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UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

ARNIE J. SUOMELA, COMMISSIONER



CANYON RESERVOIR
PROJECT

TEXAS

FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Bureau of Sport Fisheries and Wildlife
Southwest Region
Albuquerque, New Mexico

FISH AND WILDLIFE RESOURCES
of the
CANYON RESERVOIR PROJECT
GUADALUPE RIVER
TEXAS

Report Prepared by the Branch of River Basin Studies
Albuquerque, New Mexico

February 1960



ADDRESS ONLY THE
REGIONAL DIRECTOR
2-RBS

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
P. O. BOX 1306

ALBUQUERQUE, NEW MEXICO

February 3, 1960

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District Engineer
Corps of Engineers, U. S. Army
P. O. Box 1600
Fort Worth, Texas

Dear Sir:

This is a synopsis of my report on the relation of fish and wildlife resources to the construction of Canyon Reservoir, Texas. The report was prepared under authority of the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq. Detailed material is presented in the attached report.

This report has been reviewed by the Texas Game and Fish Commission. The report and, specifically, the recommendations which follow have been endorsed by the Texas Game and Fish Commission as indicated in the letter to this office dated January 28, 1960, from H. D. Dodgen, Executive Secretary of that Commission, a copy of which is appended.

Canyon Reservoir is being constructed for the purposes of flood control and storage of water for municipal, industrial, and possible future irrigational uses. The dam will be on the Guadalupe River in Comal County at river mile 303. About 11,800 acres of land will be purchased in fee simple. Flowage easement will be taken on about 3,200 acres between elevations 918-948. Most of the affected bottom land is in cultivation. The remaining reservoir area is used for grazing. Maximum releases from the reservoir will be 3,000 second-feet; minimum releases will be zero. The Guadalupe-Blanco River Authority has indicated that a constant minimum release of 100 to 200 second-feet would be made during normal water years.

Canyon Reservoir lies in an area where there is a shortage of public fishing facilities and where people must travel long distances to secure reasonable fishing opportunities. Fishing pressure on the affected reach of the Guadalupe River will result in about \$40,000 annually in associated sportsmen's expenditures.

Canyon Reservoir will eliminate a short segment of stream fishery in the Guadalupe River within the project area, improve the downstream fishery, possibly produce a rainbow trout or smallmouth bass habitat in the 10-mile reach of stream downstream from the dam, and create a reservoir-type fishery which is in great demand in the area. It is estimated that fisherman use

of the river below the dam will result in sportsmen's expenditures of about \$200,000 annually if a trout fishery develops. Sportsmen's expenditures associated with reservoir fishing will be about \$2,000,000 annually.

White-tailed deer and wild turkeys are of economic importance in the project area. Demands to hunt these species are far greater than hunting opportunities. Sportsmen will spend about \$30,000 and \$4,000, respectively, for deer and turkey hunting annually within the reservoir area. Except for a sportsmen's expenditure of about \$2,000 annually for dove hunting, upland-game hunting is of minor importance.

Construction of Canyon Reservoir is expected to result in complete loss of deer and turkey populations and hunting opportunities for these species in the project area. Losses to mourning dove populations will also occur. From sportsmen's expenditures associated with hunting wildlife in the project area, there will be an annual loss of \$31,000 as a result of the project.

The fish and wildlife plans recommended for the project include features designed to provide maximum benefits to fish and mitigate wildlife losses as a result of project construction. Enhancement to the fishery can be attained by providing a constant minimum release into the stream downstream from the dam by stocking rainbow trout on a put-and-take basis in this reach, and by providing access areas to the downstream fisheries and parking facilities around the reservoir. The exact amount of release required can only be determined when the project is completed and put into operation, but a minimum release of 150 second-feet is deemed necessary to maintain a satisfactory trout fishery. Losses to wildlife can be partially mitigated through acquisition in fee simple of lands peripheral to the reservoir.

