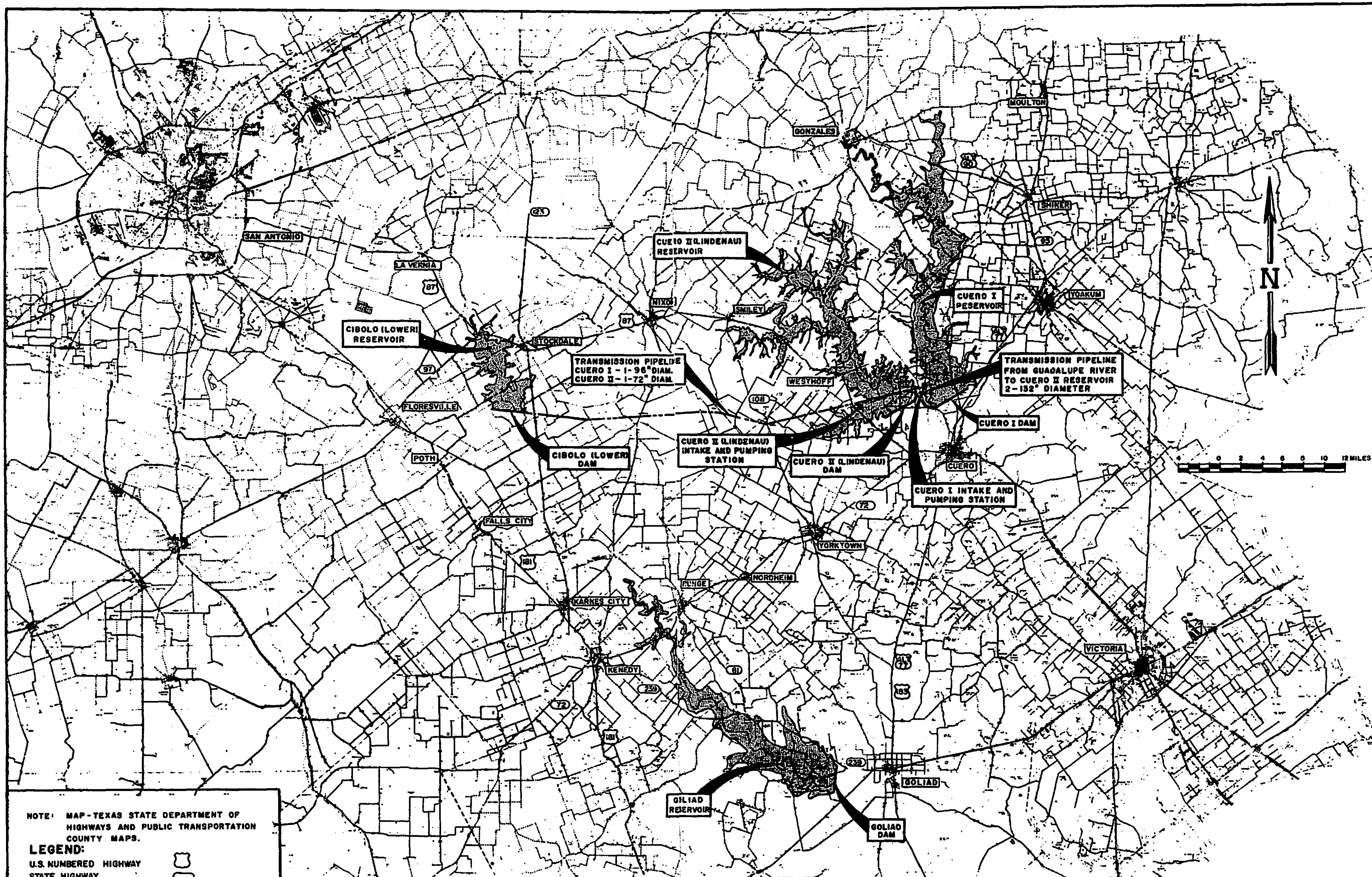
GUADALUPE – BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

GOLIAD DAM

RESERVOIR TOPOGRAPHY

PLATE 5

FILE NO. 5931



NO.	REVISION	BY	DATE

DESIGNED BY:
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APPROVED BY:
DATE: DEC., 1985

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GUADALUPE - BLANCO RIVER AUTHORITY
SAN ANTONIO RIVER AUTHORITY
CITY OF SAN ANTONIO

DIVERSION AND DELIVERY SYSTEM

TRANSMISSION PIPELINE — PLAN

PLATE 6

FILE NO. 5931