It is recommended:

- (1) That 8 parking areas, as shown on plates 2 through 6, and three access areas, as shown on plates 7 through 9, be purchased in fee simple and included as nonreimbursable project costs.
- (2) That boat-launching ramps be constructed at each proposed parking and downstream access area and also included as nonreimbursable project costs.
- (3) That a minimum instantaneous release of 150 second-feet or the natural inflow of the river, whichever is less, be provided at Canyon Dam.
- (4) That three access areas downstream from the dam be made available to the Texas Game and Fish Commission under a General Plan, as provided in Section 3 of the Fish and Wildlife

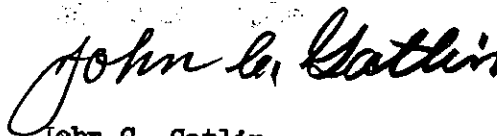
Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.

(5) That timber clearing in the reservoir area be kept to a minimum, except for clearing in parking and boat-launching areas and for construction and efficient operation of the project. Clearing in the downstream access areas should be limited to understory vegetation.

(6) That land acquisition policy take into consideration the mitigation of wildlife losses through purchase in fee simple, to the maximum extent practicable, of lands peripheral to the reservoir.

(7) That Federally owned land that is not within the wildlife management area be open to free public use, except for sections reserved for safety, efficient operation, and protection of public property.

Sincerely yours,



John C. Gatlin
Regional Director

Copies (10)

Distribution:

- (2) Executive Secretary, Texas Game and Fish Commission, Austin, Texas
- (1) Director, Marine Laboratory, Texas Game and Fish Commission, Rockport, Texas
- (1) Regional Director, Region 5, Bureau of Reclamation, Amarillo, Texas
- (1) Regional Director, Region 3, National Park Service, Santa Fe, New Mexico
- (1) Regional Engineer, Region VII, Public Health Service, Department of Health, Education, and Welfare, Dallas, Texas
- (1) Commissioner, U. S. Study Commission - Texas, Houston, Texas

GAME AND FISH COMMISSION

C O P Y

Austin, Texas

January 28, 1960

2-RBS

Regional Director
Fish and Wildlife Service
P. O. Box 1306
Albuquerque, New Mexico

Dear Mr. Gatlin:

This acknowledges receipt of the revised draft of your report on the Canyon Reservoir Project, Texas, as submitted for review and concurrence.

Please be advised of my concurrence with revisions within the report and recommendations for management of the Canyon Reservoir Project, Texas.

Sincerely yours,

/s/ H. D. Dodgen
H. D. Dodgen
Executive Secretary

HDD:PEU:mah

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PREFACE

The Canyon Reservoir Project, authorized by the River and Harbor Act approved March 2, 1945, (Public Law 14, 79th Congress) and modified by the Flood Control Act of 1954 (Public Law 780, 83d Congress, 2d Session), is designed to provide flood control and water conservation for municipal and industrial uses.

The Bureau of Sport Fisheries and Wildlife presents herein an analysis of the project's effects upon fish and wildlife resources and suggests means for both mitigating losses and realizing benefits to fish and wildlife.

The area of influence includes 53 miles of the Guadalupe River from the mouth of Comal River to the top of flood-control pool elevation and 12,890 acres in the Canyon Reservoir basin.

This report is prepared pursuant to the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq., and is based on engineering information furnished by the Corps of Engineers, Fort Worth, Texas, prior to February 15, 1959.

A previous report dated January 1951 was submitted by the Service entitled "A Report on Fish and Wildlife Resources in Relation to the Canyon Dam and Reservoir Project, Guadalupe River, Guadalupe River Basin, Texas."

Acknowledgment is made of the assistance given by the District Engineer, Corps of Engineers, Fort Worth, Texas, in furnishing necessary data regarding construction and operation plans, the Guadalupe-Blanco River Authority, the Soil Conservation Service, and the Texas Game and Fish Commission for information leading to the evaluation of the fish and wildlife resources.

INTRODUCTION

Purpose

1. Canyon Dam and Reservoir will provide flood control and water conservation storage for municipal, industrial, and possible future irrigational uses.

Location

2. Canyon Reservoir is located on the Guadalupe River in Comal County, Texas, about 12 miles northwest of New Braunfels, 40 miles southwest of Austin, and 35 miles northeast of San Antonio. The dam is located at mile 303.

DESCRIPTION OF THE AREA

3. The Guadalupe River watershed is located in the south-central part of Texas, lying in two sharply contrasted physiographic provinces; namely, the Edwards Plateau and the West Gulf Coastal Plain. The Plateau occupies that portion of the watershed lying generally north and west of the cities of New Braunfels and San Marcos. It is an area of rugged hills and narrow deep valleys, and is sharply accentuated at the eastern edge by steep hills terminating in limestone bluffs known as the Balcones Escarpment. The West Gulf Coastal Plain section, which extends from the Balcones Escarpment near New Braunfels and San Marcos to the Coast, is an area of rolling hills and broad plains changing to flat prairie in the vicinity of the Coast. The Guadalupe River originates from the confluence of the North Fork and South Fork of the Guadalupe River near Hunt, Texas. The river is deeply entrenched and flows through most of the project area in canyons 200 to 300 feet deep. Major portions of the shoreline have steep banks adjacent to rugged hills with narrow valleys.

4. The Guadalupe River is 464 miles in length and has a drainage area of 6,032 square miles, of which 1,425 square miles are above the dam site. The average stream width is about 100 feet, and it has an average depth of 4 feet. Stream gradient in the project area is 6 feet per mile and about 2.5 feet per mile in the reach below the dam. The channel capacity varies from 28,000 second-feet at New Braunfels to 12,000 second-feet in the lower reach of the stream. The stream bed is predominately gravel and limestone. Water in the stream is usually clear.

5. The average annual discharge at the New Braunfels gage for a 42-year period is 362 second-feet. The maximum instantaneous flow, 101,000 second-feet, occurred on June 15, 1935. Minimum flows of zero were recorded on July 8 and 9 and July 17 to August 20, 1956. Principal upstream tributary of the Guadalupe River in addition to the North Fork and South Fork is Johnson Creek.

6. The climate in the region is mild. Mean annual temperature is 68.6° F. The maximum temperature was 109° F., and the minimum temperature was 2° F. The frost-free period is 271 days. Average annual rainfall is 30.73 inches; the maximum was 60.21 inches in 1919; and the minimum was 10.12 inches in 1954. Average annual evaporation is 65.12 inches. Prevailing winds are from the south and southeast.

7. Soils in the project area are shallow, vary in color from light brown to black, and are friable and calcareous. The substratum is limestone exposed many places in the area. Practically all soils in the stream valley are of alluvial origin. They are light brown to black in color and are calcareous and friable. The base materials are principally calcareous clay with some sandy material and gravel.

8. Vegetation consists of live oak, shin oak, Spanish oak, blackjack oak, post oak, and juniper. Where junipers have been eliminated in connection with range lands, the general appearance is rather barren and often stony with scattered oaks, chiefly Spanish oak. The understory includes small shrubs such as agarita, deciduous hollies, and various range grasses of the country such as bluestem, bristlegrass, muhly, and three-awn. In the bottom lands arborous vegetation is more abundant with species of oak, elm, sycamore, pecan, hackberry, cypress, cottonwood, cherry, walnut, and willow.

9. Four U. S. highways, five State highways, and one railroad are found in or near the project area. About 1,000,000 people reside within a 50-mile radius of the reservoir site. Industrial developments near the project area include textile mills, meat packing, metal products, railroad shops, food products, oil production, foundries, and machine shops. Agriculture and grazing are the chief land uses. Recreation, including hunting of deer and turkey, fishing, and hiking, is important in the area.

PLAN OF DEVELOPMENT

10. The dam will be an earthfill structure 4,410 feet in length and will rise 224 feet above the stream bed. The spillway will be uncontrolled, broadcrested, cut in firm rock, 1,260 feet in length, and will have a capacity of 502,800 second-feet when the reservoir water level is at maximum design water surface elevation 969.1¹/₂. It will be located in a saddle on the right bank

¹/₂ All elevations are in feet and refer to mean sea level.

about 4,800 feet south of the river channel. Releases from the reservoir will be made through a 10-foot conduit through the dam controlled by two hydraulically operated slide gates, 5 feet 8 inches by 10 feet. Capacity of conduit is 5,200 second-feet when reservoir water level is at maximum design water surface elevation.

11. About 11,800 acres of land in the Canyon Reservoir site will be purchased in fee simple. Flowage easement will be taken on an additional 3,200 acres between elevations 918 and 948.

12. At top of flood-control pool, elevation 943, Canyon Reservoir will have 740,900 acre-feet of storage, of which 346,400 acre-feet will be for flood control; 366,400 acre-feet, for water conservation; and 28,100 acre-feet, for sediment. The Corps of Engineers plans to maintain the reservoir water level as near as possible at conservation pool, elevation 909. Water above conservation pool elevation will be released at a maximum rate of 3,000 second-feet to achieve maximum capabilities of the eight downstream power plants. Minimum releases will be zero. The Guadalupe-Blanco River Authority has purchased the conservation storage in Canyon Reservoir, has secured a permit to divert 50,000 acre-feet annually for municipal, industrial, and agricultural uses, and has expressed hopes of securing a diversion permit for 100,000 acre-feet annually. The Authority has further indicated that a constant minimum release of 100 to 200 second-feet will be made during normal water years. The average annual maximum pool will be at elevation 909.5 and will have a surface area of 8,310 acres and a capacity of 390,360 acre-feet. The average annual minimum pool will be at elevation 897.5 and will have a surface area of 6,980 acres and a capacity of 298,700 acre-feet. The average annual reservoir water level fluctuation will be 12 feet. The maximum water level fluctuation will be about 115 feet. The proposed pool elevation, capacities, surface area, and shoreline miles are listed in Table 1.

Table 1 - Pertinent Data Canyon Reservoir

	<u>Elevation (feet)</u>	<u>Area (acres)</u>	<u>Capacity (acre-feet)*</u>	<u>Shoreline (miles)</u>
Maximum design water surface	969.1	17,120	1,129,300	120
Top of flood- control pool	943.0	12,890	740,900	110
Average annual maximum pool	909.5	8,310	390,360	--
Top of conserva- tion pool	909.0	8,240	386,200	80
Average annual minimum pool	897.5	6,980	298,700	--
Upstream invert elevation	775.0	79	640	--
Stream bed	750.0	--	--	--
Silt storage	--	--	28,100	--

* Includes 28,100 acre-feet of storage for 50 years of sedimentation in proposed reservoir, with 19,800 acre-feet below elevation 909.0 and 8,300 acre-feet between elevations 909 and 943.

FISHERY SECTION

Without the Project

13. The principal fishes in the Guadalupe River are largemouth bass, Texas spotted bass, channel catfish, flathead catfish, white crappie, bluegill, redear sunfish, and Rio Grande perch. Casting, pole and line, and trotlines are the principal methods of fishing. Most fishing is done from the bank; however, boat fishing is gaining in popularity. No commercial fishing occurs in the project area.

14. Stream fisheries in the project area receive considerable use by local residents, as well as from many people of the San Antonio area. Principal reason for heavy fishing is a lack of stream of reservoir fisheries in an area where about 1,000,000 people reside. The clear-flowing stream in a canyon is scenically attractive, and many people have built homes along the stream in the project area and spend much of their time there during the summer months. The river provides good fishing, particularly for largemouth bass and catfish. The existing fishing interest and the steadily increasing number of anglers who are looking for places to fish create a great demand for fishing in this part of Texas.

15. About 49 miles of the Guadalupe River from the mouth of Comal River to conservation pool, elevation 909, of the proposed Canyon Reservoir will be affected by the project. The 26-mile reach downstream from the dam has numerous riffle areas and has an average width of 130 feet. Four small low-water power dams are located in this reach. The 30-mile reach upstream from the dam has an average width of 75 feet and is contained within deep, precipitous, rocky canyon walls. The stream in the project area has a gradient of 7 feet per mile, an average depth of 4 feet, and flows over a bedrock-rubble bottom. Heavy growths of aquatic vegetation have not become permanently established in the river because of scouring action of floods, but sparse growths of water willow, narrow-leaf pondweed, bushy pondweed, muskgrass, southern wild rice, yellow water lily, and white water lily are found in the stream. Aquatic fauna other than fish are crayfish, hellgrammites, mayfly nymphs, caddis fly larvae, and water beetles.

16. Approximately \$40,000 will be spent annually by fishermen using this stream within the project area. Limited access facilities will preclude much increase in fishing pressure in the foreseeable future.

With the Project

17. Canyon Reservoir will eliminate a short segment of stream fishery in the Guadalupe River, improve another reach of stream fishery, possibly produce a habitat which will be suitable for rainbow trout or smallmouth bass, and create a reservoir-type fishery which will be heavily fished by people from all parts of the State. Because of its location Canyon Reservoir will be one of the most popular impoundments in the State of Texas.

18. Approximately 26 miles of stream fishery from the dam site to conservation pool elevation 909 will be eliminated by permanent flooding and result in a loss of \$10,000 annually in associated fishermen's expenditures. An additional 4 miles of stream above the conservation pool elevation to top of flood-control pool elevation will be infrequently flooded by the reservoir, but its fishery will not be affected.

19. Storage of sediment in the reservoir, regulated streamflow, and bank stabilization will result in improved habitat in the 23-mile reach of stream extending downstream from the dam to the confluence with the Comal River. Aquatic vegetation will become more abundant because of stabilized waterflows. Reservoir operation studies indicate that there will be sufficient water stored in the reservoir three out of four years to provide a constant release of 150 second-feet into the stream below the dam cold enough to sustain a trout fishery. In years when storage is not sufficient to provide summer releases cold enough to maintain trout habitat, warm-water fish, principally spotted bass, smallmouth bass, and largemouth bass, will provide a limited catch. Under "put and take" trout management approximately \$200,000 will be spent annually by sportsmen using the 23-mile reach of the Guadalupe River from Canyon Dam site to the mouth of Comal River. Most of this expenditure will be associated with the trout fishery which will occur in the 10-mile reach immediately below the dam.

20. Canyon Reservoir will be 8,240 surface acres at conservation pool elevation and will have 6,980 acres of surface area at average minimum pool. Depth at the latter pool will be about 150 feet. Only 440 acres will be less than 4 feet deep; 870 acres will be less than 8 feet deep at conservation pool elevation. The reservoir will have less than 80 miles of shoreline. Average annual reservoir fluctuations will be about 12 feet; however, little or no fluctuation will occur during the bass spawning season. The reservoir water will be clear. The principal fish expected in the reservoir will be largemouth bass, white crappie, bluegill, channel catfish, flathead catfish, buffaloes, redear sunfish, yellow-bellied sunfish, river carpsucker, and gar. Sport fishing will be exceptionally good during the early years

of the impoundment, gradually tapering off as the river carpsucker becomes the predominant species. Commercial fishery of importance will not develop in Canyon Reservoir.

21. Canyon Reservoir lies in one of the most populous regions of the State where reservoir fishing is in great demand. Fishermen's expenditures associated with the reservoir will be about \$2,000,000 annually.

22. A summary of habitat and fishermen's expenditures, without and with the project, is presented in Table 2.

Table 2 - Summary of Habitat and Fishermen's Expenditures

	<u>Without the Project</u>		<u>With the Project</u>		<u>Difference</u>	
	<u>Habitat</u>	<u>Expenditures</u>	<u>Habitat</u>	<u>Expenditures</u>	<u>Habitat</u>	<u>Expenditures</u>
Guadalupe River	49 miles	\$40,000	23 miles	\$ 200,000	-26 miles	\$ 160,000
Canyon Reservoir	--	--	6,980 acres	\$2,000,000	6,980 acres	\$2,000,000
Total		\$40,000		\$2,200,000		\$2,160,000

WILDLIFE SECTION

Without the Project

23. The Canyon Project lies in a region where the soils on the uplands are thin and rocky but rich in nutritive value. On the hillsides are less fertile white caliche soils. Principal timber species on the heavily dissected uplands are juniper, shin oak, Spanish oak, and live oak. Principal grasses are three-awn, bluestem, grama, lovegrass, fescue, muhly, and bristlegrass. Along the Guadalupe River is a narrow band of large trees, including sycamore, cottonwood, pecan, elm, hackberry, live oak, wild cherry, walnut, cypress, and willow.

24. When the area was first settled in the middle of the nineteenth century, the hills were covered with grasses, and trees were found only along the streams. The introduction of excessive numbers of livestock eliminated much of the grass cover, permitting the establishment of trees, shrubs, and forbs. Today the land is devoted entirely to a livestock industry consisting principally of goats, sheep, and cattle. The uplands are pastured and the bottom lands are used for the production of corn, oats, and grain sorghums. Extensive clearing of junipers, and to a lesser extent of oaks, is going on in Comal County and the ultimate aim is to have about 80 percent of the County cleared. Table 3 lists the cover types in the project area. Wooded pastures are areas not yet cleared of timber, whereas pastures have been cleared of juniper and most of the oaks.

Table 3 - Estimated Acreage of Cover Types - Canyon Reservoir

	Conservation Pool Elevation 909 (acres)	Elevation 909 to 918 (Fee Take Line) (acres)	Elevation 918 to 948 (Flowage Easement) (acres)	Total (acres)
Cropland	3,000	740	320	4,060
Pasture	1,300	400	300	2,000
Wooded Pasture	3,940	1,120	2,480	7,540
Total	8,240	2,260	3,100	13,600

25. Downstream from the dam 157,253 acres of land will receive flood protection. Of these acreages, 63,514 acres are cultivated; 93,394 acres are grazed; and 345 acres are urban land. Because of the land's high value for crops and grazing, most of it has been cleared in spite of flood danger. Since no change in land use is anticipated the project is not expected to have any effect on the wildlife resources downstream from the dam.

26. The most important wildlife species in the project area are white-tailed deer, wild turkey, and mourning dove. Common but supporting little hunting pressure are fox squirrels, cottontails, gray foxes, and raccoons. Bobwhites are scarce and completely protected by landowners. Waterfowl are also scarce. Fur animals found in the project area are of minor importance and are expected to have no significant value in the future. Hunting opportunities are adequately provided by mourning doves and inadequately provided by turkeys, bobwhites, and waterfowl, because of their scarcity.

Big Game

27. All of the project area, 13,600 acres, is used by white-tailed deer. Deer hunting leases, which average about \$100 per gun per season, have provided a substantial income to some ranchers in the project area. Brush clearing and livestock grazing are expected to reduce the deer population on the project area; however, increased annual hunting demands will result in sportsmen's expenditures of about \$30,000 annually.

Upland Game

28. Approximately 75 percent of the wild turkeys in Comal County use the project area sometime during the year. Peak populations are in the fall and winter when turkeys roost in the river bottoms. Turkey populations have been declining in the Edwards Plateau Region for many years because of continued brush clearing and overgrazing. Although the population is expected to stabilize at a low level, hunting pressure is expected to remain about the same during the next 50 years. This situation will be due to the fact that the demand for turkey hunting is already so great that the supply cannot begin to meet the demand. Associated sportsmen's expenditures will be about \$4,000 annually.

29. Dove habitat is best on the river valley croplands, where the birds feed in the grain fields and on weed seeds in the pastures. About 770,000 dove-days annually occur on the 13,600 acres in the project area. Peak populations occur in the fall. Hunting pressure on doves has been rising steadily and is expected to increase in the future. Associated hunter expenditures will be about \$2,000 annually.

With the Project

30. Canyon Reservoir will eliminate 8,240 acres of wild-life habitat and result in serious losses to white-tailed deer and wild turkey populations. Recreation activities on Federal lands and brush clearing and overgrazing on easement lands will result in further losses to wildlife populations. The reservoir will create a limited resting habitat for waterfowl.

Big Game

31. Loss of 8,240 acres of white-tailed deer habitat within the conservation pool and crowding of the remaining 5,360 acres of habitat with deer from the reservoir basin will result in an overpopulation of deer and a die-off. Recreational use will further reduce the deer population and a low population of white-tailed deer will remain on the project area. Hunting on easement lands will be insignificant.

Upland Game

32. Loss of the timbered bottom-land habitat which provides winter roosting areas will eliminate the turkey population in the project area. The 5,360 acres remaining will provide feeding and nesting habitat for mourning doves to the extent of about 390,000 days annually. Public access to project lands will result in associated sportsmen's expenditures of about \$1,000 annually.

Waterfowl

33. Canyon Reservoir will provide a resting place for a small number of ducks and coots. Medina Lake, 50 miles to the southwest, with similar steep topographic features and fluctuating water levels provides poor habitat. It is expected that annual waterfowl use of Canyon Reservoir, which will be similar to Medina Lake, will be about 60,000 duck-days and 700,000 coot-days. Hunting will be limited and inadequate to satisfy even a small portion of the great demands of hunters from local communities and the nearby San Antonio area. Sportsmen's expenditures associated with duck and coot hunting are expected to be about \$4,000 annually.

Table 4 - Summary of Sportsmen's Expenditures for Hunting

	<u>Without the Project</u>	<u>With the Project</u>	<u>Difference</u>
White-tailed deer	\$30,000	--	-\$30,000
Turkey	4,000	--	- 4,000
Mourning dove	2,000	\$1,000	- 1,000
Waterfowl	--	4,000	4,000
<hr/>			
Total	\$36,000	\$5,000	-\$31,000

DISCUSSION

34. Canyon Reservoir appears to be sufficiently deep to have cold enough water during the summer months in most years to establish a rainbow trout fishery in the stream below the dam. Assuming that water in the reservoir reached a temperature cold enough for rainbow trout, operation studies indicate that the reservoir would have had sufficient winter-storage carry-over for summer releases 31 of 42 years to provide a constant release at the dam of 150 second-feet for the period June through November. From December through May, water temperatures in the stream and released from the reservoir are expected to be cold enough to maintain a trout fishery.

35. A minimum instantaneous release of 150 second-feet would maintain a trout fishery in the stream below the dam provided that high water temperatures do not preclude trout survival. The extent of trout habitat that would be established cannot be definitely determined until completion of the reservoir project. At this time it is estimated that trout would do well primarily within the first 10 miles below the dam.

36. Trout are not expected to reproduce in adequate numbers in the stream below the dam but will need to be stocked yearly on a put-and-take basis. In some years, it may be possible to determine prior to stocking trout whether the reservoir winter-storage capacity will be sufficient to provide the necessary cold-water releases for the period June through November. On a few occasions warm-water flood inflows during the period June through November may occupy the winter-storage capacity to the extent that downstream releases would be too warm to maintain trout. During those years, largemouth bass, Texas spotted bass, and probably smallmouth bass will provide as much fishing pressure and catch as without the project.

37. To achieve maximum fishery benefits from Canyon Reservoir, 8 parking areas around the reservoir, ranging in size from 3 to 16 acres, and 3 access areas on the Guadalupe River downstream from the dam, ranging in area from 15 to 20 acres, should be provided. Access areas should be accommodated with all-weather roads and sanitary facilities. Concrete boat-launching ramps should be constructed at such parking and access area and should have a minimum width of 14 feet. In the reservoir area ramps should extend from elevation 910 to elevation 895. When black-topped surface roads exist, as in Areas 2a and 3a, they may be used as ramps, providing concrete sills are constructed on each side of the road to prevent breaking away of the black top. The launching areas should be cleared of all obstructions to ground level for safety reasons and to prevent damages.

to boats and motors. Parking areas around the reservoir should also be cleared of all obstructions to ground level. However, downstream access areas should be cleared only of understory vegetation. Plates 2 through 6 delineate the proposed parking areas, and plates 7 through 9 delineate the downstream access areas.

38. Acquisition of downstream access areas and construction of launching ramps, sanitary facilities, and all-weather access roads should be made an integral part of the project cost, estimated at about \$115,000. This cost should be included as nonreimbursable project costs.

39. The Texas Game and Fish Commission has stated that if these access areas were made available to the Commission under a General Plan as provided in Section 3 of the Fish and Wildlife Coordination Act, it would assume the operation, maintenance, and replacement costs estimated at \$3,000 annually.

40. Access areas as discussed in the preceding paragraphs and delineated on plates 7 through 9 would appreciably increase the fisherman use on the 23-mile reach downstream from the dam. Monetary benefits associated with the increase in fisherman use resulting from these developments are estimated at \$66,000 annually.

41. Canyon Reservoir lies in some of the most important white-tailed deer and turkey areas in the State, where deer are abundant enough to meet hunters' demands, but the turkey population is not large enough to provide adequate hunting opportunities. Even with an abundance of deer, controlled hunting by most landowners results in underharvest and deprives hunters of an opportunity to participate in the sport. The nearby metropolitan areas of Austin and San Antonio are expected to double their populations within the next 50 years. The increase in population is expected to make it more difficult to meet hunters' demands. Loss of this important deer and turkey habitat through inundation will further reduce hunting opportunities in the face of a rising demand.

42. The narrow area above the conservation pool elevation to be acquired in fee simple limits the possibilities of improving the habitat as replacement for the habitat destroyed. Increasing the area to be purchased in fee simple would contribute to mitigation of wildlife losses; and wherever practicable on the project area, the land acquisition policy should take this fact into consideration.

CONCLUSIONS

43. Canyon Reservoir will provide a reservoir-type fishery in an area where there is a great demand. There will be a loss of 26 miles of stream fishery, but the improvement in quality of habitat in the stream downstream from the dam will more than compensate for the stream habitat lost. The reservoir created will provide much needed reservoir fishing opportunities.

44. About 8,240 acres of valuable wildlife habitat will be lost through inundation, and an additional 2,260 acres will be lowered in quality by intensive recreational use. Wild turkey populations will be eliminated from the project area, and white-tailed deer populations will be drastically reduced. There will be a slight gain in waterfowl use.

45. Development of 8 parking areas and boat-launching areas would provide facilities to meet the anticipated heavy fishing pressure on Canyon Reservoir. Provision of a minimum instantaneous release of 150 second-feet would create an opportunity to establish a valuable trout fishery in 10 miles of the Guadalupe River. Purchase and development of access areas on the Guadalupe River downstream from the dam would result in enhanced fishery benefits which would more than compensate for the cost of acquisition and development. Acquisition of as much peripheral land as is practicable around the reservoir would contribute to mitigating wildlife losses caused by project construction and operation.

46. This report is based upon data from the Corps of Engineers, U. S. Army, prior to April 1, 1959, and any modifications should be brought to the attention of the Bureau of Sport Fisheries and Wildlife.